# A Study on the Architect Site Project as an Application of the MODM System

Jun DONG*, Sicong YU

*School of Civil Engineering,* Northeast Forestry University, Harbin, Heilongjiang,150040，China

***Abstract* — This study adopts the method of MODM (Multi-Objective Decision-Making) system to perform scientific research on the site issues in the advance architect project. The process involves normalizing, analysis and testing the multi-dimension and multi-directional factors, then using the technique of MODM system to calculate the value of the corresponding site project, we make an optimal decision on site project. By using such method, this results in a reduction in human disturbance in architect site project, and makes the process more scientific and logical, which will improve the quality of architect site project.**

***Keywords - MODM; Architect site; Multi-dimension; Scientific logic***

## I. INTRODUCTION

American William Connor in "Architectural Record" published an article entitled "Building analysis - the beginning of a good design," the article, the article mentioned in the architectural design should not only consider the design itself, but should pay more attention to people and construction, environment and architecture, interactive experience with the construction area, so is the initiation of the construction planning ideas. However, construction did not get the expected attention to planning, the planning system has not fully formed. In the planning decision problem often faced with multiple construction site, this study uses multiple objective decision making system construction method will help the siting problem analysis, answers, this system to gradually improve the building plan.

### *A. Construction Site Planning*

Construction site planning is the forerunner of architectural design, is a research work before the start of the architectural design, through a series analysis of the survey data, to be more in line with the architectural design of the site content and meaning of the requirements. The construction site of scientific planning is particularly important. The statistical science, mathematical theory applied to the construction site in the planning, to compare the pros and cons of each construction site plan for architecture team, make construction site decision - making more scientific and rigorous, at a glance.

### *B. Objective Optimization Decision Making System*

Multiple objective optimization decision-making system, under the premise of building decision diversified, will target a variety of comprehensive consideration, and select the program to optimize the decision-making system. The core of Multiple objective optimization theory of decision-making system is mathematics, use mathematical logic rational analysis of human inductive logic, which will become uncontrollable factor into controllable, this paper use multiple objective optimization decision-making system in analysis the construction location decision the early stage is collecting community feedback, taking into account the interaction between people and architecture, make the building-environment-three Comprehensive consideration. Different dimension and multiple dimensional attribute values were normalized. In the medium term, the data collected by the analysis method of multi-objective optimization decision-making system is integrated. And the application of multi - objective decision - making system analysis method of the specific algorithm for repeated verification, and finally get the feasibility data. In the late period, the scientific feasibility data were calculated, and the optimal scheme was obtained

### *C. Significance*

Construction site planning is an important part of the construction plan. Architectural planning concept have been development for forty years, in foreign countries has formed a relatively complete system, but in China has not been enough attention, pre-construction projects in advance preparation and planning are imperfect, is more dependent on the requirements of the owner party and architect experience, the lack of scientific rigor and logic, it is difficult to measure the pros and cons.

In this case, an objective, rigorous, scientific analysis and reliable method is particularly important, multiple objective optimization decision-making system is a complete system analysis, is used in various fields of business, management, construction field problems also can use this method of analysis to resolve, such as the construction site selection, selection of construction scheme, construction material itself, volume and appearance, and so on, through a multiple objective optimization decision-making system in decision-making methods will impact factor for data analysis can be prepared options merits of intuitive show up, improve efficiency, but also the selection result more objective, reliable and true.

## II. EXAMPLES-APPLICATION

In the "first city Harbin Institute elderly conservation design" alternative, the base location A, B, C have advantages and disadvantages, multiple objective decision-making system in the analysis, the design team to help better choice, at the same time intuitive It shows the advantages of this method of analysis and scientific rigor.

A site located between Qunli cells, Qunli Sixth Avenue and Seventh Avenue. Base north of Qunli National Wetland Park, the vegetation coverage rate is high. South of the natural home residential area, residential area on the west side of home landscape. The eastern base near Medical School freshman, facilitate the elderly Medical treatment. Meanwhile Nearby the Harbin third high school.


Figure 1. Location Area A Bitmap

Location B lots located in Harbin City Haxi areas of Fudan Road, adjacent to the window of the Eurasian forests and more Harbin Medical University Hospital in the surrounding and medical facilities.


Figure 2. Location Area B Bitmap

Location C in Songbei District Source Avenue and Songbei Road intersection in the northwest side, facilitate traffic, source Avenue, south of poly source street adjacent to the medical university hospital and Songbei shopping center, on the west side of the black swan green leisure park, on the eastern side of the Harbin University of Commerce.


Figure 3. Location Area C Bitmap

### *B. Unquantifiable Factor Analysis*

After a certain understanding of the location of the three bases, the first of the same dimension of the Non quantifiable factors analysis, the establishment of hierarchical structure diagram.

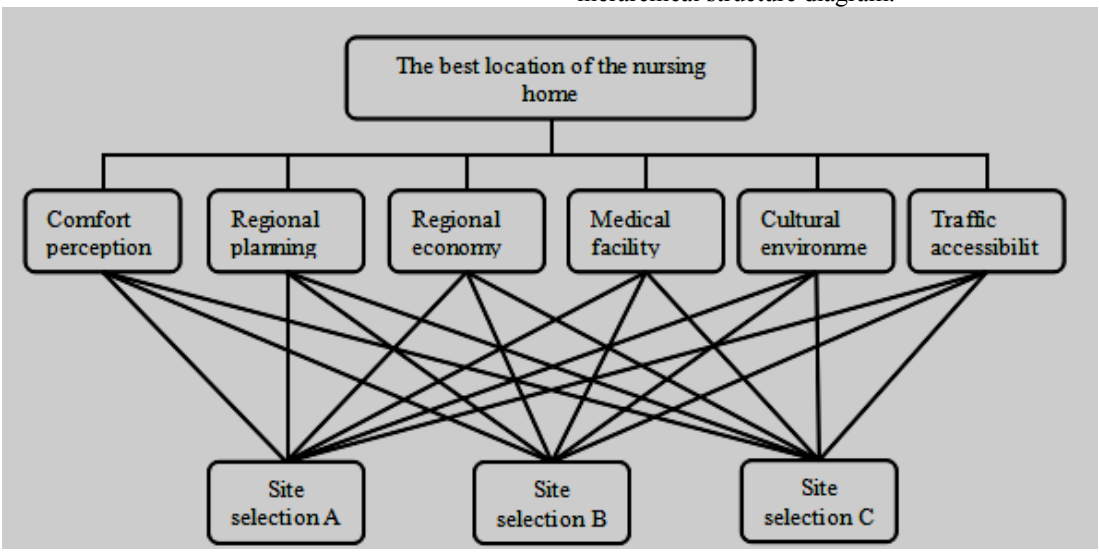


Figure 4. .Hierarchical Structure Diagram

Questionnaire survey using semantic range scaling method to obtain the score to six factors of hierarchy structure chart of the data of the research. This research adopts questionnaire survey and questionnaire survey of different strata have intention of living in the elderly in nursing homes for the elderly are scored.

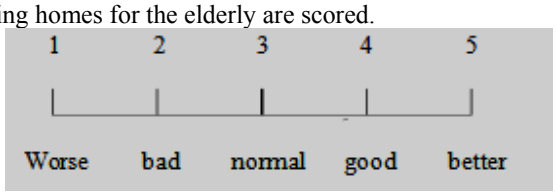


Figure 5. .Range Scale Method

After screening by two groups recognized high survey rating data and research data, the test data is an important method in analytical. Through the analysis of the test can score of survey data validation is objective.

TABLE 1. SURVEY SCORE DATA

| | Comfort perception | regional planning | Regional economy | Medical facility | Cultural environment | Traffic accessibility |
|---|---|---|---|---|---|---|
| Research score A | 5 | 3 | 4 | 4 | 3 | 2 |
| Research score B | 4 | 3 | 5 | 4 | 3 | 2 |

### *C. Factor Assignment Reliability Test*

First of all, the score A:5,3,4,4,3,2; score B:4,3,5,4,3,2; Test of consistency, consistency checking can check factor assignment, to test whether the factor value is objective and reasonable. If the weight is not consistent with the consistency test that the survey data is not reasonable. Research should be started again, Expand the

scope of research, after obtaining the new survey data and then carry out a one-time inspection and through. The first structure of the judgment matrix is as follows.

TABLE 2.A GROUP SURVEY SCORE DATA

| | | | | | |
|---|---|---|---|---|---|
| 1 | 0.6 | 0.8 | 0.8 | 0.6 | 0.4 |
| 1.67 | 1 | 1.33 | 1.33 | 1 | 0.67 |
| 1.25 | 0.75 | 1 | 1 | 0.75 | 0.5 |
| 1.25 | 0.75 | 1 | 1 | 0.75 | 0.5 |
| 1.67 | 1 | 1.33 | 1.33 | 1 | 0.67 |
| 2.5 | 1.5 | 2 | 2 | 1.5 | 1 |

TABLE 3.B GROUP SURVEY SCORE DATA

| | | | | | |
|---|---|---|---|---|---|
| 1 | 0.75 | 1.25 | 1 | 0.75 | 0.5 |
| 1.33 | 1 | 1.67 | 1.33 | 1 | 0.67 |
| 0.8 | 0.6 | 1 | 0.8 | 0.6 | 0.4 |
| 1 | 0.75 | 1.25 | 1 | 0.75 | 0.5 |
| 1.33 | 1 | 1.67 | 1.33 | 1 | 0.67 |
| 2 | 1.5 | 2.5 | 2 | 1.5 | 1 |

Two sets of data were consistent with the A group CR=0.0001758<0.1 to meet the consistency test, B group CR=0.0001624<0.1 also meet the consistency test, resulting in two groups of research data are relatively objective.

### *D. Cloud Model to Establish a Detailed Analysis of Similar Factors*

under these circumstances, Build cloud model, In the cloud model can be seen in the two groups of subtle differences in research data, so as to obtain the data of objective logic high.

The weight of the two groups of research data through MATLAB are:

A=**Error! Reference source not found.**

B=**Error! Reference source not found.**。

The A value, EN value, He value of EX, B two groups are obtained by the following three formulas respectively.

EX=**Error! Reference source not found.** (1)

EN=**Error! Reference source not found.** (2)

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He=**Error! Reference source not found.** (4)

The A group survey score EN=0.0635, EX=0.163, He=0.06352; group B research score EX=0.165, EN=0.0671, He=0.06708.

The establishment of the qualitative concept of digital features (EX, EN, He), and the sample points, I=1,2,3. n cloud model, Cloud model images generated by MATLAB program

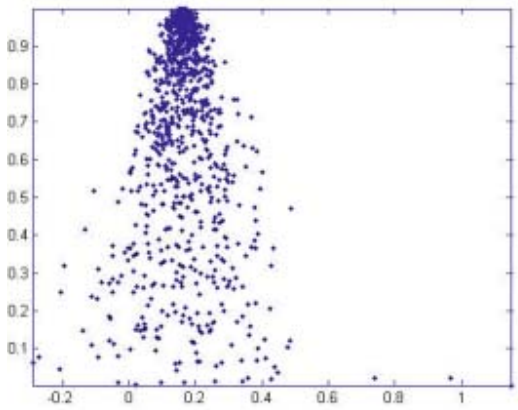


Figure 6. ResearchScore aGroup Data Cloud Model Chart

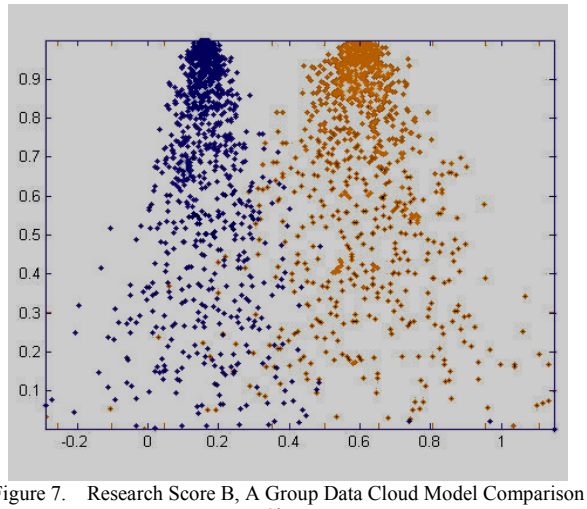


Figure 7. Research Score B, A Group Data Cloud Model Comparison Chart.

Through the image can be seen that the A image of the discrete degree is less than B image, the degree of dispersion in the cloud model image indicates the objectivity of the research score, the greater the degree of dispersion, the study indicated that there was a great difference in the perception of influence factors among the score of the research. On the contrary the discrete degree is small, indicates that the score of the impact factor is relatively objective. Therefore, in the A, B two groups of research score through the consistency test case, it can be considered that the A group's research score is more objective than the B group, and it should be adopted.

Above methods to two groups of data, for example, the same application of multiple group data.

After the analysis of the impact of factors on the nursing home survey data analysis, the same for three different location of the six impact factors for research, analysis, consistency test and cloud model comparison, the effective data of the three groups were obtained.

TABLE 4. LOCATION OF A, B, C SURVEY SCORE DATA

| | Comfort perception | regional planning | Regional economy | Medical facility | Cultural environment | Traffic accessibility |
|---|---|---|---|---|---|---|
| Research score A | 5 | 4 | 3 | 4 | 3 | 2 |
| Research score B | 4 | 5 | 3 | 4 | 2 | 3 |
| Research score C | 5 | 4 | 2 | 3 | 4 | 3 |

Calculate the location of the B, A, C six factors that affect the weight of the structure of the site selection, B, A, C of the impact factor judgment matrix is as follows.

TABLE 5. LOCATION OF A, B, C RESEARCH SCORING DATA JUDGMENT MATRIX

| **Comfort perception** | **A** | **B** | **C** | **weight** | **regional planning** | **A** | **B** | **C** | **weight** |
|---|---|---|---|---|---|---|---|---|---|
| **A** | 1 | 0.8 | 1 | 0.31 | A | 1 | 1.25 | 1 | 0.36 |
| **B** | 1.25 | 1 | 1.25 | 0.38 | B | 0.8 | 1 | 0.8 | 0.29 |
| **C** | 1 | 0.8 | 1 | 0.31 | C | 1 | 1.25 | 1 | 0.36 |
| **Regional economy** | A | B | C | weight | Medical facility | A | B | C | weight |
| **A** | 1 | 1 | 0.67 | 0.29 | A | 1 | 1 | 0.75 | 0.3 |
| **B** | 1 | 1 | 0.67 | 0.29 | B | 1 | 1 | 0.75 | 0.3 |
| **C** | 1.5 | 1.5 | 1 | 0.43 | C | 1.33 | 1.33 | 1 | 0.4 |
| **Cultural environment** | A | B | C | weight | Traffic accessibility | A | B | C | weight |
| **A** | 1 | 0.67 | 1.33 | 0.31 | A | 1 | 1.5 | 1.5 | 0.43 |
| **B** | 1.5 | 1 | 2 | 0.46 | B | 0.67 | 1 | 1 | 0.29 |
| **C** | 0.75 | 0.5 | 1 | 0.23 | C | 0.67 | 1 | 1 | 0.29 |

The weight values are obtained through calculation.

W3=**Error! Reference source not found.**

(5)

$$W = \begin{pmatrix} 0.31,0.36,0.29,0.3,0.31,0.43 \\ 0.38,0.29,0.29,0.3,0.26,0.29 \\ 0.31,0.36,0.43,0.4,0.23,0.29 \end{pmatrix} \times (0.23,0.14,0.19,0.19,0.14,0.09)^T = \begin{pmatrix} 0.32 \\ 0.31 \\ 0.35 \end{pmatrix}$$

(6)

Get the weight value after the total level of sorting, according to the hierarchical structure diagram can be seen, the first floor has a general goal, that is, =1, Hierarchical structure diagram of a total of three layers of the formula W=W3.W2. W1 can be used to determine the value of the total level of sorting.

The combined weights are calculated to represent the satisfaction degree of each factor relative to the total target,

Obviously site selection C>A>B.

## III. SYNERGISTIC ANALYSIS OF NON QUANTIFIABLE FACTORS AND MEASURABLE FACTORS

The above analysis is taken into account the old age care hospital site selection of the six more prominent impact factor, the common characteristic of these six factors is that their influence factors are not objective data, the way to solve the problem of this type of factor assignment can be taken in a large scale, given a unified scale to quantify the degree of influence of each factor. But also to consider the location of the objective of the known data. Three site of the real estate price also should be included in the scope of the site selection.

Located in the District of Qunli location A facilities in the overall planning in place, The building density of residential area is lower than that of urban central area, Leisure square, bookstores, theme parks and other facilities in the municipal building provides people a livable environment, The overall real estate price is about 8500 yuan per square meter. Located in the Nangang District Tallahassee station near the site of B, The Tallahassee station put into use, Drive the economic development of surrounding the Tallahassee, schools, hospitals also have settled in Tallahassee. Tallahassee area real estate price is 7500 yuan per square meter. Location C Songbei as a new city, Construction groups for residential and villa area. There are some close to the highway bridge and the city government prices slightly higher, but the overall average price is still relatively low, at about 6000 yuan per square meter. After the analysis of the above analytic hierarchy process, and then into the real estate price of the impact factor. Three site selection.

The following influence factor and real estate price received for the research summary.

TABLE 6. SUMMARY OF THE INTEGRATION OF THEREAL ESTATE PRICE

| | Comfort perception | regional planning | Regional economy | Medical facility | Cultural environment | Traffic accessibility | Real estate price |
|---|---|---|---|---|---|---|---|
| Research score A | 5 | 4 | 3 | 4 | 3 | 2 | ￥8500.00/ |
| Research score B | 4 | 5 | 3 | 4 | 2 | 3 | ￥7500.00/ |
| Research score C | 5 | 4 | 2 | 3 | 4 | 3 | ￥6000.00/ |

In architectural planning ,Quantifiable factors and Non quantifiable factors need to be considered together, Need to standardize the property values of different dimensions, The method of vector specification can be used in linear or interval, In this decision, because the Non quantifiable factors are obtained by the way of investigation and research, The influence scale of the first six factors is

TABLE 7. CANONICAL MATRIX

| | | | | | | |
|---|---|---|---|---|---|---|
| 0.0004 | 0.0002 | 0.0001 | 0.0002 | 0.0001 | 0 | 1.0000 |
| 0.0002 | 0.0004 | 0.0001 | 0.0002 | 0 | 0.0001 | 0.8823 |
| 0.0004 | 0.0002 | 0 | 0.0001 | 0.0002 | 0.0001 | 0.7058 |

unified, Then the real estate price should be incorporated into the standard 0-1 transform of the interval transform method to standardize the values of different dimensional attributes.

The normalized matrix is obtained as follows

The standard matrix and numerical weights W= into the formula

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$$A_1 = \sum_{j=1}^{n} W_j R_{1j} = 0.080191 \tag{7}$$

$$A_2 = \sum_{j=1}^{n} W_j R_{2j} = 0.070775 \tag{8}$$

$$A_3 = \sum_{j=1}^{n} W_j R_{3j} = 0.056627 \tag{9}$$

This is a new sort of, After the integration of the real estate price impact factor, Location sort for A greater than B greater than C, Although in the analysis of the six factors, the site selection of C is the best, Although in the analysis of the six factors, the site selection of C is the best, Theoretically understood as, The real estate price is high, the economic efficiency is relatively high, the facilities are complete, the quality of the maintenance of the hospital is

higher than the other two places, the corresponding charge standard is higher than the other two places, The economic benefit is higher than B, C in two places. If the A site construction of the elderly care homes, the elderly in the economy can withstand the ability to live more comfortable, more comprehensive conservation.

## IV. CONCLUSION

The application of multiple objective optimization decision making system in building site selection is a cross disciplinary theory application. From the application of the case, basically achieve the desired objectives, but also for other aspects of the architectural planning to provide reference, As China is still in the initial stage of construction planning, Complete decision-making system has not been established, Building planning case material library is not perfect, in recent years in the building planning has not made a breakthrough, But with the development of the construction industry, the owners, the construction side, the construction side of the building has a more in-depth understanding, At the same time, more attention to the architectural planning. Under the premise of getting attention, Architectural planning should not only uphold the scientific and logical, but also to strengthen research, collection, and the ability to induce social feedback information, As much as possible in-depth analysis of the needs of the building of the people of the index, to establish more in line with local conditions of the construction planning system, increase the use of Chinese and foreign theories and interdisciplinary theory. To the future construction of the high quality of the architectural planning under the higher economic, cultural and social value.

## CONFLICT OF INTEREST

The authors confirm that this article content has no conflicts of interest.

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