Master Facility & Real Estate Management

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Summary

Green building is a hot topic in the field of FREM, because of its remarkable energy efficiency and sustainability, it has performed very well in environmental protection. Green buildings have developed greatly in the West and have their own mature systems. However, for many developing countries, such as China, the upsurge of green buildings has only become popular in recent years. On the one hand, because China is the country with the highest carbon emissions, the development of green buildings is the inevitable result. On the other hand, the good influence of green buildings on human health is also an important factor in the development of green buildings. There has been a lot of research on the satisfaction of green building users in Australia, the United States and Europe, but there is a lack of research in this area in China. Therefore, in order to confirm the real experience and perception of users of green office buildings in southern China, this has been carried out. Research. For this study, the following main and sub-issues are listed:

MQ: What is the relation between green office building features and workplace user satisfaction in Chinese offices?

SQ1: What are Chinese office workers workspace preferences?

SQ2: What are drivers for workspace satisfaction and workspace dissatisfaction?

SQ3: Which of these drivers are aspects of green buildings?

SQ4: What is the influence of socio-demographic characteristics on workspace experience?

SQ5: What is the impact of the green office features on self-perceived productivity of Chinese office workers?

The research used quantitative research and the main method is to collect data through questionnaires.

After analysis, the following results were obtained. There is a correlation between the functions of green buildings and satisfaction. Information gathered from the social population indicates that they are not satisfied with the interior decoration, surrounding facilities and seating areas in the building, as well as the improvement of indoor lighting and ventilation. And green office buildings have a significant relationship to employee productivity. There is a negative correlation between whether researchers understand the concept of green building and satisfaction evaluation, that is, the more understanding of green building, the higher the demand for satisfaction, the higher the quality requirements for green buildings, the background Differences have different perceptions of satisfaction.

Through this research, the following suggestions have been made for the improvement of the on-site environment of green office buildings: firstly, cultivate employees' green awareness and green building related concepts, secondly manage user expectations, and then solve existing ones in a more economical way. The

problem can then be increased by facility management, and finally the regulatory authorities are regularly checked for the performance of green buildings.

Foreword

The main objective of this study is to investigate the impact of green building characteristics on overall user satisfaction and the working environment, and to make recommendations to the site in a way that improves user satisfaction. More importantly, I hope to have a certain contribution in the development of green buildings in China, so as to maximize the performance and advantages of green office buildings.

First of all, I am very grateful to my thesis supervisor Mr. Bodewes for providing me with many valuable suggestions and help, which made me successfully complete this research. I am also very grateful to the cooperation of various social organizations in the questionnaire survey in Shanghai. I have completed a large number of questionnaires in the office building in the Jin Mao Tower in Shanghai. Thanks to the practitioners who answered the questionnaire. Specific questionnaire questions can be found in the appendix.

Huimin Shu,
Deventer, August 2019

1. Introduction

Due to the ecological crisis and the high consumption of building energy, the demand and desire for green buildings in today's society are growing. The global buildings sector continues to grow, with floor area reaching an estimated 235 billion m^2 in 2016. Final energy use by buildings grew from 119 exajoules (EJ) in 2010 to nearly 125 EJ in 2016 (Abergel, Dean , & Dulac, 2017). The difference between green and traditional buildings can be divided into two aspects: economic advantages and environmental advantages. For the definition of green building, EPA (Environmental Protection Agency) has a clear explanation: Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction (EPA, 2019). From an economic point of view, although the initial cost of green building is higher, however, at a global level: Global energy efficiency measures could save an estimated €280 to €410 billion in savings on energy spending and the equivalent to almost double the annual electricity consumption of the United States (World Green Building Council , 2019). From an environmental point of view, this emissions savings potential is said to be as much as 84 gigatons of CO2 (GtCO2) by 2050, through direct measures in buildings such as energy efficiency, fuel switching and the use of renewable energy (World Green Building Council , 2019).

The employee's level of happiness and satisfaction will directly impact their working performance and affect the company's overall performance and sustainability. It is crucial for companies to keep employees satisfied because it is one of the critical components to success (Yazdanifard & Ey, 2014). For example, public organizations in South Africa have faced a huge challenge. They need to continuously improve their performance and performance in a very unstable environment and fierce competition, so they achieved this goal by improving employee satisfaction. Therefore, Mafini & Pooe (2013) confirmed in their research that employee satisfaction is not only positively related to performance but also predicts the future performance of the public organization in South Africa. There are always many different definitions of employee satisfaction, and Price (2001) defines employee satisfaction as the effective direction for employees to work. According to Sageer, Rafat, & Agarwal (2012), employee satisfaction is a term used to describe whether employees are happy, contended, and satisfied with the wishes and needs of their work. Many measures to support employee satisfaction are a factor in employee motivation, employee achievement, and employee engagement. Basically, employee satisfaction measures how happy employees are in their work and work environments.

The important role of employee satisfaction survey in enterprise development has been recognized by more and more managers and has become an important tool for daily management of enterprises. Through continuous employee satisfaction surveys, companies can “diagnose” problems in their own management, systematically solve problems, improve enterprise management, improve production efficiency, and reduce

staff turnover. Therefore, scientific employee satisfaction surveys are significant for improving the effectiveness of business management. At the same time, there is a lot of literature that proves that the work environment has a strong connection with employee satisfaction. Raziq & Maulabakhsh 's (2015)research shows that there is a positive correlation between the work environment and employee job satisfaction, and poor working conditions limit the ability of employees and influence their potential. However, if employees can work in a relaxed and free environment, there will be no burden or pressure to cause their performance to decline.

In addition to energy conservation and environmental protection, the characteristics of green buildings also have a very important feature that is beneficial to the human body and even improves the standard of living. Green building related scholars in Malaysia stated that green buildings have less indoor pollution due to the use of green materials. Compared with non-green buildings, indoor environments are of higher quality. These buildings provide better indoor air quality and ventilation, and comfortable heat, standard humidity levels and adequate lighting and acoustic systems (Ghodrati, Samari, & Shafiei, 2012).Similarly, for those working in green office buildings, the internal environment has a significant relationship to their productivity, productivity and satisfaction. Studies in Australia have shown that green buildings are generally more satisfactory than non-green buildings, especially in terms of facility management, such as overall building comfort, architectural design, demand, architectural image, cleanliness, availability of meeting rooms, storage and The health and productivity of the occupants (Khoshbakht , Gou, Xie, He, & Darko, 2018).

Therefore, ensuring the satisfaction of green building users is significant to society and the development of the company. Zuo and Zhao (2013)concluded that some studies had reported the impacts of thermal comfort and IEQ on occupants' satisfaction, performance and health conditions. Indeed, there have been claims that occupants are primarily overlooked in green building studies (Zuo & Zhao, 2013). Another research has shown that the link between user productivity, absenteeism and wastage is related to satisfaction, especially regarding thermal comfort and lighting standards (Wilkinson, Reed , & Jailani, 2011). But from the perspective of user satisfaction, additional research is needed in this area (Wilkinson, Reed , & Jailani, 2011).

Some findings point to improvements in some areas, such as image and how needs are met, but green buildings are in danger of repeating past mistakes, especially if they are too difficult to manage. Users tend to tolerate deficiencies rather more than they do with more conventional buildings (Leaman & Bordass, 2007). Some of the previous researches are mostly users' high satisfaction with green buildings, but nowadays, because of the duplication, the high cost of green buildings, and the neglect of user experience for energy conservation, many users are dissatisfied with green buildings. Indoor environmental quality in green buildings has been known to cause occupant discomfort in key workplace attributes such as acoustics, lighting conditions and glare, leading to modifications to be made that clash with initial design intentions (Brown, Cole, Robinson, & Dowlatabadi, , 2010).

Especially for users of green office buildings, uncomfortable indoor climate, ventilation, furniture, etc. will cause employees to work negatively. There is a lot of evidence that if employees have a high level of well-being in the company, they are a win-win for both the company and the employees themselves. Employee attitudes typically reflect the moral of the company. In areas of customer service and sales, happy employees are critical because they represent the company to the public (Sageer, Rafat, & Agarwal, Identification of Variables Affecting Employee Satisfaction and Their Impact on the Organization, 2012). It is increasing employee morale and employee satisfaction to enhance employee performance and productivity, which ultimately results in high profits, customer satisfaction as well as customer retention (Sageer et al.,2012). One study found that happy employees are up to 20% more productive than unhappy employees (SGROI, 2015). When it comes to salespeople, happiness has an even greater impact, raising sales by 37% (Preston, 2017). Happy employees are also good news for organizations: The stock prices of Fortune's "100 Best Companies to Work for" rose 14% per year from 1998 to 2005, while companies not on the list only reported a 6% increase (Preston, 2017).

The relationship between green buildings and real estate is also inseparable. The Chinese market now attaches great importance to the development of green buildings, and green office buildings are gradually emerging in China. Due to changes in the structure of human resources, social progress and economic development, Chinese entrepreneurs are paying more and more attention to the improvement of employees' needs and pressures. Employee satisfaction is a factor directly related to performance, and an important factor affecting satisfaction. The indicator is the office environment, so the office environment largely affects the development of an organization. This study mainly analyzes the perception of the green building office from the perspective of the users, thus maximizing the value of green building. Therefore, the main research question is formulated: How the green office keep alignment between sustainability and user's satisfaction? This paper mainly studies the satisfaction of China's current green office building users, including the location of the company's address, the surrounding facilities, the interior furniture, and design factors.

2. Literature review

In this chapter, we will focus on academic research and theoretical background on related topics. This study mainly includes four questions:
1. The history and current status of China's green office buildings
2. KPI's of green office building
3. Current occupant's perception of the green office
Therefore, the literature review is mainly elaborated from these four aspects.

2.1 The green building development history in China

The initiation of sustainable development can be traced back to the 1960s when the concept of ecological architecture was proposed. Ancient people adopted the basic principles of the "sustainable utilization of resources" and "take what you need and spare the rest," the essence of which is to oppose the destructive exploitation of resources, and to advocate for the limited development and utilization of resources to achieve their sustainable use. This is the earliest traceable green thinking in Chinese culture (Zhang, Kang, & Jin, 2018). For the majority of buildings, price and quantity have been primary concerns for developers, and many companies have given up preaching the values of green building. The introduction of the Chinese Green Building Standard in 2006 and the government's consequent pressure to build according to these norms have instigated an intense "catch-up" movement over the past five years. This has led to significantly higher growth rates over the general building for these products and services (EU SME Centre, 2013).
The chart below depicts the development of green buildings in China.

1990	Demonstration projects in Tianjin, Beijing, Chongqing, and Shenyang
2003	LEED certification introduced in China
2006	Introduction of the China's 3-star certificate
2008	First building rated according to the Chinese 3-star standard
2010	Targets for green building in the five-year plan

Figure1-China green building milestones (EU SME Centre, 2013)

The green building market is emerging rapidly in China. According to the United States Green Building Council (USGBC), China now has more than 80 million square feet of LEED-certified buildings, many of which were certified in 2011 (Figure 2). Similarly, the Chinese Three-Star Green Building Certification program, which started in 2006, has seen significant growth. Information about the total number of buildings certified under that program is not available, but experts estimate that China now has roughly

200 buildings certified at the Three-Star (highest) level of that program. Most of these are government buildings (Li & Currie, 2011).

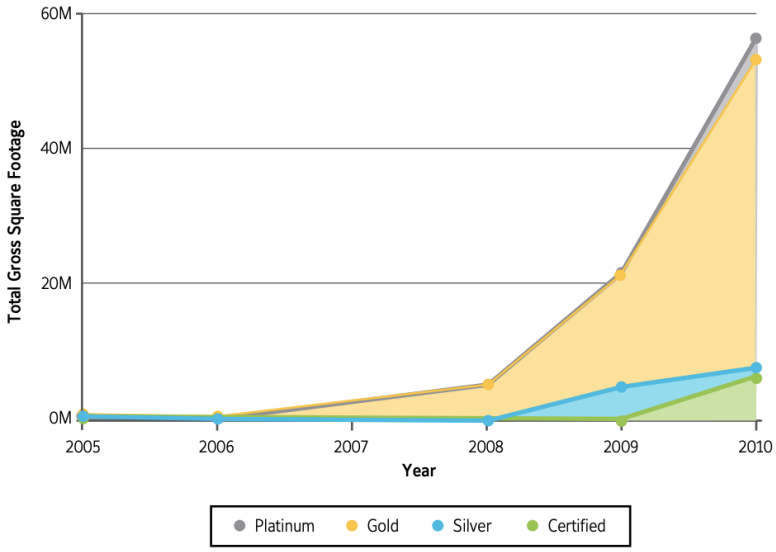


Figure2-Gross square feet of LEED-certified buildings in China by level and by year (2005-2010) (Li & Currie, 2011)

Crucially, China follows Five-Year plans to address growth and development and to do so in a sustainable way.

Now into the 3rd year of China's 13th Five-Year Plan, goals for reduction of carbon emissions and energy use are fed by specific construction-related targets, addressing the largely associated energy use and emissions from the industry, including:

− Raise building efficiency

− Initiate eco-friendliness across construction chain

− Develop a circular economy including recycling of construction refuse

− Control land use to promote urbanization and use of developed land, restricting uncontrolled expansion into green sites

− 50% of new buildings to be certified green by 2020 (BREEAM, 2018)

According to the Ministry of Finance and the MuHURD"Memorandum on Deepening Public Building Energy Efficiency," published in May 2011, all newly constructed government buildings in China must meet energy efficiency standards, as defined by MoHURD (Li & Currie, 2011). All other conditions being equal, green buildings consume significantly less energy than traditional buildings. This has been the most significant incentive for building owners to prefer green buildings. Brand image is also an important consideration for many owners. In particular, multinational companies and organisations consider it crucial to occupy green office buildings across the globe as part of their corporate social responsibility initiatives (Li & Currie, 2011).

Furthermore, green buildings pose new challenges to building design and architecture professionals. Green buildings introduce issues, such as resource conservation and pollution management that were absent in conventional instruction on building design and architecture in China. Some architects in China are resistant to green building projects because they do not see the value (Li & Currie, 2011).

Therefore, although green office buildings have been greatly developed in China, there are still technical barriers.

2.2 The status and development barriers of China's green buildings

The extensive literature review shows that most green building studies focus on the environmental aspects of sustainability such as energy consumption, water efficiency, and greenhouse gas emission together with technical solutions. The reviews on social and economic issues of sustainability are comparatively lean, despite a large number of literatures emphasizing their importance (Zuo & Zhao, 2013). The debate on the cost and benefits of green building are noticeable. More robust studies are needed to enable evidence-based decision by the client and the project team (Zuo & Zhao, 2013).
For China, the construction industry and not only a project or a unit that provides housing for people, but also an industry that provides people with a comfortable living space and has no harm to the atmosphere and the environment. In 2011, buildings accounted for just 28% of China's energy consumption, but urbanization, economic growth, and rising population could increase this number by as much as 40% over the next 15 years. The adoption of green building technologies and solutions is a key part of China's sustainability and environmental protection goals (Molinaroli, 2017). According to the above-mentioned that China faces enormous pressure to reduce emissions in the next decade, including carbon emissions, greenhouse gas emissions and the use of coal. China government must act in order to achieve these goals (Climate Action Tracker, 2019). As the national Five Year Plan is cascaded to provincial and municipal jurisdictions, nearly 20 cities have set even more ambitious targets. For example, Changde, Zhenjiang, Zibo, Wuxi, and Suzhou, Shanghai, Beijing, Shenzhen, and Chongqing will require all new commercial buildings to be green buildings. In the pursuit of even more sustainable buildings, more than 90% of China's commercial building owners plan to have at least one net or near-zero energy building in the next ten years (Molinaroli, 2017). In recent years, Chinese real estate developers have been vigorously developing green buildings in accordance with the principle of sustainable development, but due to the initial stage, the quality of early green buildings is not ideal. For the current Chinese-style green buildings, it is necessary to improve the quality of the building.

Besides China's 3-Star rating system, the U.S. Leadership in Energy and Environmental Design (LEED) certification is also prevalent in China. In 2015, LEED-certified Grade A office buildings exceeded 5.6 million square meters across ten major cities in greater China, an increase of 7.4 percent from the previous year, and accounting for 28 percent of the total market, according to a new report published by CBRE and USGBC (Export, 2017).

	2016	2017 (forecast)	2018 (forecast)	2019 (forecast)	2020 (forecast)	2021 (forecast)
Construction Industry value (USD Billion)	717.71	782.61	848.92	910.48	976.43	1042.17
Construction Industry Value, Real Growth (% year to year)	6.0	6.79	5.97	4.75	4.74	4.23
Construction Industry Value (% of GDP)	6.6	6.6	6.6	6.5	6.5	6.4

Figure 3-Overview (Export, 2017)

General green building development barriers include legal policies, technical issues, etc., but for China, the situation is different. Apart from other obstacles, China's population, high-density buildings, and relatively backward management methods have caused great uncertainty in the development and investment of green buildings (Hasan & Zhang, 2016). The following picture covers the potential obstacles to the development of green buildings in China.

No.	
	Economics
	Cost
1	Additional costs caused by green construction
	Time.
2	Incremental time caused by green construction.
	Technology
3	Reduction of structure aesthetics.
4	Uncertainty in the performance of green materials and equipment's.
5	Imperfect green technological specifications.
6	Misunderstanding of green technological operations.
7	Restrictions of new green productions and technologies.
	Awareness
8	Regional ambiguities in the green concept.
9	Conflicts in benefits with competitors.
10	Dependence on promotion by government.
	Management
	Construction Management
11	Lack of support from senior management.
12	Lack of knowledge on green technologies and materials.
13	Limited availability of green suppliers and information.
14	Lack of quantitative evaluation tools for green performance.
	Contract management
15	Additional responsibility for construction maintenance.

Figure 4-Barries for green buildings in China (Hasan & Zhang, 2016)

Because the development of green buildings has many restrictions in China, to solve these restrictions, China has improved its technical level and strengthened cooperation with the US green building industry. In solid-state lighting, the United States has technology advantages in most areas. China's strength is on "downstream" packaging and appliances. China has also begun to build manufacturing capacity for core technology products. The Chinese government is considering ways to improve building energy efficiency and has initiated several national programs to deploy energy-efficient building technologies across the country. With strong domestic efforts, there would be a great opportunity for international collaboration in building energy efficiency short (Yu & Evans , 2010). In the Paris climate conference President Xi said: through innovation and mechanism innovation system, implement and optimize the industrial structure, build a low-carbon energy system, develop green building and low carbon transport, establish the national carbon emissions trading market and a series of policies and measures to create a new pattern of the harmonious development of man and nature (Wang, 2017).

The biggest difference between the top triggers globally and those in China is the importance of healthier neighborhoods in China, with twice the percentage (30%) of Chinese respondents who consider it important compared with global respondents (15%). The challenge deemed necessary by the highest rate of Chinese respondents (60%) is higher first costs for building green. This is a higher percentage than the global average of 50% (SmartMarket, 2016). In addition to hardware problems, green building related industries and the government should pay more attention to the supervision system and feedback system of green building stakeholders.

2.3 KPI's of green office building

2.3.1 The green building criteria and measurement in China

Although every country is different for the green building rating system, the general can be summarized as three aspects to assess whether a building has green standards:

- Economic level
- Energy level
- Social level

In Western countries, such as the United Kingdom, the United States and Australia, there is a set of a mature evaluation system for green buildings, like LEED and BREEAM. In China, the Three Star System is used. This rating system does not include the satisfaction of the users for green office buildings. There are some limitations to the Three Star System (Zhou, 2014):

- Only roughly 6% of the certified building has operational certification
- Regional distribution of Three Star System is very uneven, 50% of all the green building labels are in four provinces that has 17% of the population
- Three Star System coverage is not wide enough, only involving residential and public buildings.

Because LEED was the first green building rating system introduced by China, but with China's development of three-star standards, the green buildings in mainland China

have gradually increased. But LEED and three-star standards are still different. The empirical study reveals: (1) LEED is more likely to be chosen for business and industrial buildings, whereas 3-Star is more likely to be chosen for residential buildings; (2) buildings in China's eastern region are more likely be certified via 3-Star than those in the country's central and western regions; (3) buildings in cities with higher GDP per capita, more FDI, and more real estate investment are more likely to be certified via LEED; and (4) investors and architectural firms with international backgrounds tend to prefer LEED (Zou, 2018). So, in China, different rating systems will be selected for a different group of stakeholders. Although the two systems are different, they complement each other in the Chinese market.

The following figure briefly summarizes the difference between LEED and three-star standards.

	LEED	3-Star
Running Organizations	USGBC (the United States Green Building Council) – Non-government Organization	MOHURD (Ministry of Housing and Urban-Rural Development, China) –Governmental Agency
Initiated Year	1998	2006
Application Countries	Worldwide	China
Certification Levels	Four (Certified, Silver, Gold, and Platinum)	Three (One star, two stars, and three stars)
Credit Categories	Sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environment quality, and innovation and design	Land savings and outdoor environment, energy savings, water savings, material savings, indoor environment quality, and operation management.
Numbers of Certification Criteria	The number of certification criteria is 110. The certification level is decided by the total credits satisfied of all categories.	The numbers of certification criteria of residential buildings and public buildings are 40 and 43, respectively. The certification level is decided by the minimum credits of each category.
Certification tracks	New Construction (NC), Existing Building Operations (EB), Commercial Interiors Project (CI), Core and Shell Project (CS), Homes (H), and Neighborhood (ND),	Residential buildings, public buildings
Scoring Methods	All credits are totaled together for final score regardless of the category.	Achieving the control items and a minimum score for every category.
Review and Certifying Process	The review process is straightforward based on paperwork. Certifications are awarded before the project is occupied, and credits are determined by design assumption rather than actually performance of a green building.	The review process is conducted by a committee with both paperwork and on-site reviews. Utilizing a two-stages approach – design label and operational label. The operational label tries to ensure a more accurate performance of a green building.

Figure 5-The differences between LEED and 3-star rating systems (Zou, 2018)

Comparing with those developed countries, the Chinese standards on the green building were initiated much later and incorporated a lot of valuable components from foreign standards (Geng, Dong , Xue, & Fu, 2012). The whole development progress can be categorized into three stages, and the quality has been gradually improved. These three stages are: Released China's Eco-house Technical Evaluation Handbook， Released Green Building Assessment System for Beijing Olympic (GBASBO) and Released National Green Buildings Evaluation Standard (GB/T 50378–2006) (Geng, Dong , Xue, & Fu, 2012). The final stage is also called as the " three-star standard," which is from 1 to 3 stars, with the three stars rating reserved for the best performing green buildings (Khanna, Romankiewicz, Feng, Zhou, & Ye, 2014).

The purpose of the standard is to reduce the total resources, water, energy and land use of a building and to address the following six aspects: land conservation and outdoor environment, energy conservation and utilization, water conservation and utilization, material conservation and utilization, indoor environment, Management. Detailed indicators for each aspect can be further divided into mandatory, regular and advanced projects (Geng, Dong , Xue, & Fu, 2012). There is a total of 76 residential building options, including 27 mandatory options, 40 general options, and nine advanced options. For public buildings, there are 83 options, including 26 mandatory options, 43 general options and 14 advanced options (Geng, Dong , Xue, & Fu, 2012). Figure 5 and figure 6 show the minimum requirements and rating evaluation systems for residential and commercial buildings, respectively.

Rating Level	**Mandatory Items Included (27)**	**General Items**						**Preferred Items**
		Land Use & Outdoor Environment	Energy Efficiency	Water Efficiency	Resource Efficiency	Indoor Environment	Operational Management	
		Total: 8	*Total: 6*	*Total: 6*	*Total: 7*	*Total: 6*	*Total: 7*	*Total: 9*
★	Yes	4	2	3	3	2	4	0
★★	Yes	5	3	4	4	3	5	3
★★★	Yes	6	4	5	5	4	6	5

Figure 5-Criteria for Green Building Design Label rating evaluation for residential buildings (Khanna, Romankiewicz, Feng, Zhou, & Ye, 2014)

Rating Level	**Mandatory Items Included (26)**	**General Items**						**Preferred Items**
		Land Use & Outdoor Environment	Energy Efficiency	Water Efficiency	Resource Efficiency	Indoor Environment	Operational Management	
		Total: 6	*Total:10*	*Total: 6*	*Total: 8*	*Total: 6*	*Total: 7*	*Total: 14*
★	Yes	3	4	3	5	3	4	0
★★	Yes	4	6	4	6	4	5	6
★★★	Yes	5	8	5	7	5	6	10

Figure 6-Criteria for Green Building Design Label rating evaluation for public buildings (Khanna, Romankiewicz, Feng, Zhou, & Ye, 2014)

The way to maximize the value of green buildings is to provide users with the best working environment and living environment through continuous adjustment and

change, so how to accurately measure the performance of green buildings is particularly important.

The measurement of green building performance includes many aspects: energy efficiency, ventilation rate or user satisfaction and so on. This research mainly focuses on measures data on user satisfaction so that it can be measured in the form of questionnaires, interviews, and observation.

Malcolm Wells in his book Gentle Architecture (1981) developed a matrix as a first attempt regarding a Sustainable Architecture Matrix (SAM), first published in Progressive Architecture, March 1971. SAM is a distinctive matrix subdivided into categories representing a group of sustainability indicators. Each category is further sub-divided into sub-categories, the indicator weighting criteria (WAER & SIBLEY , 2005). The following is a schematic diagram of the SAM assessment tool.

	-100 always	-75 usually	-50 sometimes	-25 seldom	Priority Level	+25 seldom	+50 sometimes	+75 usually	+100 always		
Negative Extreme (-)					Water					Positive Extreme (+)	Score
Destroys pure water			■	■	7.00					Creates pure water	-350.00
Wastes precipitation					4.00	■	■	■		Stores pure water	+300.00
Ignores use of grey-water	■	■	■	■	9.00					Uses grey-water	-900.00
Wastes run-offs					5.00	■				Creates percolation	+125.00
Obtains water from hinterland						■	■			Obtains water locally	+400.00

Score= -425

Figure 7-SAM test of the category of water (WAER & SIBLEY , 2005)

According to Dwaikat and Kherun's research (2016), it is found that the EVM (Earned value management) method is applicable and meaningful in measuring the actual energy cost performance in green buildings. This research presents a novel approach to measure the actual energy cost performance of green buildings. It is the first research that examines the earned value management (EVM) within the context of buildings life cycle cost (Dwaikat & Ali , 2016).

2.3.2 The most important indicator about green office buildings

The previous sub-section introduced the green building rating criteria, which will focus on the most important relevant indicators for green office buildings, including indoor facilities, environmental quality (ventilation, air quality, etc.), lighting and other factors.

From the perspective of environmental impact, the indicators in the green office include:

1. Use of resources (e.g. energy, water and office supplies);
2. Waste disposal (e.g. food waste, paper, office equipment or worn-out fixtures and fittings);
3. Air emissions (e.g. from boilers or heating and cooling systems);
4. Noise pollution (e.g. from parking lot or on-site repair);
5. “Water pollution” (e.g. unauthorized discharge from food and beverage facilities, contaminated runoff from parking lots or use of cleaning and chemical products) (WRAP, 2014).

Resource usage

The use of resources in the green office is not exactly the same as that of ordinary buildings. It is mainly for the resources that the office needs to use, such as paper usage, whether the printer ink is green, etc. The goal is low-carbon office. With the rapid development of science and technology, the concept of young people in China has begun to change dramatically. The green and low-carbon health of office buildings needs to be considered from the design and development of office buildings. The selection of materials and equipment must meet the needs of green and low-carbon office. In software and hardware, it is necessary to provide office buildings with the possibility of low carbonization.

Waste - A good practice office each employee produces less than 200 kilograms of waste per year.

Recycling - A good practice office - Efficient recycling program for paper, glass, cardboard, cans and toner cartridges - 60% to 70% recovery.

Thesis - A Best Practice Office Each staff member can only use seven sheets of paper per year (500 sheets of paper on one sheet).

Water - Best Practice Office Buildings should use no more than 2 cubic meters (2,000 liters) of water per employee per year (or 7.9 liters per employee per day)3. If the office has a canteen that is cooked with raw materials, the amount of water associated with preparation, cooking and cleaning will increase to about 40 liters per worker per day. Table 2.3 “Water Key Performance Indicators and Benchmarks for Offices and Hotels” of the CIRIA publication gives details of the office's further water baseline.

Energy - Energy use and emissions are best compared to the consumption per square meter of treated building area (TFA), as shown in the table below. Typical practices for office energy use are almost twice as good as good practices (WRAP, 2014).

	Gas/oil consumption (kWh/m²)	Emissions (kg CO_2/m²)
Naturally ventilated smaller office	79	32.2
Naturally ventilated, open-plan office	79	43.1
Air-conditioned, standard office	97	85.0
Air-conditioned headquarters	107	143.4

Figure 8-Good practice energy use and emissions per m^2 of treated floor area (WRAP, 2014)

Waste disposal

Green building materials are used in the process of green high-rise office buildings. The production of building materials uses wastes such as garbage and waste as raw materials to achieve the goal of energy saving and emission reduction, thereby reducing the consumption of natural resources to a certain extent. On the other hand, the waste of resources will increase the cost of the company to a certain extent, because waste is being repeatedly produced. One point to note is the close link between procurement and waste management. The first step is to confirm that these items must be bought. In the second step, the purchaser needs to ask if he can reuse it and whether it is enough

to avoid waste. It is important to discourage employees from using disposable products. Therefore, in general, the waste treatment of green buildings requires attention to purchase in addition to increasing the recycling rate (WRAP, 2014).

Air emissions

Under the green office building environment in China, one of the most admired points is “returning to nature”, which is closely related to Chinese culture. In the Chinese market, the green office building not only needs to place a lot of green plants in the office area, but also needs to pay attention to the supply of oxygen and the absorption of carbon dioxide. In general, the following two points need to be paid attention to during the construction of green buildings:

Reduce outdoor environmental emissions:

-Operating emissions: Reduce the impact of the built environment on global air pollution by limiting greenhouse gas emissions and short-term climate pollutants, thereby benefiting human health, the natural environment, and limiting sectoral contributions to climate change.

-Implement emissions: Recognize strategies to reduce greenhouse gas emissions throughout the building's life cycle. Our goal is to raise awareness of the health and environmental threats of unsustainable building practices, as well as the effects of material transport, demolition and waste throughout the supply chain.

Reduce indoor air pollution sources:

-Materials: Promote the importance of sustainable, non-toxic and air-purifying building materials to limit emissions from buildings

-Building fabrics: the importance of improving the quality of architectural fabrics and construction, as well as the role of retrofitting existing stocks to reduce the risk of moisture and mold

-Ventilation: Champion appropriate ventilation strategy to achieve energy efficiency and health priorities for efficient indoor air management (World Green Building Council, 2019).

Noise pollution

According to numerous studies cited in the Centers for Disease Control's (CDC's) report "Review of the Effects of Noise on Man" and Toronto Public Health's report "Health Effects of Noise," long-term occupational exposure to noise -- especially high-frequency noise -- leads to hearing loss. The studies cited in these reports also suggest that long-term exposure to noise can lead to stress-related conditions such as hypertension, and endocrine and neurological responses, but the exact correlation is unclear and there's great individual variation in tolerance to noise. Some studies have also shown a relationship between high noise levels and decreased performance at school or in the workplace (Browne, 2017). Therefore, it can be proved that the pollution of noise is very large and harmful to Chinese employees who have been under high-intensity work pressure for a long time. The Chinese government emphasizes people-oriented, so a necessary feature of green buildings is to reduce noise pollution.

Commonly used in noise control are building materials that block noise, glass, etc., and must be non-toxic. Acoustic sustainable materials, whether natural or recycled, are often an effective alternative to traditional synthetic materials. The air insulation of

natural materials such as linen or regenerated cellulose fibers is similar to rock or glass wool. Many natural materials (bamboo, kenaf, sisal, coconut fiber) exhibit good sound absorption properties; cork or recycled rubber or polymer layers are very effective for sound insulation. These materials also have good thermal insulation properties, usually very light, and are not harmful to human health (Asdrubali, 2006).

Water pollution

The source of fresh water that humans can use in their daily lives is limited. As the population grows rapidly, the demand for water is also growing. At present, the world population is about 6.7 billion, with an annual growth rate of about 80 million. This means that the demand for fresh water is increased by 64 billion cubic meters per year. By 2001, due to the rapid increase in population, the global per capita water supply had decreased by a third in the past 1970. According to UN statistics, by 2050, two-thirds of the population or as many as 5 billion people will face a shortage of clean fresh water (Das, Bera, & Moulick, 2015).

The total water supply of domestic water in the city has increased year by year, and many companies are not aware of their specific water consumption, resulting in a large amount of water wastage. Therefore, a qualified green building should have a water environment system. Its design should be reflected in three aspects: water saving, water recycling and water environment integration. In the aspect of water saving, we should focus on strengthening the use of water-saving appliances; in terms of water recycling, the focus should be on the middle water and rainwater collection and utilization systems; the landscape water system should be specifically designed and incorporated into the water system to consider (Gujian China, 2018).

2.4 Research on the satisfaction of green office buildings

Factors affecting employee well-being and satisfaction are multifaceted, including internal factors and external factors. Internal factors are mostly influenced by the relationship between working conditions and colleagues. External conditions include social factors and personal factors. In the face of a rapidly changing world, companies face many challenges, one of which is how to improve employee productivity and efficiency by improving the working environment. There is research has shown that the working environment has a positive impact on the Job satisfaction of employees. Lousy working conditions restrict employees to portray their capabilities and attain full potential, so it is imperative that businesses realise the importance of a good working environment (Raziq & Maulabakhsh, Impact of Working Environment on Job Satisfaction, 2014). Therefore, the current enterprises provide employees with green certification offices, on the one hand for corporate social responsibility, to achieve the purpose of energy conservation and emission reduction, on the other hand, to enhance and encourage employees to be motivated. Because the cost of green buildings still stays at a relatively high level, it is necessary to confirm the enthusiasm of employees and the satisfaction of employees in China's green office buildings through research, to better realise the value of green buildings by adjusting various functions.

One study in Australia found that the physical green office environment was divided into 13 items based on the Green Star rating of a healthy indoor environment.

Occupants were asked to rate their satisfaction level with their workplace. The "ability to change lighting, airflow, temperature, etc." Scored the lowest with only 22 percent being satisfied in this area. "Stability of air temperature" was another area of low satisfaction level at 38 percent. "Level of privacy "also scored low with 43 percent satisfied. The items with the highest satisfaction levels were "outside noise" (80 percent satisfied); "artificial lighting" (66 percent); "natural light" (58 percent) and "glare" (56 percent) (Armitage , Murugan, & Kato, 2011). Appendix 2 and three can see the employee's satisfaction with different indicators of the office environment.

In the green building certified factory study in Sri Lanka, it was found that the unavailability of relevant controlling facilities for the light, room temperature, room ventilation and moisture level with the workers, and controllers are available at the engineering control rooms are the leading causes for dissatisfaction. Use of evaporative cooling systems and deficiencies of the housekeeping and maintenance systems are contributing factors to this end. Hence, the research identified that the satisfaction level of occupants is at a reasonable level though some factors lead to occupants' dissatisfaction (Rajini, 2016). According to Khoshbakht's research, for the accident where the baseline is high and the improvement from green buildings would result in minimal satisfaction increases. However, for the Orient where the benchmark is not high, and the progression from green buildings would achieve significant satisfaction increases (Khoshbakhta, Gou, Lu, Xie, & Zhang, 2018). The analysis shows that specific objective building aspects seem to have an influence on user comfort and with that also an impact on productivity, although, in most cases, this impact appears limited. As a first point, it can be stated that the building itself, besides other influencing parameters such as job design and social work environment, has a definite impact on the comfort level of the building user. Also, the positive effects of features such as operable windows and the absence of air conditioning can be seen. This shows that building users feel the need to have an influence on their work environment and do not wish to work in buildings which are fully automated. While productivity is not definitively correlated to comfort levels, work engagement is (Feige, Wallbaum, Janser, & Windlinger, 2013).

Altomonte (2017) stated that IEQ metrics and criteria need to consider the substantial differences – demographic, physiological, socio-cultural – that characterize building occupants, rather than solely responding to the needs and expectations of an average standard user credits should address user training on building operating strategies, which can increase satisfaction and foster adjustments and adaptive behaviors rating. Systems should encourage continuous building performance monitoring and offer opportunities for recertification over time. There are many types of research have pointed out that social demographic characteristics will affect job satisfaction. According to Loscocco and Roschelle (1991) situational and specific individual characteristics influence job satisfaction. Situational characteristics include job characteristics, organizational characteristics, and promotion opportunity while individual characteristics include personality, education, gender, and family roles.

Ozturk and Hancer (2011) did a study of the impact of demographics on hotel manager satisfaction, and the results showed a significant and positive relationship between job satisfaction dimensions and demographics and overall satisfaction levels. The data shows that as the education level of middle-rise hotel managers increases, their job satisfaction increases. The results of the study also show that there is a significant correlation between the satisfaction of middle-level hotel managers and the age of promotion opportunities.

Therefore, according to current research, there is evidence that the green office user experience is not completely positive so that the leverage effect may have an impact on the company's negative economic performance (productivity declines, sick leave increases, employee turnover increases). Many companies often neglect the experience of employees to pursue energy conservation and emission reduction. So, how to ensure user satisfaction is a challenge under the premise of ensuring green indicators.
The following figure is a conceptual model based on the literature review.

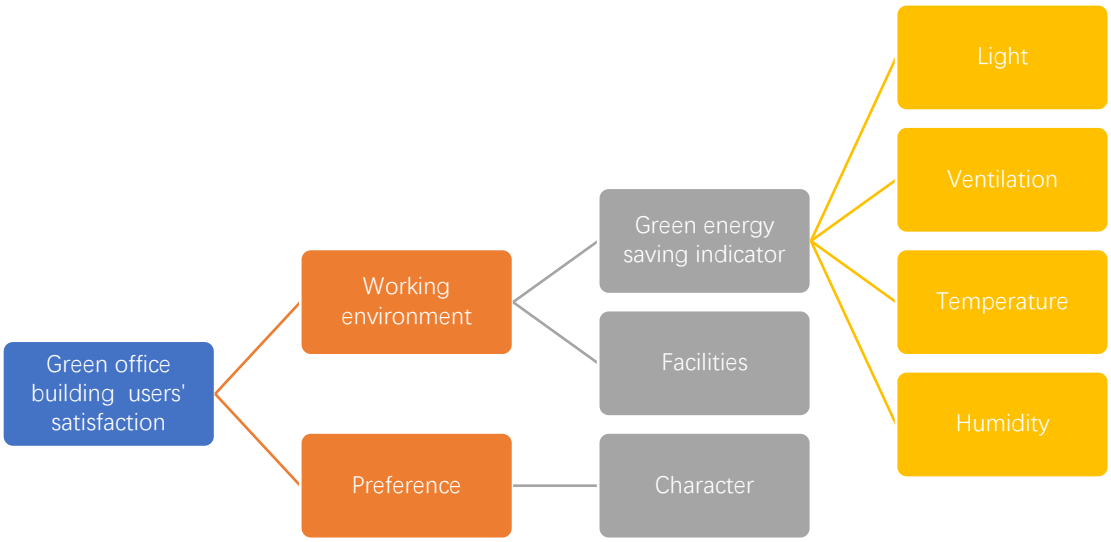


Figure 9- Conceptual model

3. Questions, objectives and hypotheses

Based on the literature review in chapter 2, this chapter focuses on research objectives and questions.

3.1 Research objective

User satisfaction surveys have been conducted for many products and users on the market, including green office buildings, which are rare in Australia, the US and Europe. However, as a start-up industry, the green building market is very unstable in China. Apart from the assessment of energy grades, research on green building permits is rare. Therefore, the main objective of this research is to investigate and confirm the influence of green building characteristics on overall user satisfaction with their work environment to make recommendations to the field on ways to enhance user satisfaction.

3.2 Research questions

The following main research questions and word questions are based on the literature studied.

MQ: What is the relation between green office building features and workplace user satisfaction in Chinese offices?

SQ1: What are Chinese office workers workspace preferences?

SQ2: What are drivers for workspace satisfaction and workspace dissatisfaction?

SQ3: Which of these drivers are aspects of green buildings?

SQ4: What is the influence of socio-demographic characteristics on workspace experience?

SQ5: What is the impact of the green office features on self-perceived productivity of Chinese office workers?

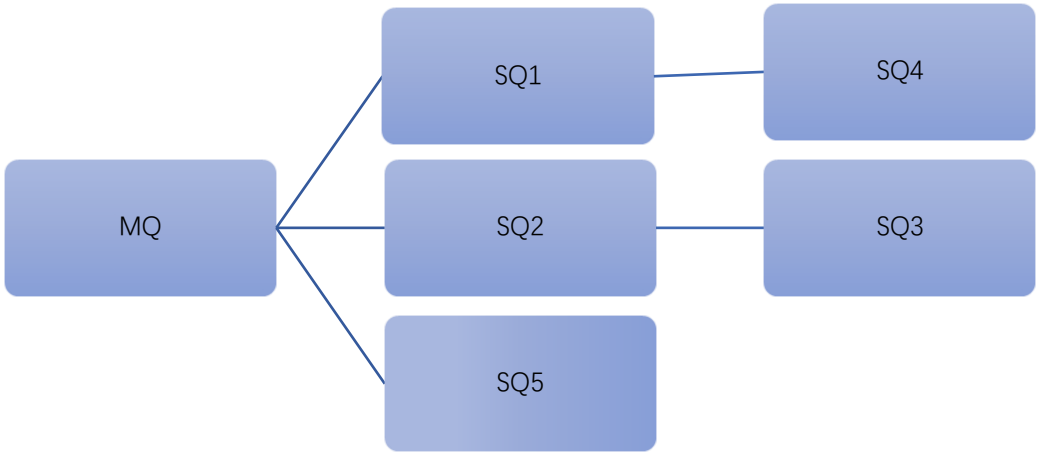


Figure 10- Tree diagram for questions

4. Research methods, operationalization and analysis

This chapter mainly describes the information on the chosen research methods, research strategy, data collection techniques, and operationalization.

4.1 Research strategy and approach

The research strategy is about plan of data collection and analysis. The main problem of this research is to explore the relationship between green building characteristics and occupant satisfaction. Descriptive and exploratory research is needed, so researchers will mainly use quantitative research to conduct the research.

Data collection methods for quantitative research will take the form of questionnaires, which are popular because they allow large amounts of data to be collected from a significant population in a very economical manner. It is usually obtained using a questionnaire survey of the samples, which are standardized and can be easily compared. In addition, survey strategies are considered authoritative and relatively easy to interpret and understand (Saunders , Lewis , & Thornhill, 2009). For the survey of green office building occupant satisfaction, the sample to be selected is also very targeted. The main ideal sample is the employees of the green office building in Shanghai in the south of China. The respondent's answers are compared in the form of questionnaires and then analyze what reasons cause of this phenomenon. A very important feature of quantitative research is generalizing. By using quantitative research, it can greatly help the Chinese real estate market to better plan and use green buildings.

4.2 Data collection techniques and instruments

Data collection methods mainly include experiments, observations, investigations, and access to literature and materials. This research mainly collects data through investigation.

The investigation method mainly includes a questionnaire survey, which is also the method of collecting information in this research. Researcher mainly want to use the online questionnaire because the amount of data that needs to be collected is relatively large, while the response rate of the online questionnaire is higher. Survey research is a commonly used method of collecting information about a population of interest. There are many different types of surveys, several ways to administer them, and many methods of sampling. The questionnaire is one of the most widely used data collection techniques within the survey strategy. Because each person (respondent) is asked to respond to the same set of questions, it provides an efficient way of collecting responses from a large sample before quantitative analysis (Saunders , Lewis , & Thornhill, 2009). In addition, the questions set in the questionnaire of this study were inspired by the general POE (Post-Occupancy Evaluation) questionnaire and the questionnaires involved in WEBB (1999). Specific questionnaire questions can be found in Appendix 1.

4.3 Sampling technique

For the first part of the study, data must be collected in a green office building. Participants can fill in the real answers based on their own feelings and promise that the questionnaire will not reveal any information from the participants, which will greatly affect the response rate. In addition, the selected green office building is relatively representative. The research selected is the green building with the lead gold certification. The sample selection is one of the most representative Jinmao Towers in Shanghai. In 2013, it won the gold-certified green building with LEED certification (GBIG, 2019). And more than one hundred companies choose to work in this building, so it is an ideal sample selection location. In order to maximize response rates, researchers can use clear, easy-to-understand questionnaires to enable participants to quickly answer questions and avoid excessive technical terminology.

At the time of the questionnaire survey, the screening of samples is also very important. This study is based on probability sampling. The probability sampling process can be divided into four stages:

1. Determine the appropriate sampling frame according to the researcher's research questions or goals.
2. Determine the appropriate sample size.
3. Select the most appropriate sampling technique and select the sample.
4. Check if the sample represents the population (Saunders , Lewis , & Thornhill, 2009).

Therefore, the target population of this research is part of a whole green office building, because it is difficult to collect questionnaires for all employees, because the pace of work in China is very fast, many people are not willing to waste their time to complete a questionnaire without economic return.

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	139	100.0
	Excluded[a]	0	.0
	Total	139	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.829	36

Figure 10- The reliability of the questionnaire

The questionnaire was kept open and advertised through various channels such as email, WeChat group and internal social media channels, so 139 online questionnaires were collected. The questionnaire was continuously open and promoted through various channels such as email, WeChat group and internal social media channels. Therefore,

139 online questionnaires were collected, and the reliability of the questionnaire was 0.829, which was greater than 0.8. Explain that the research data reliability is high. For the “alpha coefficient of item deleted”, the reliability coefficient value after the analysis item is deleted has not been significantly improved, so the description items should all be retained, further indicating that the research data reliability level is high.

Factor Analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.760
Bartlett's Test of Sphericity	Approx. Chi-Square	2653.817
	df	1128
	Sig.	.000

Figure 11- The validity of the questionnaire

It can be seen from the above table that the common value corresponding to all the research items is higher than 0.4, indicating that the research item information can be effectively extracted. In addition, the KMO is 0.760, greater than 0.6, which means the data is valid. Detailed points can be found in Appendix 2.

4.4 DATA ANALYSIS

Because the questionnaire is a quantitative study, quantitative data in a raw form, that is, before these data have been processed and analyzed, convey very little meaning to most people. These data, therefore, need to be processed to make them useful, that is, to turn them into information (Saunders , Lewis , & Thornhill, 2009). Quantitative analysis techniques such as graphs, charts, and statistics allow us to do this; helping us to explore, present, describe and examine relationships and trends within our data (Saunders , Lewis , & Thornhill, 2009).

This research mainly analyzes the collected data through statistical analysis methods. The main source is the data collected by the questionnaire. In academic research methods, the ordinal regression method was used to model the relationship between the ordinal outcome variable (Chen & Jr, 2004). In many studies, the satisfaction results from the questionnaire surveys have been used as feedback information to help them achieve better goals. Different statistical methods used to analyze satisfaction data yield results with different focuses. These methods include descriptive statistics, chi-square, linear regression analysis, multilevel modeling, and ordinal regression techniques (Chen & Jr, 2004). Nowadays, the availability of statistical software routines in the Statistical Package for the Social Sciences (SPSS) or the Statistical Analysis System (SAS) makes it computationally possible to build an ordinal regression model (Chen & Jr, 2004). In the analysis of SPSS, a combination of univariate and bivariate analysis is performed. The specific data analysis results will be described in detail in the next chapter.

5. Results

In this chapter, the data collection results for all research questions will be discussed and the relationships between the variables.

5.1 Case description

The building used in this case study is Jinmao Tower, located in the Lujiazui Finance and Trade Zone on the Huangpu River in Pudong New Area, Shanghai, China. It is 420.5 meters high and is the 3rd tallest skyscraper in Shanghai and the 10th tallest building in mainland China by 2015. The building started in 1994 and was completed in 1998. The whole building has 88 floors on the ground, plus 93 floors on the minaret and 3 floors on the ground. The total area is 278,707 square meters. There are 130 elevators and 555 rooms in the building. The building is a landmark in Shanghai. It is a multi-functional skyscraper that combines modern office buildings, five-star hotels, convention centers, entertainment, shopping malls and other facilities to blend Chinese tower style with Western architecture. It was designed by Adrian Smith, a former design partner at SOM Design in Chicago, USA. Jinmao Tower is owned by Jinmao Group. The daily maintenance cost of the building is RMB 1 million per day (Wikipedia, 2019). The tenants of Jinmao Tower have more than 100 companies including financial, office, restaurant, concert hall, hotel and other industries, which can accommodate more than 10,000 people. (Wikiwand, 2019). The energy consumption of Jinmao Tower is mainly electricity, natural gas and municipal water. The energy system includes an air conditioning power system, an elevator power system, a lighting power system, an office power system, other power systems, a steam boiler system, a natural gas use system, and a water facility using municipal water. The main technical highlights are: In early 2000, the Energy Management System (EM) was put into use, and the building BA system intelligently controlled more than 30,000 control points, including all lighting equipment and more than 1600 variable air volume air conditioners for real-time tracking. In 2002, the contract energy management work was carried out. In 2003, the "Energy Star" cooperation project was carried out with the US Environmental Protection Agency. Jinmao Tower is the first comprehensive building in China to adopt the "Energy Star" assessment tool. In 2012, through the energy management system certification, Jinmao Tower became the first public building in China to obtain an energy management system certification (Shgbc, 2014). At present, China Jinmao is providing 35 energy transportation and maintenance services and about to provide operation and maintenance services, with a total area of about 10 million square meters. It is estimated that the annual carbon emissions will reach 100,000 tons (Xinhuanet, 2018).

All in all, Jinmao Building is implementing a green standard in the construction process and in actual operation, and actively responds to the national policy of zero carbon emissions.

The pictures of Jinmao Tower can be seen in Appendix 3.

5.2 Respondents

The full demographics of the respondents are given in Appendix 4.
Respondents ranged in age from 20 to 59. The largest age group was between 20 and 29 years old, with 63.31% of women and 33.09% of men. The rest did not want to tell gender. Respondents have heard that the concept of green building is 69.06%. 30.94% of people have not heard of this concept. The data of technical and non-technical respondents are similar, with 45.32% and 54.68 respectively. This data shows that most of the respondents still understand the concept of green building, so the answer value of the questionnaire will be higher.

20-29	93	66.91%
30-39	31	22.3%
40-49	14	10.07%
50-59	1	0.72%
60+	0	0%

Figure 12- The age description of the respondents

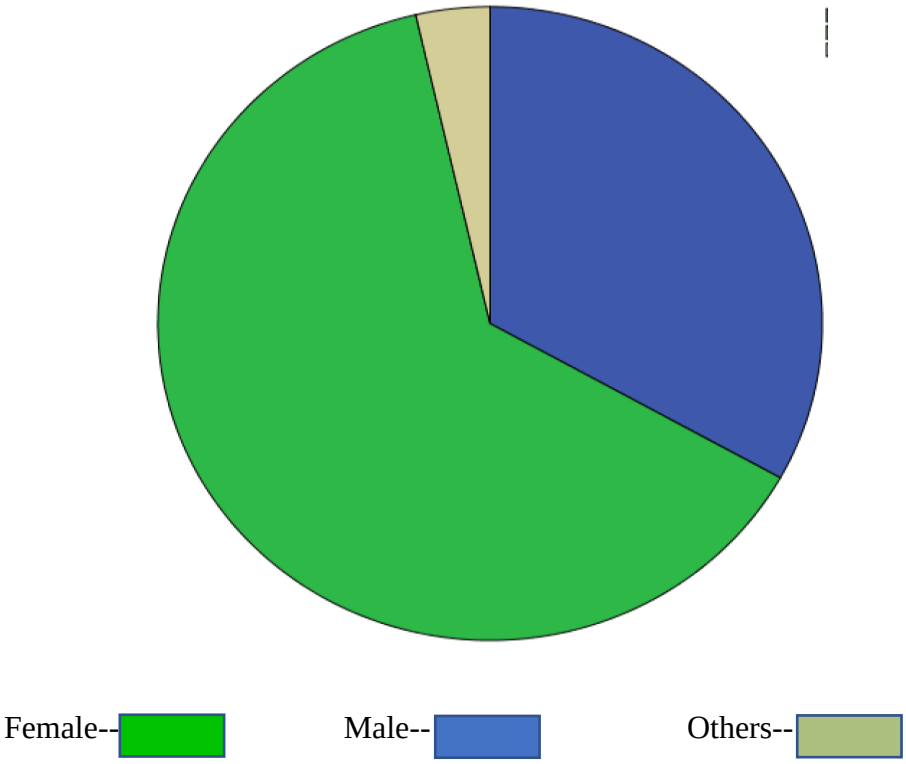


Figure 12- The gender description of the respondents

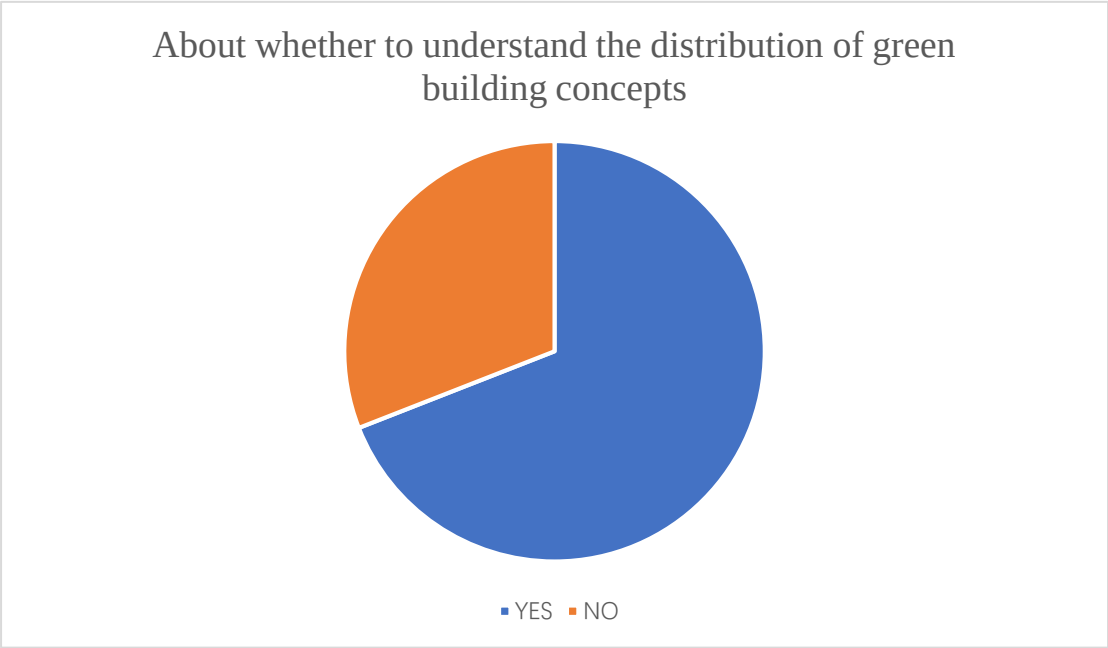


Figure 13- The basic concept understanding description of the respondents

5.3 Univariate analysis

Satisfaction with Air conditioning form

Descriptive analysis describes the overall condition of the data by means of the mean or median. It can be seen from the above table that the minimum value of the satisfaction evaluation for the building using the air-conditioning form is less than the average of 3 standard deviations, so the median is used for the description analysis instead of the average. In summary, the highest value (min/max) of a total of 1 data for the satisfaction of the building using the air-conditioning form exceeds the average of 3 standard deviations [indicating that the data fluctuates greatly, relative average, using the median to describe the whole Level is more suitable. The chart below shows a median of 4 with an average of 3.5 and a total score of 5(The median interval is 1 to 5). According to the following chart and analysis, the incumbents in Jinmao Building are still satisfied with the use of air conditioners, but the satisfaction is not so high.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Satisfaction evaluation for indoor use air conditioning form	139	1	5	3.50	.802
Valid N (listwise)	139				

N	Valid	139
	Missing	0
Median		4.00

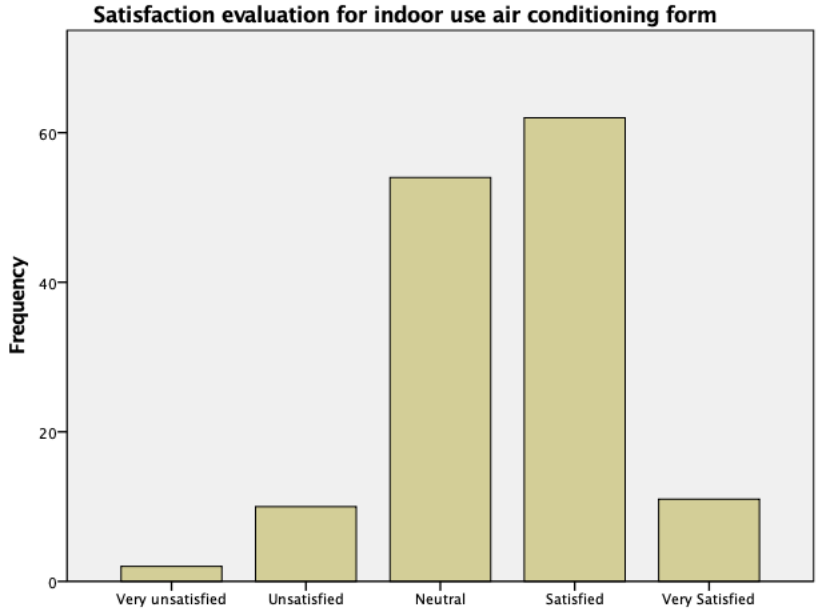
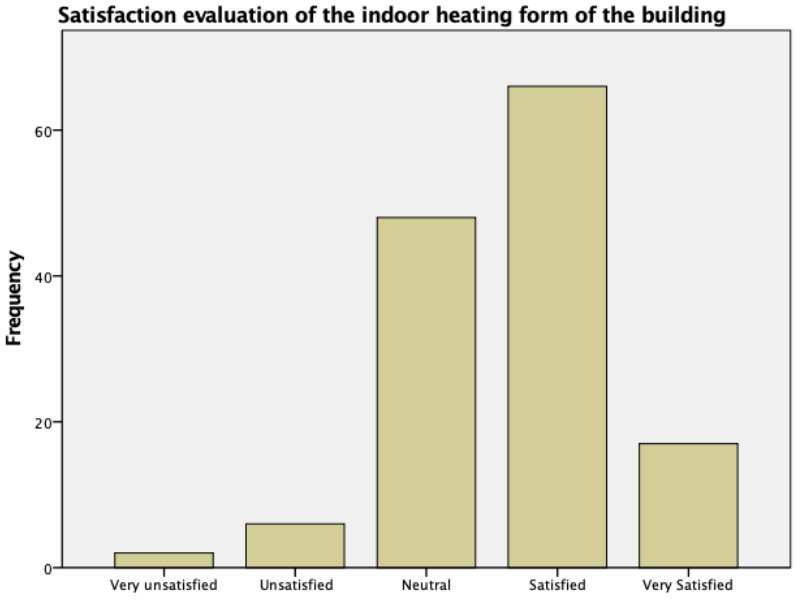


Figure 14- Satisfaction evaluation for indoor use air conditioning form

Satisfaction with indoor heating form

The same as the air conditioner, the median is also used to describe the indoor heating form. For the 57.7% of indoor heating forms, they were satisfied and very satisfied, so the average and median still showed satisfactory results, indicating that most of the respondents were satisfied with the heating form.



N	Valid	139
	Missing	0
Mean		3.65
Median		4.00

Figure 15- Satisfaction evaluation of the indoor heating form of the building

Satisfaction with indoor hot water supply in the building

Through analysis, employees are very satisfied with the performance of the indoor hot water supply form, reaching 63% of the total, and the dissatisfied number only occupied 7.2%.

Satisfaction evaluation of the form of indoor hot water supply in the building

		Frequency	Percent	Valid Percent
Valid	Very unsatisfied	2	1.4	1.4
	Unsatisfied	8	5.8	5.8
	Neutral	40	28.8	28.8
	Satisfied	73	52.5	52.5
	Very Satisfied	16	11.5	11.5
	Total	139	100.0	100.0

N	Valid	139
	Missing	0
Mean		3.67
Median		4.00

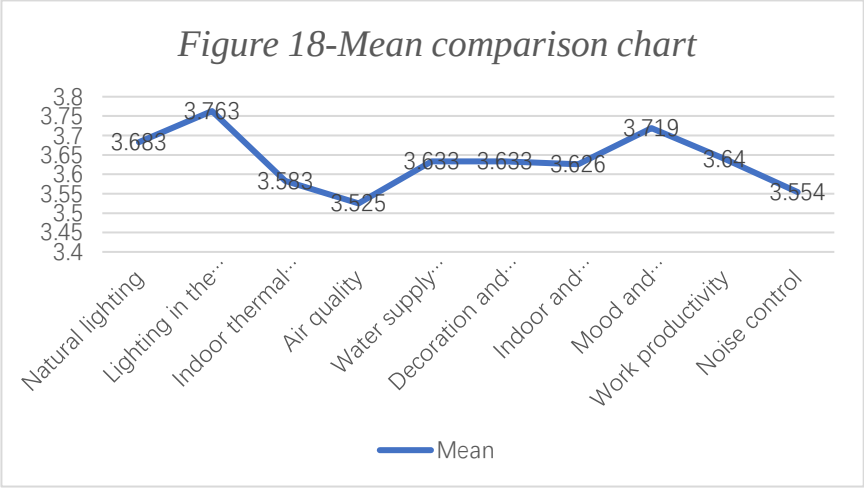
Figure 16- Satisfaction evaluation of the indoor hot water supply in the building

Satisfaction with noise control/ natural lighting/ lighting in the building interior/ indoor thermal comfort (temperature, humidity, wind speed, cleanliness)/ air quality (air odor, fresh air volume)/ water supply quality (water supply facilities, indoor water appliances, water volume, water pressure, water quality)/ decoration and design in building interior/ Satisfaction evaluation of indoor and outdoor landscape green space/ Satisfaction evaluation of the mood and psychological condition/ work productivity

From the table below, one of the most dissatisfied indicators for employees is indoor air quality. The average satisfaction rate is only 3.53, and the highest satisfaction is indoor lighting. The average value is 3.76, and the median is It is 4, so the overall satisfaction performance is positive, and no average of the indicators is in an unsatisfactory state.

Basic indicator						
Series	**Sample size**	**Minimum**	**Maximum**	**Mean**	**Standard deviation**	**Median**
Natural lighting	**139**	**1**	**5**	**3.683**	**0.868**	**4**
Interior Lighting	**139**	**1**	**5**	**3.763**	**0.848**	**4**
Indoor thermal comfort	**139**	**1**	**5**	**3.583**	**0.908**	**4**
Air quality	**139**	**1**	**5**	**3.525**	**0.98**	**4**
Water supply quality	**139**	**1**	**5**	**3.633**	**0.791**	**4**
Decoration and design in building interior	**139**	**1**	**5**	**3.633**	**0.964**	**4**
Indoor and outdoor landscape green space	**139**	**1**	**5**	**3.626**	**0.95**	**4**
Mood and psychological condition	**139**	**1**	**5**	**3.719**	**0.808**	**4**
Work productivity	**139**	**1**	**5**	**3.64**	**0.893**	**4**
Noise control	**139**	**1**	**5**	**3.554**	**0.918**	**4**

Figure 17- Satisfaction evaluation of rest indicator



One-year absent in green office building

It can be seen from the following table that there is no abnormal value in the current data, and the data values fluctuate within the range of 3 standard deviations of the average value, so the analysis can be directly performed on the average value according to the SPSS analysis. The average value of the indicator is 2.69 days, which is lower than the median of 3. This indirectly confirms that the sickness rate will be reduced in the green office building.

N	Valid	139
	Missing	0
Mean		2.68
Median		3.00
Mode		2

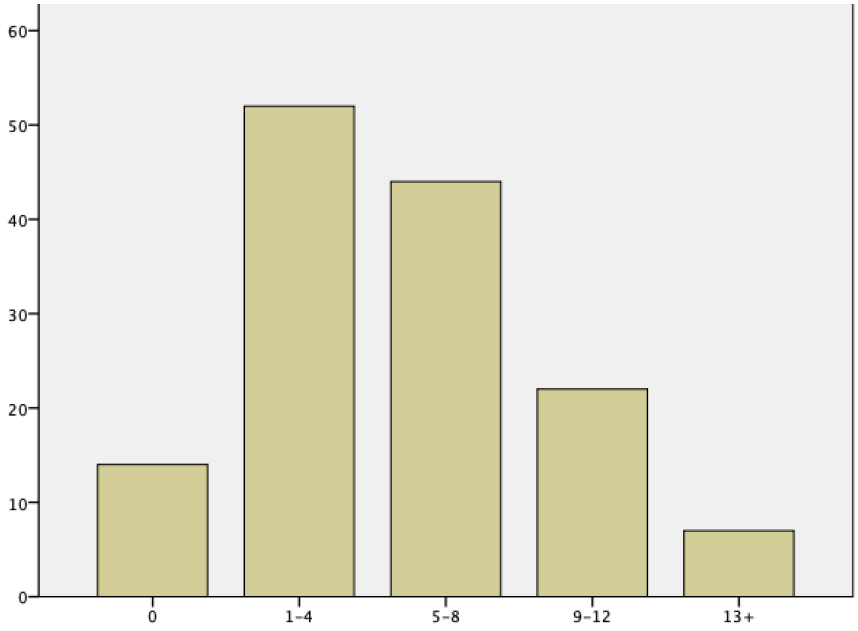


Figure 19- One-year absent in green office building

Demographic opinions for good quality of green building

Through data analysis, it is found that the statistical population thinks that a green building should have a healthy and comfortable working environment. The mean of this indicator is up to 0.78, another point, from the number and percentage of responses to this option is also the first option. They think that the least important thing is that the service is convenient, the mean is only 0.42.

Series	Sample size	Minimum	Maximum	Mean	Standard deviation	Median
Safe and durable	139	0	1	0.475	0.501	0
Convenient service	139	0	1	0.424	0.496	0
Healthy and comfortable	139	0	1	0.777	0.418	1
Environmentally livable	139	0	1	0.727	0.447	1
Resource conservation	139	0	1	0.561	0.498	1
Energy saving and environmental protection	139	0	1	0.568	0.497	1

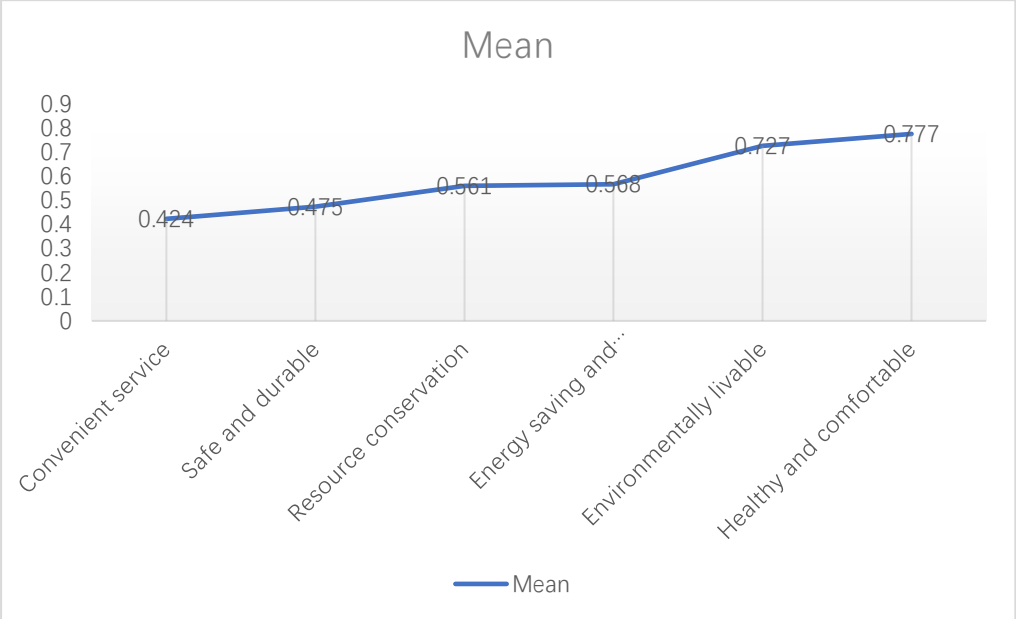


Figure 20- Demographic opinions for good quality of green building

Demographic preference for the office

In the comparison between traditional and green office, the data shows that most of the participants prefer green office, which accounts for 88.49%, so in the future development, green office will be a trend.

Frequency analysis result			
	Options	Frequency	Percentage
Demographic preference for the office	Traditional office	16	11.51
	Green office	123	88.49
Total		139	100

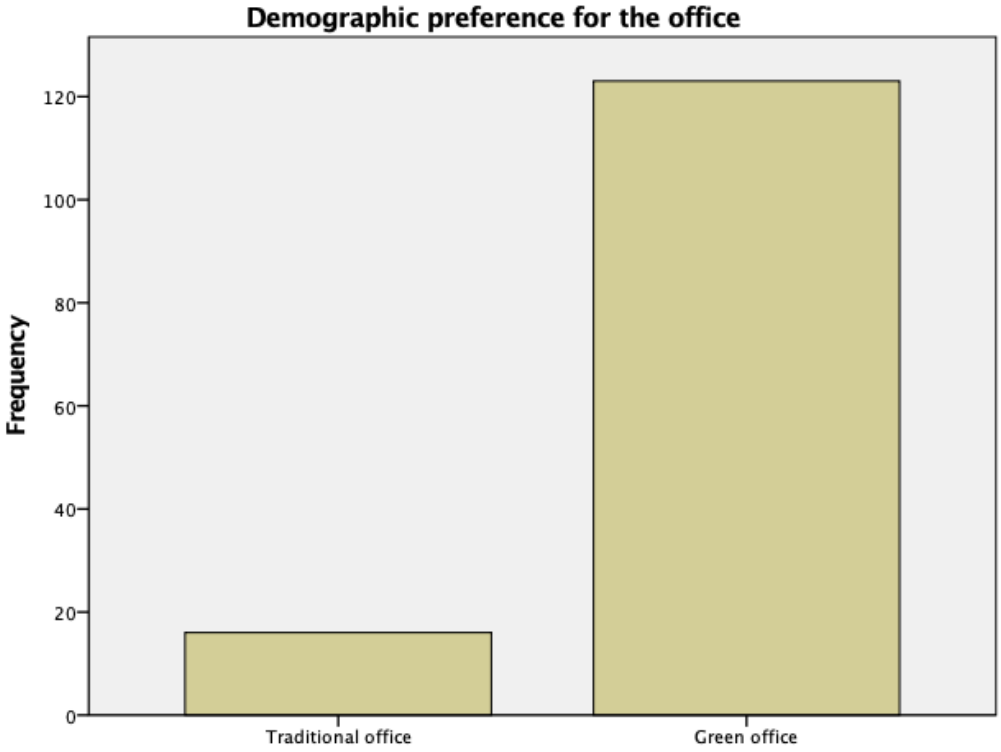


Figure 21- Demographic preference for the office

Demographic current office environment

As can be seen from the table below, the proportion of "Lijiang Old Town---Comfort and Harmony" in the sample is 45.3%, which is the largest in the sample, followed by the Sahara Desert - monotonous and boring, and the last one is the harsh environment in Siberia, which shows that the green In fact, the internal working environment tends to be a comfortable and harmonious atmosphere. Only a very small number of office environments will still be very bad.

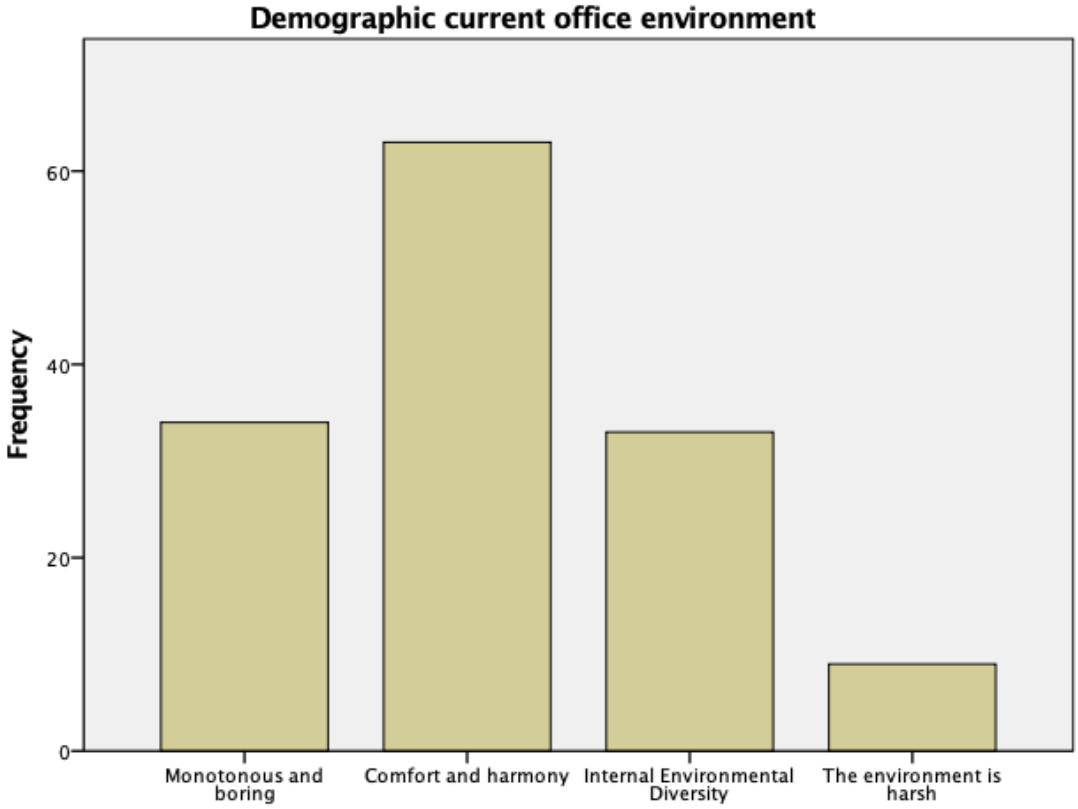
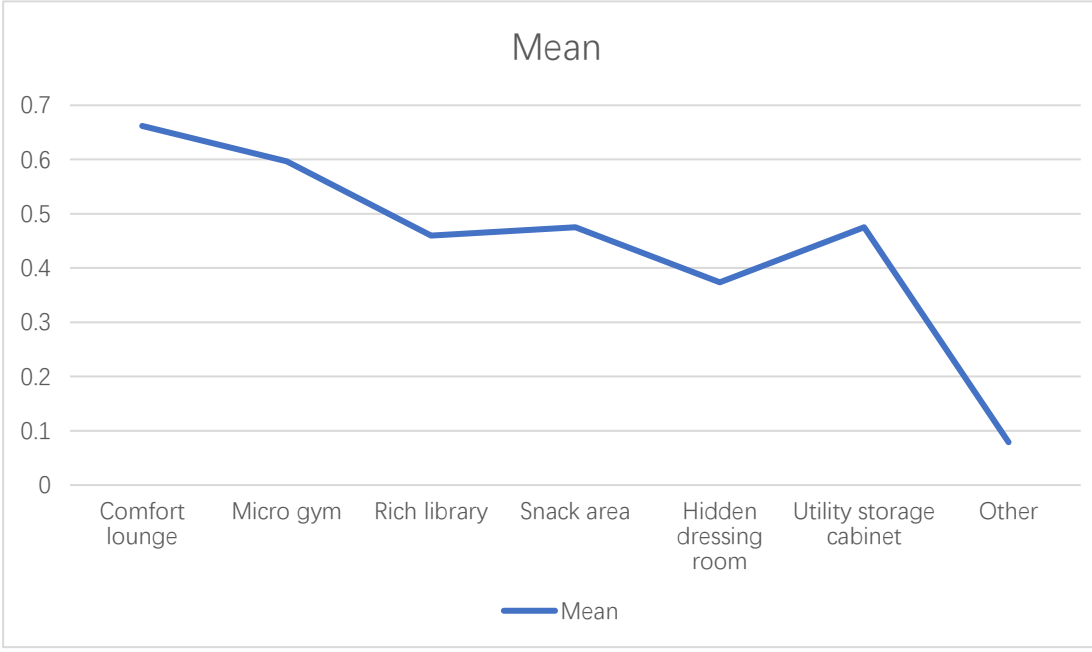


Figure 22- Demographic current office environment

Demographic preference for the facilities in the office

For all the office facilities that the participants think are most needed, it is the best choice to have a comfortable rest area in all valid answers. The demand for hidden dressing rooms and others are not significant.



Demographic preference for the facilities in the office

Basic indicator						
Series	**Sample size**	**Minimum**	**Maximum**	**Mean**	**Standard deviation**	**Median**
Comfort lounge	139	0	1	0.662	0.475	1
Micro gym	139	0	1	0.597	0.492	1
Rich library	139	0	1	0.46	0.5	0
Snack area	139	0	1	0.475	0.501	0
Hidden dressing room	139	0	1	0.374	0.486	0
Utility storage cabinet	139	0	1	0.475	0.501	0
Other	139	0	1	0.079	0.271	0

Figure 23- Demographic preference for the facilities in the office

Indicators that need improvement

According to the analysis in the figure below, participants are most dissatisfied with indoor lighting and ventilation, and hope to improve. Among the relatively good cleaning conditions, the mean is only 0.35, while the lighting and ventilation have reached 0.52.

Basic indicator						
Series	**Sample size**	**Minimum**	**Maximum**	**Mean**	**Standard deviation**	**Median**
Cleanliness	139	0	1	0.345	0.477	0
Pattern	139	0	1	0.446	0.499	0
Lighting ventilation	139	0	1	0.518	0.501	1
Decoration and design	139	0	1	0.439	0.498	0
Temperature regulation	139	0	1	0.439	0.498	0
Office facilities	139	0	1	0.388	0.489	0

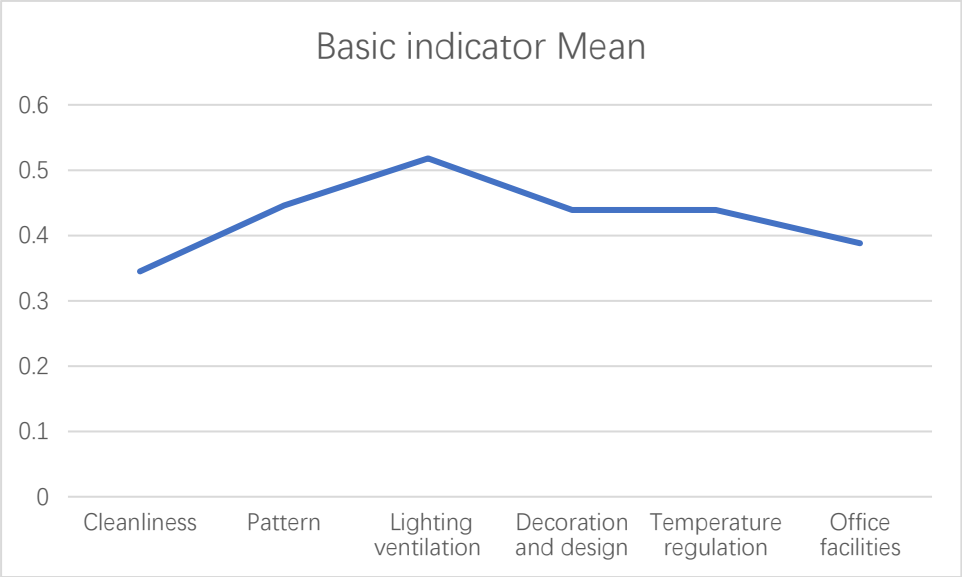


Figure 24- Indicators that need improvement

Factors affecting work

Through graph analysis, noise has the greatest impact on the state of the work, with an average value of 0.75, so it can be inferred that the noise control will greatly affect the working conditions of the participants.

Basic indicator						
Series	Sample size	Minimum	Maximum	Mean	Standard deviation	Median
Odor	139	0	1	0.619	0.487	1
Noise	139	0	1	0.748	0.436	1
Lighting	139	0	1	0.496	0.502	0
Thermal comfort	139	0	1	0.525	0.501	1
Ventilation	139	0	1	0.46	0.5	0

Figure 25- Factors affecting work

5.4 Bivariate analysis

Bivariate analysis will use a variety of analytical methods for data processing, which mainly analyzes relevance and significance

Green building concept understanding

As can be seen from the table below, participants have heard of the concept of green building as an independent variable and will use the satisfaction evaluation of the building's air-conditioning form as a dependent variable for linear regression analysis. As can be seen from the above table, the model R-squared value A value of 0.052 means that the participant has heard of the concept of green building can explain the 5.2% change in the satisfaction rating of the building using air conditioning. When the model was tested by F, the model was found to pass the F test (F=7.444, P<0.05), which means that the participants have heard that the concept of green building will definitely affect the satisfaction evaluation of the air-conditioning form of the building. And the model formula is satisfaction evaluation for the use of air conditioning forms for the building = 4.017-0.392 * independent variable. The final concrete analysis shows that:

Did the participants hear that the concept of green building has a regression coefficient of -0.392 (t=-2.728, P=0.007<0.01), which means that participants have heard that the concept of green building will use air conditioning for the building. Satisfaction evaluation produces a significant negative impact relationship.

Summary analysis shows: Have you heard of the concept of green building? All have a significant negative impact on the satisfaction assessment of the use of air conditioning in the building.

Linear regression analysis results									
	Unstandardized Coefficients		Standardized Coefficients	*t*□	*p*□	VIF□	R^2□	Adjusted R^2□	*F*□
	B□	Std. Error□	*Beta*□						
Model	4.017	0.200	-	20.115	0.000**	-	0.052	0.045	7.444(0.007**)
Independent variable	-0.392	0.144	-0.227	-2.728	0.007**	1.000			
Dependent variable：Satisfaction evaluation for indoor use air conditioning form									
Durbin-Watson：1.787									
* *p*<0.05 ** *p*<0.01									

Independent variable：Have you heard of the concept of green building?

Through the above analysis methods, we will continue to analyze other variable factors, and the results are as follows:

Has the participant heard that the concept of green building will be the indoor heating form of the building, indoor hot water supply form, natural lighting, indoor lighting, thermal comfort, air quality, water supply quality, interior decoration, indoor and outdoor landscape green space , psychological status, satisfaction evaluation, resulting in a significant negative impact relationship. However, there is no significant effect between the noise and productivity satisfaction evaluation data analysis results. The specific analysis form can be seen in Appendix 4.

The impact of technical and non-technical positions on the satisfaction of various indicators

The analytical method is the same as above, and the linear regression analysis is adopted. The results are as follows:

The types of employees (technical and non-technical) have no direct impact on the satisfaction of factors such as air conditioning, heating, hot water supply, noise control and so on, so they cannot affect the relationship.

The important data for linear regression can be seen in Appendix 5.

The gender for the significance of these indicators

The data analysis method uses ANOVA analysis, which can accurately analyze the significance between the indicators.

Through analysis of variance, we can see that different gender samples are used for the building, such as air conditioning, indoor heating, hot water supply, noise control, indoor natural lighting, indoor lighting, indoor thermal comfort, air quality, water quality, indoor The decoration, indoor and outdoor landscape green space, mood, psychological status and job productivity satisfaction evaluation, all will not show significant differences. Detailed analysis data can be seen in Appendix 6.

Significance of different ages for each indicator

The method used is also an analysis of variance. Because there are multiple options for the independent variables, ANOVA is the most suitable analysis method. Through analysis, we can know that samples of different ages are used for the building, such as air conditioning, indoor heating, indoor hot water supply, indoor noise control, indoor natural lighting, indoor lighting, indoor thermal comfort, indoor air. Quality, interior decoration, indoor and outdoor landscape green space, the building's mood, psychological status and job productivity satisfaction evaluation, a total of 12 items will not show significant differences. However, the different age-level samples showed a significant difference in the satisfaction evaluation of the water supply quality (water supply facilities, indoor water appliances, water volume, water pressure, water quality) in the building. This shows that different age groups have different views on the quality of indoor water supply, and there is a significant relationship between the two. Detailed charts and data can be seen in Appendix 7.

Addition analysis

- Linear regression analysis shows that different job types have no significant impact on sick leave rates, according to the analysis, linear regression analysis is performed on the number of sick days of different post types and dependent

variables as independent variables. The R-squared value of the model is 0.000, which means that the number of sick days in the building can explain the reason of 0.0% change of different post types. When the model was tested by F, it was found that the model did not pass the F test (F=0.000, P>0.05), which means that the number of sick leave days in the building does not affect the different post types. However, there is a significant positive impact on individual preferences for the office. Through analysis, the individual's preference for the office as a dependent variable for linear regression analysis, the model R square value is 0.046, personal preference for the office can explain the 4.6% change in different post types. When the model was tested by F, the model was found to pass the F test (F=6.640, P<0.05), which means that the individual's preference for the office must have an impact on different job types. The final specific analysis shows that the individual's preference for the office's preference is 0.335 (t=2.577, P=0.011<0.05), which means that the individual's preference for the office will have a significant positive impact on different job types.

- Linear regression analysis showed that different genders had no significant effect on the absence rate and demographic preferences. The R-squared value of the model could explain the change of 0.0% of the employee's one-year sick leave days in the building. When the model was tested by F, it was found that the model did not pass the F test (F=0.000, P>0.05), which means that different genders do not affect the number of absent days and demographic preferences.
- Using analysis of variance (full name for one-way analysis of variance) to study the differences in the age of the participants in the building for the number of one-year sick leave days and the individual's preference for the office, all of which would not be significant. (P>0.05), meaning that different ages showed consistency in the number of one-year sick leave days and personal-to-office preferences of the participants in the building, and there was no difference. As we can see, there are no significant differences between your age sample, the number of sick days a year, and your personal preferences for the office.

6. Conclusion and recommendations

This chapter will discuss the entire report based on the results found during the rsearch, including a literature review.

6.1 Conclusions

The main purpose of this study is to investigate and confirm the impact of China's green building characteristics on the overall user satisfaction with the work environment, to provide suggestions for ways to improve user satisfaction, and to enhance the use value of green buildings and to realize their potential. Because there are foreign literatures,

in fact, the green office buildings in the West are actually not performing well in some factors and indicators. Although they have already reached the stage of maturity, POE in green buildings is due to the green stage of China. More attention needs to be paid. And unfortunately, at present, China's survey on the satisfaction of green office building users or related research is very lacking, so the goal of this research is to provide a reference value for China's green building industry.

Main Question

What is the relation between green office building features and workplace user satisfaction in Chinese offices?

Hypothesis

According to the quantitative data collected, the results show that the participants are less satisfied with indoor decoration, surrounding facilities, and rest areas in the building. In other words, dissatisfaction is greater than or equal to satisfaction, so these three items are urgently needed to be solved. problem. In addition, for the indoor environment indicators that need to be improved, indoor lighting and ventilation results show that the most need to be improved. The question of whether green buildings can increase productivity is that the impact is relatively positive, and most participants believe that the characteristics of green buildings can increase their productivity. However, the relevant background of the participants has a positive or negative relationship with the assessment of satisfaction with green buildings. Does the researcher understand that there is a negative relationship between the concept of green building and satisfaction evaluation, that is, the more understanding of green buildings, the higher the requirements for satisfaction, and the higher the quality requirements for green buildings. There is no direct correlation and significance in the evaluation of different job types and gender and satisfaction, but different age levels have a significant correlation with indoor water supply demand. So, based on the results of this case study, this assumption is true.

This result can be clearly understood or even promoted through literature review. Because in other regions and countries, the performance of green office buildings is actually reasonable, its excellent sustainability and people-oriented philosophy, the main purpose is to provide a more comfortable and safe office space for the environment. There is also a possibility that because the participants in this study are mostly young people, this is the result of higher acceptance of new ideas and green offices.

Sub-question 1

What are Chinese office workers workspace preferences?

Based on the discussion in the previous sections, it can be concluded that there is a high degree of susceptibility to health and comfort and environmental livability in the preferences of the socially statistical population. At the same time, most of the respondents prefer a green office with comfortable health and a miniature gym.

Sub-question 2

What are drivers for workspace satisfaction and workspace dissatisfaction?

First, the background of the participants is part of the driver of satisfaction or dissatisfaction. Secondly, some facilities and environmental factors in the green office

will directly lead to their satisfaction or dissatisfaction. According to the above, the characteristics of the green office can be determined. There is a certain correlation and significance between satisfaction and satisfaction.

Sub-question 3

Which of these drivers are aspects of green buildings?

According to data analysis, the biggest factor affecting dissatisfaction is indoor noise, followed by odor. Although the results of the indicator data in each building are shown as positive performance, the factors that can affect the employees' perception of green buildings to the greatest extent are noise and odor. If these two items are well controlled, there is a lot of satisfaction in green building.

Sub-question 4

What is the influence of socio-demographic characteristics on workspace experience?

In the first section of this chapter and mentioned, different age levels and understanding of green buildings have a significant impact and relevance to the work experience.

Sub-question 5

What is the impact of the green office features on self-perceived productivity of Chinese office workers?

According to the data analysis, there are linear correlations between the functions and characteristics of the green office and the self-perceived productivity of the employees, and the participants have high requirements for indoor air and ventilation, as well as the interior decoration style, the current problem. It is employees who feel that the interior decoration style is too singular, so they hope to be improved and thus positively related to productivity.

6.2 Recommendations

Since the goal of this research is to maximize the practical value of green buildings and the real users' satisfaction, researcher hope to give some advice on the green building site after discussing the results.

Although the results of the questionnaire show that the satisfaction of important indicators of many green office buildings exceeds the average level, there is still much room for improvement. But the first step needs to be promoted to cultivate employees' awareness of green environmental protection and green building related concepts. They know more about green buildings and more timely feedback to relevant departments to improve the interior of the building. Second, by managing their expectations, they can inform users that they can achieve certain effects through the internal questionnaires or interviews and reduce the inappropriate expectations through communication to improve employee satisfaction. Third, solve existing problems in a more economical way. It is worth noting that green buildings are different from traditional buildings and that their maintenance costs are very expensive, so the best way is to identify which problems can be improved by increasing the cost of the controllable range through effective communication and interpretation. That is, it does not require large-scale construction and can be consistent with the user's expectations. For example, the user has higher requirements for indoor water supply, and can be improved by simple measures such as controlling the indoor water temperature. Fourth, through the internal

budget planning of the organization, increase the facility management in the rest area to improve employee satisfaction, because the facility management is an urgent need to improve, can be managed by the outsourcing company, which is relative to the company's internal training and human resources. Arrangements and other methods are more economical. Hardware facility management such as this can be improved very well in a short period of time. The fifth and very important point is that the regulatory department can be set up in the property department to respond quickly to changes in the interior of the green building, thus forming a continuous cycle management system. Finally, since the future is an information technology era, green office buildings can also introduce high-tech technologies for daily management and support, adhere to the people-oriented, and strive to achieve the goal of “zero carbon emissions”.

7.Discussion

This chapter will focus on the validity, reliability, and limitations of this study and critically evaluate and discuss it.

7.1 VALIDITY

7.1.1 Construct validity

The principles of validity and reliability are fundamental cornerstones of the scientific method. Together, they are at the core of what is accepted as scientific proof, by scientist and philosopher alike. By following a few basic principles, any experimental design will stand up to rigorous questioning and skepticism (Shuttleworth, 2008).
Validity encompasses the entire experimental concept and establishes whether the results obtained meet all of the requirements of the scientific research method. For example, there must have been randomization of the sample groups and appropriate care and diligence shown in the allocation of controls. Internal validity dictates how an experimental design is structured and encompasses all of the steps of the scientific research method. Even if your results are great, sloppy and inconsistent design will compromise your integrity in the eyes of the scientific community. Internal validity and reliability are at the core of any experimental design (Shuttleworth, 2008).
Therefore, the validity of the thesis research is the first step of the report, and it is also a very important step.

7.1.2 Internal validity

Internal validity about questionnaires refers to the ability of my questionnaire to measure what I intend to measure (Saunders , Lewis , & Thornhill, 2009). As for the validity of a questionnaire, I will refer to content validity, criterion-related validity and construct validity (Saunders , Lewis , & Thornhill, 2009). Regarding content validity, it can be through careful definition of the research through the literature reviewed and, where appropriate, prior discussion with others. Reuse validated surveys, have a test survey round to make sure people understand the questions, dispatch the survey in Chinese to prevent misunderstanding of questions (construct validity). Internal validity in quantitative research is also about the coherence of the constructs. I can statistically test the quality of the measurement instrument after data collection. In the validity analysis of the questionnaire, it can be concluded from the table in Appendix 2 that the common value corresponding to all the research items is higher than 0.4, indicating that the research project information can be effectively extracted. In addition, the KMO is 0.760, which is greater than 0.6, which means the data is valid.

7.1.3 External validity

As mentioned above and mentioned, in order to ensure the external validity of this quantitative study, probability sampling is used to select the case organization, and the most important feature of probability sampling is the specific promotion, according to the analysis result of this case can be promoted in a larger population. Because the object of this study is the satisfaction of users of green office buildings, this sample frame is limited to representative green office buildings. In the process of operation, the researchers persuaded the property management department to distribute and promote the online questionnaire through the internal communication group through field visits and telephone communication and collected 139 valid questionnaires.

7.2 RELIABILITY

Reliability addresses the overall consistency of a research study's measure. If a research instrument, for example, a survey or questionnaire, produces similar results under consistently applied conditions, it lessens the chance that the obtained scores are due to randomly occurring factors, like seasonality or current events, and measurement error (Loyal, 2016). Measurement error can be reduced by standardizing the administration of the study, i.e., ensuring that all measurements be taken in the same manner among all the study participants; making certain the participants understand the purpose of the research and the instructions; and thoroughly training data collectors in the measurement strategy (Loyal, 2016).

Reliability is mainly divided into two types as stability and internal consistency reliability. Stability: It is defined as the ability of a measure to remain the same over time despite uncontrolled testing conditions or respondent. It refers to how much a person's score can be expected to change from one administration to the next. A perfectly stable measure will produce the same scores time after time.

Because the questionnaire may be contaminated for various reasons (such as incomplete knowledge, assistants instead of completing internal and external reasons such as questionnaires) So, ensuring the reliability of research is a very crucial criterion for research and the baseline. For this reason, random checks of interviewers are often made by survey organizations. When writing your project report, you will be expected to state your response rate. When doing this you need to be careful not to make unsubstantiated claims if comparing with other surveys' response rates (Saunders , Lewis , & Thornhill, 2009). If the collected receipt is of poor quality or is missing, it will be removed and only the most effective data will be retained. Other reasons that may affect reliability include investigator bias, researcher's mistakes, so avoid investigators' subjective bias toward participants. In order to minimize the errors and errors in reliability, several measures have been taken. To ensure the transparency of the program, all details of the research design, analysis procedures, and sample selection are detailed in the Methodology chapter. The data of this study was collected from April to May 2019. At that time, the climatic conditions in Shanghai were in a very warm and humid condition, so the sense of body would be better regardless of

indoor and outdoor. In the first paragraph of the questionnaire setting, all respondents accepted the same introductory text attached to the questionnaire, and then they decided whether to continue to answer the questionnaire. At the same time, in order to reduce the possibility of participant bias to a certain extent, respondents used an anonymous form. In order to ensure the reliability of the quantitative data, the credibility test was carried out before the data set was analyzed. The reliability of the questionnaire was relatively high in the above and the reliability was as high as 0.829.

7.3 Limitations

The limitations of the case study mainly include the following:

1. The response to the sample is not sufficient.
2. This is too laborious because you need to collect opinions from the entire building user on the workplace.
3. It is difficult to copy.

In the empirical research, a probability sampling scheme was adopted. Therefore, not all the users and user groups could be covered (Wu , 2016). In the actual situation, since heating and air conditioning in southern China will only heat the interior in the winter, there may be a large error in the satisfaction of the heating form. Because of the law of large numbers. Researchers normally work to a 95 per cent level of certainty. This means that if your sample was selected 100 times, at least 95 of these samples would be certain to represent the characteristics of the population. The confidence level states the precision of your estimates of the population as the percentage that is within a certain range or margin of error (Saunders , Lewis , & Thornhill, 2009). Therefore, the more importantly, according to the total population of Jinmao Tower, the response volume of 200 to 300 valid questionnaires is within a low error range, so the limited sample size greatly affects the data quality of the analysis. Moreover, it is difficult to avoid the heterogeneity between buildings and users. Due to the different evaluation criteria for green office buildings in China, and because of the time-consuming research, it is impossible to investigate the user satisfaction of all Chinese green office buildings. Another important limitation is that because of the online questionnaire format, the current experience of respondents in different scenarios is different, which will affect the authenticity of the data.

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Appendix

Appendix 1- Green office building satisfaction survey

Green office building satisfaction survey

1. Have you heard of the concept of green building? [Single choice questions]
○ Yes
○No
2. Are you a technical or non-technical position? [Single choice questions]
○Technical position
○Non-technical positions
3. What is your gender? [Single choice questions]
○ male
○ female
4. What is your age? [Single choice questions]
○20-29
○30-39
○40-49
○50-59
○60+
5.Satisfaction evaluation for indoor use air conditioning form [Single choice questions]
○ Very unsatisfied
○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
6. Satisfaction evaluation of the indoor heating form of the building [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
7. Satisfaction evaluation of the form of indoor hot water supply in the building [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○Neutral
○ Satisfied
○ Very satisfied
8. Satisfaction evaluation of noise control in building interior [Single choice question]
○ Very unsatisfied

○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
9. Satisfaction evaluation of natural lighting in the building interior? [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
10. Satisfaction evaluation of lighting in the building interior [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○Neutral
○ Satisfied
○ Very satisfied
11. Satisfaction evaluation of safety protection measures for building interior installation [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
12. Satisfaction evaluation of indoor thermal comfort (temperature, humidity, wind speed, cleanliness) [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
13. Satisfaction evaluation of air quality (air odor, fresh air volume) in building interior [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
14. Satisfaction evaluation of water supply quality (water supply facilities, indoor water appliances, water volume, water pressure, water quality) in buildings [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○ Neutral

○ Satisfied
○ Very satisfied
15. Satisfaction evaluation of decoration and design in building interior [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
16. Satisfaction evaluation of indoor and outdoor landscape green space of the building [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○Neutral
○ Satisfied
○ Very satisfied
17. Satisfaction evaluation of the mood and psychological condition brought about by the building [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
18. Satisfaction evaluation of work productivity in the building [Single choice question]
○ Very unsatisfied
○ Unsatisfied
○ Neutral
○ Satisfied
○ Very satisfied
19. What is your one-year absent days in the building? [Single choice question]
○0 days
○1-4 days
○5-8 days
○9-12 days
○13 days+
20. What do you think is the quality of green office buildings? [Multiple choice questions]
□ Safe and durable
□ Convenient service
□ Healthy and comfortable
□ Environmentally livable
□ Resource conservation
□ Energy saving and environmental protection

21. What is your personal preference for the office? [Single choice question]
○Traditional office
○Green office
22. How do you feel about the current office environment? [Single choice question]
○ Sahara Desert---Monotonous and boring
○ Lijiang Old Town---Comfort and harmony
○ Amazon Rainforest---Internal Environmental Diversity
○ Siberia---The environment is harsh
23. What facilities do you most want to have in your office? [Multiple choice questions]
○ Comfort lounge
○ Micro gym
○ Rich library
○ Snack area
○ Hidden dressing room
○ Utility storage cabinet
○ Others
24. What do you think is the current office environment to be improved? [Multiple choice questions]
○ Cleanliness
○ Pattern
○ Lighting ventilation
○ Decoration and design
○ Temperature regulation
○ Office facilities
25. What will affect you in the work environment? [Multiple choice questions]
○ Odor
○ Noise
○ Lighting
○ Thermal comfort
○ Ventilation

Appendix 2- Questionnaire validity

Communalities

	Initial	Extraction
1. Have you heard of the concept of green building?	1.000	.682
2. Are you a technical or non-technical position?	1.000	.734

3. What is your gender?	1.000	.675
4. What is your age?	1.000	.603
5.Satisfaction evaluation for indoor use air conditioning form	1.000	.646
6. Satisfaction evaluation of the indoor heating form of the building	1.000	.673
7. Satisfaction evaluation of the form of indoor hot water supply in the building	1.000	.624
8. Satisfaction evaluation of noise control in building interior	1.000	.531
9. Satisfaction evaluation of natural lighting in the building interior?	1.000	.659
10. Satisfaction evaluation of lighting in the building interior	1.000	.667
11. Satisfaction evaluation of safety protection measures for building interior installation	1.000	.714

12. Satisfaction evaluation of indoor thermal comfort (temperature, humidity, wind speed, cleanliness)	1.000	.602
13. Satisfaction evaluation of air quality (air odor, fresh air volume) in building interior	1.000	.583
14. Satisfaction evaluation of water supply quality (water supply facilities, indoor water appliances, water volume, water pressure, water quality) in buildings	1.000	.724
15. Satisfaction evaluation of decoration and design in building interior	1.000	.646
16. Satisfaction evaluation of indoor and outdoor landscape green space of the building	1.000	.702

17. Satisfaction evaluation of the mood and psychological condition brought about by the building	1.000	.736
18. Satisfaction evaluation of work productivity in the building	1.000	.654
19. What is your one-year absent days in the building?	1.000	.621
20. What do you think is the quality of green office buildings? (Safe and durable)	1.000	.633
20. What do you think is the quality of green office buildings? (Convenient service)	1.000	.672
20. What do you think is the quality of green office buildings? (Healthy and comfortable)	1.000	.635
20. What do you think is the quality of green office buildings? (Environmentally livable)	1.000	.554

20. What do you think is the quality of green office buildings? (Resource conservation)	1.000	.694
20. What do you think is the quality of green office buildings? (Energy saving and environmental protection)	1.000	.755
21. What is your personal preference for the office?	1.000	.593
22. How do you feel about the current office environment?	1.000	.696
23. What facilities do you most want to have in your office? (Comfort lounge)	1.000	.730
23. What facilities do you most want to have in your office? (Micro gym)	1.000	.755
23. What facilities do you most want to have in your office? (Rich library)	1.000	.645

23. What facilities do you most want to have in your office? (Snack area)	1.000	.656
23. What facilities do you most want to have in your office? (Hidden dressing room)	1.000	.595
23. What facilities do you most want to have in your office? (Utility storage cabinet)	1.000	.705
23. What facilities do you most want to have in your office? (Others)	1.000	.506
24. What do you think is the current office environment to be improved? (Cleanliness)	1.000	.612
24. What do you think is the current office environment to be improved? (Pattern)	1.000	.610
24. What do you think is the current office environment to be improved? (Lighting ventilation)	1.000	.740

24. What do you think is the current office environment to be improved? (Decoration and design)	1.000	.731
24. What do you think is the current office environment to be improved? (Temperature regulation)	1.000	.644
24. What do you think is the current office environment to be improved? (Office facilities)	1.000	.708
25. What will affect you in the work environment? (Odor)	1.000	.566
25. What will affect you in the work environment? (Noise)	1.000	.684
25. What will affect you in the work environment? (Lighting)	1.000	.677
25. What will affect you in the work environment? (Thermal comfort)	1.000	.580

25. What will affect you in the work environment? (Ventilation)	1.000	.622

Appendix 3-The pictures of Jinmao Tower


AND ENVIRONMENTAL DESIGN
LEED
2013

Appendix 4- Linear regression analysis of green building concept understanding

Linear regression analysis results									
	Unstandardized Coefficients		Standardized Coefficients	*t*□	*p*□	VIF□	R^2□	Adjusted R^2□	*F*□
	B□	Std. Error□	*Beta*□						
Model	4.214	0.200	-	21.098	0.000**	-	0.062	0.055	9.038(0.003**)
Independent variable	-0.432	0.144	-0.249	-3.006	0.003**	1.000			
Dependent variable: Satisfaction evaluation of the indoor heating form of the building									
Durbin-Watson：1.757									
* p<0.05 ** p<0.01									

Linear regression analysis results									
	Unstandardized Coefficients		Standardized Coefficients	*t*□	*p*□	VIF□	R^2□	Adjusted R^2□	*F*□
	B□	Std. Error□	*Beta*□						
Model	4.188	0.202	-	20.732	0.000**	-	0.051	0.044	7.421(0.007**)
Independent variable	-0.396	0.145	-0.227	-2.724	0.007**	1.000			
Dependent variable: Satisfaction evaluation of the indoor heating form of the									

building
Durbin-Watson：1.831
* p<0.05 ** p<0.01

Linear regression analysis results									
	Unstandardized Coefficients		Standardized Coefficients	t	p	VIF	R^2	Adjusted R^2	F
	B	Std. Error	$Beta$						
Model	3.855	0.233	-	16.528	0.000**	-	0.013	0.006	1.869(0.174)
Independent variable	-0.230	0.168	-0.116	-1.367	0.174	1.000			
Dependent variable: Satisfaction evaluation of noise control in building interior									
Durbin-Watson：1.647									
* p<0.05 ** p<0.01									

Linear regression analysis results									
	Unstandardized Coefficients		Standardized Coefficients	t	p	VIF	R^2	Adjusted R^2	F
	B	Std. Error	$Beta$						
Model	4.188	0.202	-	20.732	0.000**	-	0.051	0.044	7.421(0.007**)
Independent variable	-0.396	0.145	-0.227	-2.724	0.007**	1.000			
Dependent variable: Satisfaction evaluation of the form of indoor hot water supply									

in the building
Durbin-Watson：1.831
* p<0.05 ** p<0.01

Linear regression analysis results									
	Unstandardized Coefficients		Standardized Coefficients	t□	p□	VIF□	R^2□	Adjusted R^2□	F□
	B□	Std. Error□	$Beta$□						
Model	4.230	0.216	-	19.537	0.000**	-			
Independent variable	-0.417	0.156	-0.223	-2.676	0.008**	1.000	0.050	0.043	7.158(0.008**)
Dependent variable: Satisfaction evaluation of natural lighting in the building interior									
Durbin-Watson：1.831									
* p<0.05 ** p<0.01									

c								
	Unstandardized Coefficients		Standardized Coefficients	t□	p□	VIF□	R^2□	Adjusted R^2□	F□
	B□	Std. Error□	$Beta$□						
Model	4.635	0.202	-	22.964	0.000**	-			
Independent variable	-0.666	0.145	-0.365	-4.584	0.000**	1.000	0.133	0.127	21.017(0.000**)

Dependent variable: Satisfaction evaluation of lighting in the building interior
Durbin-Watson：1.897
* p<0.05 ** p<0.01

c									
	Unstandardized Coefficients		Standardized Coefficients	t□	p□	VIF□	R^2□	Adjusted R^2□	F□
	B□	Std. Error□	$Beta$□						
Model	4.114	0.227	-	18.111	0.000**	-	0.043	0.036	6.158(0.014*)
Independent variable	-0.406	0.164	-0.207	-2.482	0.014*	1.000			
Dependent variable: Satisfaction evaluation of indoor thermal comfort									
Durbin-Watson：1.972									
* p<0.05 ** p<0.01									

c									
	Unstandardized Coefficients		Standardized Coefficients	t□	p□	VIF□	R^2□	Adjusted R^2□	F□
	B□	Std. Error□	$Beta$□						
Model	4.036	0.246	-	16.378	0.000**	-	0.034	0.027	4.830(0.030*)
Independent variable	-0.390	0.177	-0.185	-2.198	0.030*	1.000			
Dependent variable: Satisfaction evaluation of air quality									

Durbin-Watson：2.226
* p<0.05 ** p<0.01

c									
	Unstandardized Coefficients		Standardized Coefficients	t□	p□	VIF□	R^2□	Adjusted R^2□	F□
	B□	Std. Error□	$Beta$□						
Model	4.040	0.199	-	20.318	0.000**	-	0.033	0.026	4.704(0.032*)
Independent variable	-0.311	0.143	-0.182	-2.169	0.032*	1.000			
Dependent variable: Satisfaction evaluation of water supply quality									
Durbin-Watson：1.860									
* p<0.05 ** p<0.01									

c									
	Unstandardized Coefficients		Standardized Coefficients	t□	p□	VIF□	R^2□	Adjusted R^2□	F□
	B□	Std. Error□	$Beta$□						
Model	4.437	0.236	-	18.833	0.000**	-	0.087	0.080	13.082(0.000**)

Independent variable	-0.614	0.170	-0.295	-3.617	0.000**	1.000			
Dependent variable: Satisfaction evaluation of decoration and design in building interior									
Durbin-Watson：1.942									
* p<0.05 ** p<0.01									

c								
	Unstandardized Coefficients		Standardized Coefficients	t□	p□	VIF□	R^2□	Adjusted R^2□	F□
	B□	Std. Error□	$Beta$□						
Model	4.195	0.237	-	17.671	0.000**	-	0.045	0.038	6.468(0.012*)
Independent variable	-0.435	0.171	-0.212	-2.543	0.012*	1.000			
Dependent variable: Satisfaction evaluation of indoor and outdoor landscape green space of the building									
Durbin-Watson：1.716									
* p<0.05 ** p<0.01									

c								
	Unstandardized Coefficients	Standardized Coefficients	t□	p□	VIF□	R^2□	Adjusted R^2□	F□

	B□	Std. Error □	*Beta*□						
Model	4.334	0.199	-	21.784	0.000**	-	0.073	0.066	10.726(0.001**)
Independent variable	-0.469	0.143	-0.269	-3.275	0.001**	1.000			
Dependent variable: Satisfaction evaluation of the mood and psychological condition brought about by the building									
Durbin-Watson：1.928									
* p<0.05 ** p<0.01									

c									
	Unstandardized Coefficients		Standardized Coefficients	*t*□	*p*□	VIF □	R^2 □	Adjusted R^2□	*F*□
	B□	Std. Error □	*Beta*□						
Model	4.016	0.226	-	17.790	0.000**	-	0.022	0.015	3.122(0.079)
Independent variable	-0.287	0.163	-0.149	-1.767	0.079	1.000			
Dependent variable: Satisfaction evaluation of work productivity in the building									
Durbin-Watson：2.114									
* p<0.05 ** p<0.01									

Appendix 5- Linear regression important data - employee type

Air conditioning form :R^2= 0.005 F=0.625，P>0.05
Indoor heating form :R^2= 0.001 F=F=0.142，P>0.05
Indoor hot water supply :R^2= 0.001 F=0.203，P>0.05
Noise control :R^2= 0.009 F=1.200，P>0.05
Natural lighting :R^2= 0.000 F=0.043，P>0.05
Lighting in the building interior :R^2= 0.005 F=0.625，P>0.05
Indoor thermal comfort :R^2= 0.003 F=352，P>0.05
Air quality :R^2= 0.001 F=0.183，P>0.05
Water supply quality :R^2= 0.002 F=0.286，P>0.05
Decoration and design in building interior :R^2= 0.000 F=0.036，P>0.05
Indoor and outdoor landscape green space :R^2= 0.000 F=0.024，P>0.05
The mood and psychological condition :R^2= 0.001 F=0.124，P>0.05
Work productivity :R^2= 0.005 F=0.684，P>0.05

Appendix 6- The gender for the significance of these indicators

ANOVA analysis results					
	Gender (Mean ± standard deviation)			*F*	P
	Male(N=46)	Female(N=88)	Others (N=5)		
Air conditioning form	3.52±0.89	3.49±0.77	3.60±0.55	0.062	0.940
Indoor heating form	3.52±0.96	3.75±0.70	3.00±0.71	2.965	0.055
Indoor hot water supply	3.65±0.85	3.69±0.81	3.40±0.55	0.321	0.726
Noise control	3.54±0.96	3.58±0.92	3.20±0.45	0.405	0.668
Natural lighting	3.72±0.98	3.67±0.81	3.60±0.89	0.067	0.935
Lighting in the building interior	3.87±0.78	3.74±0.89	3.20±0.45	1.514	0.224
Indoor thermal comfort	3.65±0.90	3.57±0.91	3.20±1.10	0.586	0.558
Air quality	3.59±1.00	3.51±0.98	3.20±0.84	0.372	0.690
Water supply quality	3.63±1.00	3.66±0.66	3.20±0.84	0.795	0.453

Decoration and design in building interior	3.80±1.00	3.59±0.92	2.80±1.10	2.744	0.068
Indoor and outdoor landscape green space	3.72±1.11	3.59±0.85	3.40±1.14	0.411	0.664
The mood and psychological condition	3.78±0.76	3.72±0.84	3.20±0.45	1.178	0.311
Work productivity	3.72±1.03	3.61±0.82	3.40±0.89	0.388	0.679
* p<0.05 ** p<0.01					

Appendix 7- Significance of different ages for each indicator

ANOVA analysis results						
	Age(Mean ± standard deviation)				F	p
	20-29(N=93)	30-39(N=31)	40-49(N=14)	50-59(N=1)		
Air conditioning form	3.57±0.74	3.45±0.85	3.14±1.03	4.00±null	1.337	0.265
Indoor heating form	3.74±0.79	3.61±0.80	3.14±0.77	3.00±null	2.572	0.057
Indoor hot water supply	3.75±0.73	3.48±0.93	3.57±1.02	3.00±null	1.167	0.325
Noise control	3.60±0.90	3.48±0.89	3.36±1.15	4.00±null	0.433	0.730
Natural lighting	3.67±0.89	3.81±0.65	3.50±1.16	4.00±null	0.466	0.707
Lighting in the building interior	3.77±0.81	3.74±1.00	3.71±0.83	4.00±null	0.052	0.984

Indoor thermal comfort	3.59±0.85	3.58±1.03	3.50±1.09	4.00±null	0.110	0.954
Air quality	3.63±0.91	3.32±1.17	3.21±0.97	4.00±null	1.385	0.250
Water supply quality	3.70±0.73	3.71±0.82	3.07±0.92	3.00±null	3.005	0.033*
Decoration and design in building interior	3.62±0.94	3.65±1.08	3.71±0.91	3.00±null	0.178	0.911
Indoor and outdoor landscape green space	3.61±0.92	3.68±0.91	3.57±1.28	4.00±null	0.101	0.959
The mood and psychological condition	3.82±0.79	3.52±0.81	3.50±0.85	4.00±null	1.510	0.215
Work productivity	3.56±0.88	3.84±0.90	3.79±0.97	3.00±null	1.063	0.367
* $p<0.05$ ** $p<0.01$						