Basic Research on the Satisfaction of Building Indoor Personnel Based on Personnel Portrait

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Abstract. During the operation phase, energy conservation of buildings gets much attention. Controlling methods are often based on physical parameters, ignoring the specific needs of different groups of people for the environment. To evaluate the current status, the questionnaire is used to investigate the relationship between personnel comfortability and various factors. This article aims to introduce the method of personnel portraits, balance the personality and common conflicts of the crowd, and solve the control problem of comfort that varies from person to person. Finally, combined with the analysis of the results of the questionnaire, a multi-faceted study of personnel satisfaction was provided to provide a reference for methods that can achieve energy-saving and satisfaction control at the same time.

1. Introduction
As spending more time indoors, people’s requirements for the environment in the building are getting higher. In the control of the internal environment of the building, energy-saving is as important as the comfortability of indoor environment. Our goal is to find a method that can not only meet the requirements of comfortability but also realize the energy-saving control of the indoor environment. The control logic between them is the key to the solution. The purpose of this research is to initially obtain a representative indoor personnel satisfaction evaluation program that can truly reflect the situation of the indoor personnel and has practical significance for the control system. The completion of this work will provide important support for the optimization of green building operations.

2. Research background
The predicted mean vote (PMV) approach, the adaptive comfort model, or the human body exergy analysis method has been used to predict indoor thermal conditions[1]. To maintain the thermal comfortability, some scholars[2] analyzed the impact of various environmental factors on PMV and proposed an optimized control scheme for the air conditioning system. With the usage of big data management, more interactive intelligent control methods have been applied, Y F Si[3] established dynamic optimization of the building's indoor thermal environment, indoor air quality, and building air...
conditioning operation that is based on the needs of indoor personnel for the building environment, and intelligently controlled key indicators KPI. Research focuses on the analysis of physical parameters, but the differences in human perception of comfortability should include individual differences in physique and psychological differences. After referring to traditional thermal environment satisfaction indicators and combining human psychological and physiological factors, we select the key factors affecting personnel satisfaction such as air environment, light environment, thermal environment, acoustic environment, and energy-saving awareness. To obtain a more common satisfaction evaluation, the user portrait was applied to classify the individual's energy consumption, the feeling of heat and cold, environmental awareness and actions, etc., and summarize the personality problems of people.

3. Personnel portrait technology concept
   User Portrait (Personas)—The concept was first proposed by Alan Cooper, the father of interaction design. The user portrait is the outline of the user's characteristics, the performance of the user's characteristics is intuitive and clear, and the user's touchpoints and pain points are reflected. The purpose of the user portrait is to achieve links between products and services or evaluation[4]. User portrait technology can classify the surveyed, and mark the habits of each type of user based on the feedback information. Adjust the control system through the number and proportion of various types of people in the building to meet the needs of most people. Some scholars sort out the reconstruction process of user portraits as data collection, data mining and filtering, label extraction and reorganization[5].

User profile technology categorize user information as static data and dynamic information data. Static data refers to relatively stable data, such as gender, age, occupation. Dynamic information data includes changing data in user behavior, such as comments and goals. The specific research steps of this study are as follows: the first step is to collect data; the second step is to refine the key elements and build a model; the third step is to assign data labels through the data processing results, and the user portrait is completed.

In this questionnaire, combined with the research on factors affecting personnel satisfaction, we will investigate the five static data of gender, age, physique, education, and occupation. Investigate the three dynamic data of behavior habits, environmental awareness, and environmental behavior.

4. User portrait label classification
   A total of 211 valid questionnaires were obtained in this survey. Males are 47.39%; females account for 52.61%, which is relatively average. The statistical age group is divided into 34% from 18-23 years old, 8% from 24-29 years old, 21% from 30-39 years old, 14% from 40-49 years old, 22% from 50-55 years old, and retirement ages over 56 years old1 %. The evaluation statistics of the interviewees' physique are as follows. More people are neither heat-resistant nor cold-tolerant, accounting for 34.12% of the total; the number of people who are more sensitive to cold or heat is similar, each with 25%; heat-resistant and cold-tolerant accounted for 17%. Undergraduates accounted for 67% of the survey. Overall, the respondents have a higher level of education.

For personnel portraits, attention on classification of detail is meaningless for research. Considering the limited amount of questionnaire data, we have to analyze the relationship between the data and simplify the classification of portraits. Specifically discuss the five relationships between gender and physique, age and physique, physique and environmental awareness, age and environmental awareness, and educational background and environmental awareness.

Gender-physique. There are differences in physique between different genders. Men are generally more resistant to cold, while women are more resistant to heat. In comparison, the proportion of men who are resistant to heat and cold is 13% higher than that of women, and the proportion of men who are neither resistant to heat nor cold is 9% lower, which shows that men are less sensitive to the environment than women.

Age-physique. People's sensitivity to the environment decreases with age, and the proportion of heat intolerance is increasing, which indicates that people's tolerance to cold will gradually decrease.
Environmental awareness—physique. The respondents who are resistant to heat and cold are the most environmentally conscious, at 42%. For the other types, the proportion of certain or strong environmental awareness is around 95%. In general, there is no strong correlation between the human body constitution and environmental awareness.

Age-environmental awareness. Respondents of all age groups have the same environmental awareness. The proportion of people born in the 70s and 60s with weak environmental awareness is 7%, which is slightly higher than that of young people. It is impossible to conclude that a certain age group has better environmental awareness.

Educational background—environmental awareness. The correlation between awareness of environment protection and educational background is not as higher as we expect. People with weak environmental awareness are less than 10%. Therefore, it can be considered that all groups with academic degrees have a certain environmental awareness.

5. Personnel profile analysis

In the person profile, we choose one of the two related variables and connect it with other unrelated variables. In the end, two types of portraits of people—age and environmental awareness were determined. For these portraits, we will study the evaluation of objective environmental factors such as air quality, light environment, thermal environment, acoustic environment, and the degree of emphasis on various factors.

Figure 1. Gender-age portrait
For (category I) people with strong environmental awareness, 60% think the current environment is comfortable, while 51% still expect a lower indoor temperature. For (category J) people with general environmental awareness, 65% are satisfied with the indoor temperature, while 50% still expect a lower indoor temperature. For (category K) people with weak environmental awareness, 34% think the current environment is comfortable, and 29% still expect a lower indoor temperature.

6. Summary
This paper takes the green building operation optimization technology as the background and puts forward the key to the satisfaction of personnel to control the building environment. Obtain a new intersection satisfaction evaluation method based on multiple methods. Summarize based on the survey results: (1) Different types of people have different preferences for environmental satisfaction factors; (2) the male group under the age of 50 wants a lower room temperature to improve satisfaction. At the same time, women over the age of 40 feel that the current room temperature is relatively cold, and the post-70s group is most satisfied with the current overall environment; (3) environmental awareness seems to have little effect on people's evaluation and expectations of indoor temperature. People with...
high environmental awareness do not show obvious tolerance for air-conditioning temperature, and they did not put forward energy-saving recommendations for temperature settings.

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