CONSTRUCTION OF AN AHP-BASED MODEL TO CATCH CRITERIA WEIGHTS IN POST-OCCUPANCY EVALUATION

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ABSTRACT

The comprehension of customer's perceptions is a necessity in all types of business. In the context of Architecture and Civil Engineer, Post-Occupancy Evaluation is the main strategy adopted to catch customer's perception about building performance. Usually, questionnaires adopted in POE, take in account subjective criteria whose importance degree are estimated in an arbitrary way. The present work proposes an original variation of POE which makes it able to evaluate criteria degree importance, taking into account the analysis of coherency degree of the arbitrary evaluations. The proposal was applied in a case which results showed the applicability of the proposal and, also, the main difficulties found in its implementation.

Keywords: AHP, APO, EPO, Evaluation, Multicriteria, MCDA.

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1. Introduction

A building is a multifunctional and complex environment, since it has to attend several human necessities such as protection from atmospheric phenomena, patrimonial security, comfort and other subjective needs.

Post-occupancy evaluation (POE) contributes to improve future buildings by identifying failures and no expectative attendance. It deals with subjective evaluation of the environment during its occupation or using phase. There are several researches about POE in a large variety of fields. Those works measure evaluation as perceived by the building occupants; that is in a subjective context. Despite this, no previous work was found that links POE with any multicriteria approach, which has been developed since the later '60s to deal with problems under subjective evaluations.

1.1 Objective

The present work intends to fulfill the lack of linking highlighted above presenting a model that uses AHP (Analytic Hierarchy Process) to help defining weights of criteria used in an application of POE to a residential building, under the viewer of multiple evaluators. Human madden

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1.2 Why AHP

The choice of AHP is due to the fact that this is the unique method that allows measuring the consistency degree of judgments issued by evaluators.

1.3 Relevance

One of the challenges faced by the construction industry is to get a closer relationship between customers and builders. Thus, this article is justified by the relevance of POE in the context of construction. Also, it responds to the calling for models that integrate POE to operational research methods able to map inconsistencies in value judgments.

1.4 Structure of this paper

In the following section, it is presented a short description of POE main central concepts, and then, in the next one, a brief description of AHP, followed by the model construction explanation and application. Finally, the conclusion of the research highlights the main contribution and constraints accomplished by the modeling discussed.

2. Post-occupancy evaluation

It is presented here a brief summary of the main concepts on POE. For detailed discussion about this theme, the reading of Zimring (1987), Preiser et al (1988), Bordass and Leaman (2005), Zhao (2007), Hadjri and Crozier (2009) is recommended.

It is worth noting that Council (2001) presented an important survey on the state of the art of POE. In addtion to presenting the different streams of POE development, this study highlights the fact that POE focuses on the needs of the building occupants under multiple aspects such as health, safety, functionality, efficiency, psychological comfort, aesthetics, quality and satisfaction. Therefore, POE meets both behavioral assessments (under the occupant view) and technical performance of the built environment. The possibility of linking POE with psychology is surveyed in Ornstein et al. (2009), who highlighted the advantages of this joint.

The POE can be accomplished in several ways: interviews, photographic records, films, technical surveys or questionnaires filled by users or professionals involved in the construction industry. In Brazil, the Center of Studies and Innovation in Building at the Federal University of Rio Grande do Sul (NORI / UFRGS) in partnership with the Office for Support of Small Enterprises (SEBRAE), also in Rio Grande do Sul, built a system of quality and productivity indicators for construction. The main features of this system are reported in some texts such as Formoso & Lantrelme (2000) and Navarro (2006) This system developed a questionnaire that takes into account the Brazilian behavioral assessment, covering aspects regarding the care and quality of the building, focusing on residential use.

In the present work, the criteria adopted for modeling are based on that questionnaire.

3. AHP: method and core concepts

Since AHP is a well known method, a deeper description is not necessary. For the reader who wants to know more about this method, it is suggested the reading of Saaty (1980), Barba-Romero & Pomero, (1997) (in Spanish) or Costa (2006) (in Portuguese).

3.1 Main principles

AHP is a method developed to solve problems of choice (selection of one alternative among a set of alternatives). One of the main advantages of using this method is the possibility to assess the degree of consistency of value judgments. It is based on 3 principles of analytical thinking:

Construction of hierarchies: to decompose the complexity of the problem to make it more comprehensible and reasonable.

Setting priorities: to get the perceptions about the relationship among the elements in the hierarchy, through pair wise comparison.

Logical consistency: to check the consistency of the pair wise comparison.

Based on these principles, AHP attempts to get and treat (which differ from eliminate) the subjectivity inherent to qualitative evaluations.

3.2 Construction of hierarchies

The first step on an AHP-based modeling is to construct the hierarchy. To do this it is necessary to define: the focus or the overall objective; the set of alternatives or the feasible options; and the criteria set. Depending on the complexity of the problem, multiple layers of criteria or sub-criteria can be used in the hierarchy.

3.3 Judgments of value

On the AHP, the evaluator makes pairwise comparison in each node of the hierarchy, comparing the elements in the same level of the hierarchy under the perspective of each element connected to them in a higher layer of hierarchy. The judgments are supported by the scale showed in Table 1, which was primarily reported by Saaty (1980).

Table 1. Scale for pair wise assessment of preference and importance (Saaty, 1980)

Numerical Scale	Verbal scale
1	Equal importance (preference)
3	Moderate importance
5	Strong importance
7	Very strong importance
9	Absolute importance
2, 4, 6 and 8	Intermediate values

It is valuable to say that this scale agrees with the main principles stated for scales done in order to collect subjective judgments, such as those reported in: Likert (1932), Miller (1954) and Parducci (1965), Kline (1996), Mann et al. (1997), Zagreus et al. (2004), Spicer and Sadler-Smith (2005), Simon et al. (2006), Rosen and Olsen (2006), Creed and Yin (2006) and Evans et al. (2007).

3.4 Prioritization

In this step, AHP calculates priorities taking into account the judgments obtained in the previous step, described above. The procedures to calculate the priorities can be organized into four stages:

- Structure the Matrices of Judgments: construct, for each node in the hierarchy, a matrix that stores the judgments on that node. All of these matrices are squared, positive and reciprocal;
- Obtain Normalized Matrices: over each one of the Matrices of Judgments, apply a normalization procedure, obtaining the normalized matrices;
- Calculate the arrays of Local Average Priorities (LAP): find the averages of the columns of each Normalized Matrices, providing an array of priorities for each node in the hierarchy. It is relevant to highlight that for the node which corresponds to the hierarchy's focus, the array retains the weights or priorities of the criteria set.

- Obtain an array with the Global Average Priorities (GAP): combine the LAPs as like in a decision tree, obtaining the GAP. This array (GAP) keeps the overall priorities of the options. The choice must be the option which has the bigger GAP.

It is important to highlight that the text above is a short description of AHP, and to do it, the author used an unusual nomenclature. So, terms like LAP and GAP, with the meaning described above, are primarily creations reported in the present text to describe, in a short way, the procedures that take part in the AHP. Therefore, they are not present in other texts which describe AHP in a more detailed way, although the concepts are the same.

3.5 Analysis of consistency

Human judgments can be inconsistent or incoherent. AHP recognizes this fact and provides a procedure for assessing consistency degree of judgments. Saaty (1980) proposed the Consistency Index (CI) as a measure of the degree of inconsistency in the matrix of joint membership judgments:

$$CI = \frac{\left| \lambda_{\max} - N \right|}{N - 1}$$

Where:
N is the order of the matrix of the judgments;
$\lambda_{\max}$ is the largest eigenvalue of the matrix of the judgments.

Complementing the consistency analysis, Saaty (1980) proposes a comparison between *CI* and a Random Consistency Index (*RI*). This comparison provides a Consistency Ratio (*CR*), which is calculated according to the equation:

$$CR = \frac{CI}{RI}$$

Saaty (1980) proposes the acceptance of judgments with Consistency Ratio smaller than 0.1 (RC < 0.1).

4. Modeling and case of application

This section presents a modeling to integrate AHP to POE an also describes an application of this proposal. Specifically, it describes the use of AHP to identify weights to POE evaluation.

4.1 Object of study

The experiment focuses the importance degree assigned to POE aspects by the users of residential units in a condominium sited in the district of Barra da Tijuca, located in the city of Rio de Janeiro, Brazil. This area has been under a strong tendency of growth since the South region of Rio de Janeiro (Copacabana, Ipanema, Leblon and their neighborhoods) has been saturated.

This condominium is a building of 21 (twenty one) floors, containing 8 (eight) apartments per floor, making a total of 168 (one hundred and sixty-eight) residential units. On the ground floor, there are dispersed areas for administration and leisure (swimming pool, sauna, recreation area, ballroom). Parking for residents and visitors isdistributed in the underground and ground floors.

The survey was conducted 14 (fourteen) months after the building units had been delivered to their owners.

4.2 Defining the criteria and structure of the hierarchy

Based both on the literature review about POE and in the fact that the case was located in Brazil, it was decided to adopt the aspects reported by Romero and Ornstein (2003) as the basis to start the definition of the set of criteria. This was due to the proximity of this work to Brazilian construction and habitation particularities.

The work of Romero and Ornestein (2003) recommended taking into account criteria reated to the following aspects when doing a POE evaluation: social areas, layout, construction, finishing, electrical, hydraulic and sanitary features and materials, maintenance, sound, thermal and visual comfort, and economic. In the process of defining the criteria set, it was also took into account the quality of the service by the construction firm in supporting and helping the users of the habitation units at the pos-occupancy period.

The AHP hierarchical structure of criteria was structured into twenty-five sub-criteria, grouped into five criteria. Figures 1 shows the linkage structure among focus, criteria and sub-criteria in hierarchy.

4.3 Data collection

A questionnaire was used in this study to collect the data. The Appendix shows a translation of this questionnaire to English (as it was applied in Rio de Janeiro, Brazil, it was originally written in Portuguese). As one can see, the questions presented included in the questionnaire tried to get the pairwise comparison of relative importance of the criteria using Saaty's Scale.

The questionnaires were distributed throughout the mailboxes of all the habitation units, one questionnaire per residence (168 questionnaires as total) accompanied by a cover letter and guidelines to make it easier to fulfill them. Because of economic reasons, data collection was carried out without the presence of an interviewer.

Initially, it was given a deadline of 10 days for returning the questionnaires fulfilled. Only 16 (sixteen) responses were received within this deadline. This number was found insufficient to achieve the objectives of the research. To avoid this difficulty, the data collection was changed to direct approach throughout interviews, which raised the number of responses to 24 (twenty four). It is worth to say that all the residents were asked to participate in the interview, although only 24 agreed to take part in the research, which has resulted in a rate response equal to 14.3%. As reported in Zagreus et al. (2004), the usual response rates in POE surveys typically stays between 27% and 88%, using questions about users satisfaction under aspects like: layout, office furnishings, thermal comfort, indoor air quality, lighting, acoustics, and building cleanliness and maintenance.

C_1 **– Service by construction company**
- C_1S_1 - Responsiveness
- C_1S_2 - Meeting deadlines
- C_1S_3 - Technical assistance
- C_1S_4 - Prestigious of the construction company
- C_1S_5 - Documentation and user guide

C_2 – Financial aspects
- C_2S_1 - Cost of purchasing
- C_2S_2 - Cost of maintenance the condominium
- C_2S_3 - Cost of maintenance the residential unit

C_3 - Quality of the construction
- C_3S_1 - Areas for common use
- C_3S_2 - Localization of the building
- C_3S_3 - External appearance **o**f the building
- C_3S_4 - Performance of facade
- C_3S_5 - Security of the building
- C_3S_6 - Conformity with specifications

C_4 – Quality of the residential unit project
- C_4S_1 - Layout
  - $C_4S_1S_1$ - Social areas
  - $C_4S_1S_2$ - Service areas
  - $C_4S_1S_3$ - Bedrooms
  - $C_4S_1S_4$ - Bathrooms
- C_4S_2 - Environmental comfort
  - $C_4S_2S_1$ - Indoor temperature on winter
  - $C_4S_2S_2$ - Indoor temperature on summer
  - $C_4S_2S_3$ - Lighting
  - $C_4S_2S_4$ - Sound insulation
- C_4S_3 - Quantitative and localization of electrical features
- C_4S_4 - Quantitative and localization of hydraulic and sanitary features
- C_4S_5 - Quality of indoor materials
  - $C_4S_5S_1$ - Tiles
  - $C_4S_5S_2$ - Floorings
  - $C_4S_5S_3$ – Sanitary ware
  - $C_4S_5S_4$ – Frames, fixtures and locks
  - $C_4S_5S_5$ - Paint
- C_4S_6 - Project flexibility

C_5 – Quality of finish
- C_5S_1 - Quality and finish of electrical features
- C_5S_2 - Quality and finish of hydraulic and sanitary features
  - $C_5S_2S_1$ – Materials finish
  - $C_5S_2S_2$ - Performance of hydraulic features
  - $C_5S_2S_3$ - Performance of sanitary features
- C_5S_3 - Indoor features putting
  - $C_5S_3S_1$ - Tiles
  - $C_5S_3S_2$ - Flooring
  - $C_5S_3S_3$ – Frames and fixtures (doors and windows)
  - $C_5S_3S_4$ - Paint
- C_5S_4 - Waterproofing
- C_5S_5 - Achieving specifications for finishing

Figure 1. Hierarchic structure of criteria and sub-criteria.

4.4 Calculation of priorities (weights of criteria and sub-criteria)

The calculation of the priorities has been done in four steps:

First, the relative importance of the criteria for each one of the evaluators (respondents of the questionnaire) was calculated using the algorithm of the AHP prioritization proposed by Saaty (1980).

After this, the consistency analysis proposed by Saaty (1980), was applied over the data to avoid inconsistent judgments. Adopting this procedure, the judgments of four respondents were eliminated, since their consistency ratio were bigger than 0.10. This resulted on the elimination of approximately 16.7% of the initial judgments.

In a third step, taking into account only the consistent judgments, the individual judgments were aggregated through the use of the geometric mean (as reported in Aczel & Saaty (1983)) to obtaining a set of pairwise judgment matrixes.

Finally, the priorities (weights) were calculated through the applications of Saaty's algorithm over the data in the matrixes. Figure 2 shows the tree with the average weight distribution of the weights obtained for each of the criteria and sub-criteria in the hierarchy.

4.5 Analyzing the results

As one can note while analyzing the results shown in Figure 2:

The criterion with minor importance was criteria C1 (service by the company), this is possible because the data were collected after a large period after the occupancy had began. As mentioned in section 4.1, the survey was conducted 14 (fourteen) months after the building units had been delivered to their owners.

The criteria with major importance are S4 and S5, both related to quality aspects. S4 was related to the quality of the project and S5 related to quality of the finish.

Into the most important criterion (S5), the most important subcriteria is related to the waterproofing (S5S4) and the second more important is related to the finish of hydraulic and sanitary features.

These results are coherent with the classification adopted by the builder firm which has classified the building project as "high-luxurious".

5. Conclusion

The original integration of the Analytic Hierarchy Process (AHP) with post-occupancy evaluation (POE) was able to identify and avoid inconsistencies in assessments, contributing to reduce uncertainty in subjective evaluations. This is the main contribution of this work.

Although some works, such as the recent one by Sato (2009), deal with application of AHP to customer's satisfaction evaluation, it is worth noting that the features which have been proposed in the present work were not found in any previous research related to POE or to AHP.

The essay developed in this research points toward the proposal of helping companies in construction industry with a strategic tool, since it allows identifying the worthiest aspects under customers' point of view, highlighting opportunities for improvement and innovation.

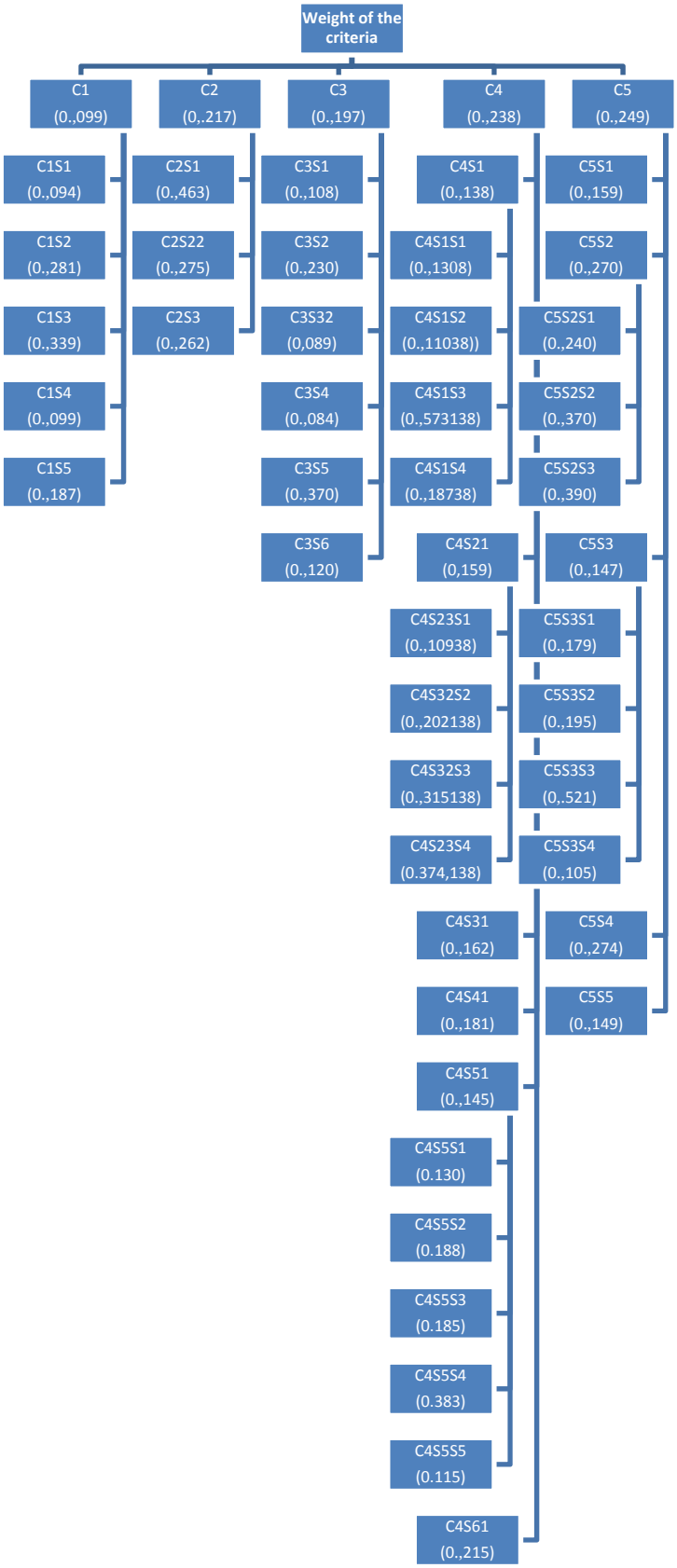

Figure 2. Weights of criteria and sub-criteria.

The main difficulties identified while implementing the proposal were the complexity and the size of the questionnaire. To avoid those difficulties, data collection must be done through interviews supported by a facilitator who is an expert in pairwise comparisons.

It is also worth highlighting that the research was neither supported by the construction company nor the condominium administration. These facts may also have contributed to the small number of answers, since, if the respondents had perceived the research as an initiative of those actors as a signal of partnership, they might have felt more encouraged to express their views by identifying an opportunity to express their judgments directly to the building board.

It is interesting to state that, as usual in case studies, the weights found for the criteria and sub-criteria sets are valid only for the sample investigated, which has limitations imposed by the context and temporal aspects. It is, therefore, recommended no extrapolation of the results to other situations. It is not a strong limitation to the research, since the focus was not to map the criteria weights, but to produce, apply and evaluate the limitations of an original model to make the link between AHP and POE.

For future and further developments, it could be interesting:

- To review the set of criteria, including variables linked explicitly with sustainability and social responsibility as well as green construction;
- To extend this research, covering a more significant sample. To achieve this goal, it would be interesting to get an explicit support from both: the condominium administration and the construction company.

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REFERENCES

Aczel, T.L. & Saaty,T. (1983). Procedures for synthesizing ratio judgment. *Journal of Mathematical Psychology, 27*, 93–102.

Barba-Romero, S., & Pomerol, J.-C. (1997). *Decisiones multicritério: Fundamentos teóricos y utilizacion prática*. Madrid: Universidad de Alcalá.

Bordass, B., & Leaman, A. (2005). Making feedback and post-occupancy evaluation routine 1: A portfolio of feedback techniques. *Building Research and Information, 33(4),* 347-352.

Costa, H.G. (2006). *Auxílio Multicritério à Decisão: Método AHP*. Rio de Janeiro, Brasil: Associação Brasileira de Engenharia de Produção (ABEPRO).

Council, F.F. (2001). *Learning from Our Buildings: A State-of-the-practice Summary of Post-occupancy Evaluation*. Washington, DC: National Academy Press.

Formoso, C.T., & Lantrelme, E.M.V. (2000). A performance measurement system for construction companies in Brazil. *International Project Management Journal, 6(3*), 54-60.

Hadjri, K., & Crozier, C. (2009). Post-occupancy evaluation: Purpose, benefits and barriers. *Facilities, 27(1-2),* 21-33.

Navarro, G.P. (2006). Proposta de Sistema de Indicadores de Desempenho para a Gestão da Produção em Empreendimentos de Edificações Residenciais. M.Sc. Thesis. Porto Alegre, Brasil: Universidade Federal do Rio Grande do Sul.

Ornstein, S.W., Ono, R., Lopes, P.A., França, A.J. G. L., Kawakita, C.Y., Machado, M.D., et al. (2009). Performance evaluation of a psychiatric facility in São Paulo, Brasil. *Facilities, 27(3-4),* 152-167.

Romero, M. de A.; Ornstein, S.W. (2003). *Avaliação pós-ocupação: métodos e técnicas aplicados à habitação social*. Porto Alegre, Brasil: Coleção Habitare ANTAC, 294.

Preiser, W.F.E., Rabinowitz, H.Z., & White, E.T. (1988). *Post-occupancy evaluation*. New York: Van Nostrand Reinhold.

Saaty, T.L. (1980). The Analytic Hierarchy Process. (W. d. S. e. Silva, Trans.). Pittsburgh, PA: RWS Publications.

Sato, Y. (2009). How to measure human perception in survey questionnaires. *International Journal of the Analytic Hierarchy Process, 1(2),* 64-82.

Zagreus, L., Huizenga, C., & Arens, E. (2004). *A Web-based POE Tool for Measuring Indoor Environmental Quality*. UC Berkeley: Center for the Built Environment. Retrieved from: http://escholarship.org/uc/item/56s462z4

Zhao, D. (2007). The development of post occupancy evaluation abroad and its feasibility in China. Beijing *Acta Scientiarum Naturalium Universitatis Pekinensis, 43(6),* 797-802.

Zimring, C.M. (1987). *Evaluation of Designed Environments*. New York: Van Nostrand Reinhold.

Appendix – Questionnaire applied in the survey[1]

GENERAL INSTRUCTIONS

Why this form

The main goal of this form is to evaluate the satisfaction with the performance of habitation unit, and also to gauge the importance of same aspects to over the satisfaction and dissatisfaction of the habitants of residential units.

The knowledge of your opinion is essential to achieve our goal: offer to our customers a portfolio of products and services that exceed their expectative.

Instructions to fulfill this questionnaire

In this questionnaire you are going to evaluate the importance of a good performance of your residential unit under viewpoints. Please use the following scale to make pair wise comparisons about the importance of the aspects over your satisfaction with the residential unit. In the case of two aspects have the same importance to you, please check (I – from "equal importance"). Otherwise, express the importance degree by checking it in the column which is closer to the more important criterion under your opinion

Scale for pairwise comparisons

Code	Meaning
A	Absolute more important
V	Very strongly more important
S	Strongly more important
M	Moderately more importance
I	Indifference or Equal importance

Using the scale above, make pair wise comparisons regarding the relative importance of a good performance of your residential unit under the criteria set

0 – OVERALL IMPORTANCE

In your opinion, what is the relative importance the following criteria to a good performance of your residential unit, under an overall perspective?

Criterion	A	V	S	M	I	M	S	V	A	Criterion
Service										Financial
Service										Construction
Service										Project
Service										Finishing
Financial										Construction
Financial										Project
Financial										Finishing
Construction										Project
Construction										Finishing
Project										Finishing

In your opinion, **regarding to company's service**, what are the relative importance of the following criteria to a good performance of your residential unit?

Criterion	A	V	S	M	I	M	S	V	A	Criterion
Responsiveness										Meeting deadlines
Responsiveness										Technical assistance
Responsiveness										Prestigious of the construction company
Responsiveness										Documentation and user guide
Meeting deadlines										Technical assistance
Meeting deadlines										Prestigious of the construction company
Meeting deadlines										Documentation and user guide
Technical assistance										Prestigious of the construction company
Technical assistance										Documentation and user guide
Prestigious of the construction company										Documentation and user guide

[1] The survey was distributed in Portuguese. It is translated into English here for the benefit of the readers.

In your opinion, **regarding to financial aspects**, what are the relative importance of the following criteria to a good performance of your residential unit?

Criterion	A V S M I M S V A	Criterion
Cost of purchasing		Cost of maintenance the condominium
Cost of purchasing		Cost of maintenance the residential unit
Cost of maintenance the condominium		Cost of maintenance the residential unit

In your opinion, regarding to the **quality of the construction viewpoint**, what are the relative importance of the following criteria to a good performance of your residential unit?

Criterion	A V S M I M S V A	Criterion
Areas for common use		Localization of the building
Areas for common use		External appearance **o**f the building
Areas for common use		Performance of façade
Areas for common use		Security of the building
Areas for common use		Conformity with specifications (6)
Localization of the building		External appearance **o**f the building
Localization of the building		Performance of façade
Localization of the building		Security of the building
Localization of the building		Conformity with specifications (6)
External appearance **o**f the building		Performance of façade
External appearance **o**f the building		Security of the building
External appearance **o**f the building		Conformity with specifications (6)
Performance of façade		Security of the building
Performance of façade		Conformity with specifications (6)
Security of the building		Conformity with specifications (6)

In your opinion, regarding to the **quality of the residential unit's project**, what are the relative importance of the following criteria to a good performance of your residential unit?

Criterion	A V S M I M S V A	Criterion
Layout		Environmental comfort
Layout		Quantitative and localization of electrical features
Layout		Quantitative and localization of hydraulic and sanitary features
Layout		Quality of indoor materials
Layout		Project flexibility (6)
Environmental comfort		Quantitative and localization of electrical features
Environmental comfort		Quantitative and localization of hydraulic and sanitary features
Environmental comfort		Quality of indoor materials
Environmental comfort		Project flexibility (6)
Quantitative and localization of electrical features		Quantitative and localization of hydraulic and sanitary features
Quantitative and localization of electrical features		Quality of indoor materials
Quantitative and localization of electrical features		Project flexibility (6)
Quantitative and localization of hydraulic and sanitary features		Quality of indoor materials
Quantitative and localization of hydraulic and sanitary features		Project flexibility (6)
Quality of indoor materials		Project flexibility (6)

IV – QUALITY OF THE RESIDENTIAL UNIT PROJECT LAYOUT										
In your opinion, regarding to the **layout aspects** related in the **residential unit's project**, what are the relative importances of the following criteria to a good performance of your residential unit?										
Criterion	**A**	**V**	**S**	**M**	**I**	**M**	**S**	**V**	**A**	**Criterion**
Social areas										Service areas
Social areas										Bedrooms
Social areas										Bathrooms
Service areas										Bedrooms
Service areas										Bathrooms
Bedrooms										Bathrooms (4

IV – QUALITY OF THE RESIDENTIAL UNIT PROJECT ENVIRONMENTAL COMFORT										
In your opinion, regarding to the **environmental comfort** related in the **residential unit's project**, what are the relative importances of the following criteria to a good performance of your residential unit?										
Criterion	**A**	**V**	**S**	**M**	**I**	**M**	**S**	**V**	**A**	**Criterion**
Indoor temperature on winter										Indoor temperature on summer
Indoor temperature on winter										Lighting
Indoor temperature on winter										Sound insulation
$Indoor temperature on summer										Lighting
Indoor temperature on summer										Sound insulation
Lighting										Sound insulation

IV – QUALITY OF THE RESIDENTIAL UNIT PROJECT QUALITY OF INDOOR MATERIALS										
In your opinion, regarding to the **quality of indoor materials** related in the **residential unit's project**, what are the relative importances of the following criteria to a good performance of your residential unit?										
Criterion	**A**	**V**	**S**	**M**	**I**	**M**	**S**	**V**	**A**	**Criterion**
Tiles										Floorings
Tiles										Sanitary ware
Tiles										Frames, fixtures and locks
Tiles										Paint
Floorings										Sanitary ware
Floorings										Frames, fixtures and locks
Floorings										Paint
Sanitary ware										Frames, fixtures and locks
Sanitary ware										Paint
Frames, fixtures and locks										Paint

V – QUALITY OF FINISH										
In your opinion, regarding to the **quality of finish**, what are the relative importance of the following criteria to a good performance of your residential unit										
Criterion	**A**	**V**	**S**	**M**	**I**	**M**	**S**	**V**	**A**	**Criterion**
Quality and finish of electrical features										Quality and finish of hydraulic and sanitary features
Quality and finish of electrical features										Indoor features positioning
Quality and finish of electrical features										Waterproofing
Quality and finish of electrical features										Achieving specifications for finishing
Quality and finish of hydraulic and sanitary features										Indoor features putting
Quality and finish of hydraulic and sanitary features										Waterproofing
Quality and finish of hydraulic and sanitary features										Achieving specifications for finishing
Indoor features putting										Waterproofing
Indoor features putting										Achieving specifications for finishing
Waterproofing										Achieving specifications for finishing

V – QUALITY OF FINISH QUALITY AND FINISH OF HYDRAULIC AND SANITARY FEATURES										
In your opinion, regarding to the **quality and finish of hydraulic and sanitary features** related to the **quality of finish**, what are the relative importances of the following criteria to a good performance of your residential unit?										
Criterion	**A**	**V**	**S**	**M**	**I**	**M**	**S**	**V**	**A**	**Criterion**
Materials finish										Performance of hydraulic features
Materials finish										Performance of sanitary features
Performance of hydraulic features										Performance of sanitary features

V – QUALITY OF FINISH INDOOR FEATURES INSTALLATION										
In your opinion, regarding to the **indoor features installation** related to the **quality of finish**, what are the relative importances of the following criteria to a good performance of your residential unit?										
Criterion	**A**	**V**	**S**	**M**	**I**	**M**	**S**	**V**	**A**	**Criterion**
Tiles										Flooring
Tiles										Frames and fixtures (doors and windows)
Tiles										Paint
Flooring										Frames and fixtures (doors and windows)
Flooring										Paint
Frames and fixtures (doors and windows)										Paint