

# USING ANALYTIC HIERARCHY PROCESS TO EVALUATE HUMAN PERFORMANCE

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## ABSTRACT

This article proposes a reference model to assess performance of human resource for the supervision and management of horse racing in the appraisal context. Performance appraisal is defined as the formal process of evaluating organizational members. The present paper uses Analytic Hierarchy Process (AHP) to evaluate human performances and provides a way to rank the alternatives of the problem by deriving priorities.

Keywords: AHP, human resources, decision support system, performance appraisal

## 1. INTRODUCTION

In the global economy, the modern commercial and industrial organization needs to develop better methods of assessing the performance of the human resource than simply using performance measures such as efficiency or effectiveness (Albayrak and Erensal, 2004; Mani, 2002).

Thus, performance appraisal is a human resource management tool that has received much attention for more than seven decades (Erdogan, 2002). Fairness of performance appraisals has been identified as an important criterion in judging their effectiveness and usefulness for organizations. This problem is complex and, like most real world problems depend upon a number of tangible and intangible factors which are unique to each problem. The complexity stems from a multitude of quantitative and qualitative factors influencing location choices as well as the intrinsic difficulty of making numerous trade-offs among those factors (Suwignjo et al., 2000).

One analytical approach often suggested for solving such a complex problem is the Analytic Hierarchy Process (AHP) introduced by Saaty (Saaty, 1980). The AHP enables the decision maker to structure a complex problem in the form of a simple hierarchy and to evaluate a large number of quantitative and qualitative factors in a systematic manner under conflicting multiple criteria (De Felice, 2012). It is developed and designed to solve complex problems involving multiple criteria. It is a highly flexible decision methodology that can be applied in a wide variety of situations (De Felice *et al.*, 2012)

There are two types of measurement involved in the AHP, absolute and relative. The first requires a standard with which to compare elements, but mostly alternatives at the bottom of the hierarchy. The process leads to absolute preservation in the rank of the alternatives no matter how many are introduced. The second is based on paired comparisons among the elements of a set with respect to a common attribute. This process is essential for comparing intangible attributes for which there are no agreed upon measures.

At the level of alternatives new elements (i.e. alternatives) do introduce new information generated by the changing number in the set and by their measurement which essentially rescales the criteria and hence can lead to reversals of previous rank orders.

Absolute measurement is used on standardized problems whereas relative measurement is used in new learning situations (Saaty, 2005). Absolute method is typically used in a decision situation, which involve selecting one (or more) decision alternatives from several candidate decision alternatives on the basis of multiple decision criteria of a competing or conflicting nature (McCarthy, 2000; Roberts, 2003).

In this paper, we have developed a case study to evaluate human performance using AHP absolute model. Though AHP has been applied in numerous real settings, but there is few evidence that AHP has been applied in human performance evaluation (De Felice and Petrillo, 2013; Sun *et al.*, 2008). This paper attempts to fill up the gap. This article proposes a multicriteria decision model of antecedents and consequences of justice perceptions in the appraisal context based on Erdogan's model (Erdogan *et al.*, 2001) in order to develop a flexible decision model useful for evaluating the performance of human resources.

A real case study applied for evaluate the performance of human resource appraisal for the horse racing supervision and management is proposed.

The paper is structured in section 2 in which problem statement is analyzed; section 3 in which methodological approach is presented; section 4 in which the case study is presented. Finally conclusions are reported.

## 2. PROBLEM STATEMENT

Performance appraisals are essential for the effective management and evaluation of staff. There is increasingly a need for performance appraisals of staff and especially managers, directors and CEO's. The performance appraisal process is an interactive process between the supervisor and the employee meant to assess and summarize the work performance of the employee as well as set new goals and identify new career development plans and training (UCSD, 2005; Liden *et al.*, 2004).

The performance appraisals process is a very difficult process because involves different aspects and problems. We based our study on Erdogan's model reported in Figure 1 (see appendix).

According to this model it is possible to differentiate between four types of justice perceptions in performance appraisals (Wayne *et al.*, 1997; Masterson *et al.*, 2000; Bauer *et al.*, 2012). The model introduces several antecedents of justice perceptions:

- *Proposition 1a:* Components of adequate notice will be differentially related to system and rater procedural justice such that, communication of appraisal criteria and involvement in development of appraisal criteria will be positively related to system procedural justice, whereas frequent feedback during appraisal period will be positively related to rater procedural justice.
  - *Proposition 1b:* Components of fair hearing will be differentially related to system and rater procedural justice such that, having a rater familiar with ratee's work will be positively related to system procedural justice, whereas allowing ratees input in decision-making will be positively related to rater procedural justice.
  - *Proposition 1c:* Components of judgment based on evidence will be differentially related to system and rater procedural justice such that, existence of effective appeal mechanisms will be positively related to system procedural justice, whereas consistent application of standards and explaining the decision to the ratee will be positively related to rater procedural justice.
  - *Proposition 2a:* POS - Perceived Organizational Support- before the appraisal will be positively related to system procedural justice perceptions during the appraisal.
  - *Proposition 2b:* Organizational culture will be related to perceptions of rater procedural justice such that, in constructive cultures compared to passive-defensive or aggressive-defensive cultures, the highest levels of rater procedural justice will be observed.
  - *Proposition 2c:* LMX - Leader Member Exchange Quality - quality before the performance appraisal will be positively related to perceptions of rater procedural justice.
- *Proposition 3:* The rater's use of job focused impression management tactics will be negatively related to interactional justice perceptions, whereas the use of supervisor and subordinate focused tactics will be positively related.
  - *Proposition 4:* Pre-appraisal LMX quality will be positively related to perceptions of interactional justice during performance appraisal.
  - *Proposition 5:* The relationship between ratings and distributive justice perceptions will be moderated by LMX quality such that, for high LMX employees, there will be a stronger positive relationship between ratings and distributive justice perceptions.
  - *Proposition 6a:* When ratees do not know the performance ratings of their coworkers, they will believe that those with higher LMXs are more likely to receive higher performance ratings.
  - *Proposition 6b:* The perception that the leader forms LMXs based on work-related factors will be positively related to distributive justice perceptions.
  - *Proposition 6c:* The perceived type of information used in appraisals will be related to distributive justice perceptions, such that the use of consistency and distinctiveness of information will be positively related to distributive justice perceptions, whereas the use of consensus information will be negatively related.
  - *Proposition 7a:* System procedural justice will be positively related to post-appraisal POS.
  - *Proposition 7b:* Post-appraisal POS will mediate the relationship between system procedural justice and organizational outcomes.
  - *Proposition 8a:* Rater procedural justice and distributive justice perceptions would be positively related to post-appraisal LMX.
  - *Proposition 8b:* The relationship between rater procedural justice, interactional justice, distributive justice, and leader-related outcomes will be mediated by post-appraisal LMX.
  - *Proposition 9a:* Distributive justice perceptions in performance appraisals will be positively related to perceived accountability.
  - *Proposition 9b:* The relationship between distributive justice perceptions and performance related outcomes will be mediated by perceived accountability.

The above model presents some weaknesses this is the reason because we propose an “integration” with AHP.

### 3. METHODOLOGICAL APPROACH

The aim of our paper is to explain the uses of multi-criteria prioritization, and in particular the use of absolute measurement in the optimal evaluation of human performance.

Below are the steps of absolute measurement process adopted (De Felice and Petrillo, 2011):

- Step 1: Definition of the experts team.
- Step 2: Identification the criteria, subcriteria for evaluation and put them into the AHP hierarchy.
- Step 3: Identification of the alternatives.
- Step 4: Calculate the weights of the decision criteria by the relative measurement of AHP.
- Step 5: Evaluation of consistency analysis.
- Step 6: Division of each subcriterion into several intensities or grades.
- Step 7: Measurement of performance intensity under each subcriterion.

In figure 2 (see appendix) is shown the methodological approach.

### 4. CASE STUDY

In this paragraph we analyze the AHP model adopted in order to evaluate human performance. In particular, following, the different steps are detailed.

#### *Step 1: Definition of the experts team.*

First of all experts team were defined. The experts team consisted of 4 Gallop experts and 3Trot experts. The experts team developed the AHP Model. In figure 3 is shown AHP Model (see appendix).

As is shown in Figure 3 the criteria C1.3, C2.1 and C2.2 are outlined because as we will underline in step 6 for these criteria the experts team defined a different scale of intensity.

#### *Step 2: Identify the criteria, subcriteria.*

The experts team defined criteria and subcriteria in order to assess the human performance. Here below criteria and subcriteria are detailed.

- *C1 - Core competencies:* skills without which it is not possible to perform the functions of the components of the direction racing:
  - *C1.1 - Knowledge of Regulation:* knowledge of all regulations and their updates;
  - *C1.2 - Technical knowledge:* Excellent knowledge of the peculiarities of horse racing and the technical elements;
  - *C1.3 - Qualification:* Evaluation of the process of training for the qualification competition judge;
  - *C1.4 - Problem solving:* Proactive attitude and management capabilities.

- *C2 - Complementary skills:* skills that enhance the actions by making them more effective:
  - *C2.1 – Experience and CV :* evaluation of the Curriculum Vitae;
  - *C2.2 - Education:* evaluation of training and qualification;
  - *C2.3 - Professional ethics:* formal and informal attitudes appropriate for the respect and the fulfillment of the institutional role;
  - *C2.4 - Availability:* attitude to hold the post received as a priority over the needs / preferences or otherwise professional.
- *C3 - Relational skills:* ability to interact optimally with regard to the context in which a person works:
  - *C3.1 - Authority and Charisma:* ability to exert a strong influence on other people;
  - *C3.2 - Teamwork:* ability to interact with the different positions, dealing with different opinions and find a constructive synthesis;
  - *C3.3 - Interpersonal relationships:* ability to manage external relations.
- *C4 - Skills for implementing Regulation:* ability to enforce formal rules and regulations in a uniform manner with respect to the context.
  - *C4.1 - Written and verbal presentation skills:* ability to represent verbally and / or in writing in a clear and concise;
  - *C4.2 - Correct formulation of regulation:* ability to accurately report the infringements;
  - *C4.3 - Personal integrity:* the ability to apply the regulation adequately;
  - *C4.4 - Perseverance and determination:* ability to enforce the regulation always with moderation and with the same commitment and willingness.

#### *Step 3: Identify the alternative or “guide profiles”.*

In the present step the experts team defined the different alternatives characterizing the human performance that they called “guide profiles”. In detailed the experts team defined:

- 4 guide profiles for Trot: President; Starter, Junta member and Commissioner.
- 3 guide profiles for Gallop: Commissioner; Official and Starter.

#### *Step 4: Calculate the weights of the decision criteria and subcriteria.*

The experts team developed pairwise comparison matrices to determine the criteria weights. We note that in the AHP paired comparisons are made with judgments using numerical values taken from the AHP absolute fundamental scale of 1-9. In particular the constructed the pairwise comparison matrix for all the criteria and compute the normalized principal right

eigenvector of the matrix. This vector gives the weights of the criteria and subcriteria. Then in similar way weights for subcriteria were calculated. Finally these weights were multiplied by the weights of the parent criteria.

In Figure 3 is shown an example of pairwise comparison.

|                     |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |           |
|---------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|-----------|
| <b>C1</b>           | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | <b>C1</b> |
| <b>C1</b>           | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | <b>C1</b> |
| <b>C1</b>           | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | <b>C1</b> |
| <b>C2</b>           | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | <b>C2</b> |
| <b>C2</b>           | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | <b>C2</b> |
| <b>C3</b>           | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | <b>C3</b> |
| <b>CI = 0.07475</b> |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |           |

Figure 3: Pairwise comparison – Gallop - Commissioner

The judgments of all the experts were aggregated using the geometric mean. Here below are the weights calculated for Gallop – profile Commissioners.

Table 1: Weights- Gallop - Criteria

| Gallop - Commissioners |       |       |       |       |         |
|------------------------|-------|-------|-------|-------|---------|
| Criteria               | Exp.1 | Exp.2 | Exp.3 | Exp.4 | Weights |
| C1                     | 0,565 | 0,366 | 0,356 | 0,577 | 0,491   |
| C2                     | 0,041 | 0,047 | 0,044 | 0,103 | 0,059   |
| C3                     | 0,205 | 0,155 | 0,474 | 0,104 | 0,215   |
| C4                     | 0,187 | 0,430 | 0,125 | 0,213 | 0,233   |

Table 2: Weights- Gallop – Sub Criteria

| Gallop – Commissioners |       |       |       |       |         |
|------------------------|-------|-------|-------|-------|---------|
| SubCriteria            | Exp.1 | Exp.2 | Exp.3 | Exp.4 | Weights |
| C1.1                   | 0,454 | 0,200 | 0,401 | 0,215 | 0,316   |
| C1.2                   | 0,252 | 0,327 | 0,102 | 0,349 | 0,247   |
| C1.3                   | 0,040 | 0,092 | 0,092 | 0,112 | 0,070   |
| C1.4                   | 0,252 | 0,379 | 0,450 | 0,322 | 0,364   |
| C2.1                   | 0,048 | 0,155 | 0,247 | 0,335 | 0,173   |
| C2.2                   | 0,048 | 0,049 | 0,062 | 0,177 | 0,078   |
| C2.3                   | 0,653 | 0,575 | 0,375 | 0,400 | 0,533   |
| C2.4                   | 0,249 | 0,219 | 0,314 | 0,086 | 0,214   |
| C3.1                   | 0,500 | 0,559 | 0,708 | 0,549 | 0,591   |
| C3.2                   | 0,250 | 0,352 | 0,178 | 0,209 | 0,246   |
| C3.3                   | 0,250 | 0,088 | 0,112 | 0,242 | 0,161   |
| C4.1                   | 0,166 | 0,170 | 0,135 | 0,097 | 0,140   |
| C4.2                   | 0,166 | 0,185 | 0,180 | 0,164 | 0,175   |
| C4.3                   | 0,333 | 0,363 | 0,331 | 0,376 | 0,352   |
| C4.4                   | 0,333 | 0,279 | 0,352 | 0,360 | 0,331   |

In a similar way the weights for:

- Gallop – profile Officials and Starters
- Trot – profile Presidents, Starters, Junta members and Commissioners

were obtained.

*Step 5: Consistency analysis.*

After all pairwise comparison the consistency index (CI) of the derived weights was calculated by Equation (1):

$$CI = \frac{\lambda_{max} - n}{n - 1} \tag{1}$$

In general, if CI is less than 0.10, satisfaction of judgments may be derived.

*Step 6: Divide each subcriterion into several intensities or grades.*

To implement the absolute measurement model in AHP, each criterion is divided into several intensity ranges to differentiate the qualifications of the candidates with respect to that criterion (Saaty, et al. 2007).

Experts team defined 4 different intensity scales:

- *Scale 1:* For the evaluation of the criteria C1.1, C1.2, C1.4, C2.3, C2.4, C3.1, C3.2, C3.3, C4.1, C4.2, C4.3 and C4.4 the experts team defined the following intensities (see Table 3).
- *Scale 2:* For C1.3 the experts team defined intensities reported in Table 4.
- *Scale 3:* For C2.1 the experts team defined intensities reported in Table 5.
- *Scale 4:* For C2.2 the experts team defined intensities reported in Table 6.

Also in this case the judgments of all the experts were aggregated using the geometric mean.

Table 1: Scale 3 – Intensities - Gallop

| Score | Intensity           | Weight |
|-------|---------------------|--------|
| 8     | Exceptional         | 0,420  |
| 6     | Exceed Expectations | 0,309  |
| 5     | Good                | 0,162  |
| 3     | Satisfactory        | 0,071  |
| 1     | Poor                | 0,035  |

Table 4: Scale 2 – Intensities - Gallop

| Score | Intensity         | Weight |
|-------|-------------------|--------|
| 8     | Absolutely agree  | 0,455  |
| 6     | Partly agree      | 0,300  |
| 5     | Neutral           | 0,119  |
| 3     | Slightly disagree | 0,890  |
| 1     | Strongly disagree | 0,442  |

| Score | Intensity | Weight |
|-------|-----------|--------|
| 3     | Level 1   | 0,068  |
| 5     | Level 2   | 0,129  |
| 6     | Level 3   | 0,253  |
| 8     | Level 4   | 0,548  |

Step 7: Measure performance intensity under each subcriterion.

In this step performance intensity under each subcriterion was calculated. The process was repeated for all types of profile (see Table 11 and Table 12).

Table 5: Scale 3 – Intensities - Gallop

| Score | Intensity         | Weight |
|-------|-------------------|--------|
| 8     | Absolutely agree  | 0,402  |
| 6     | Partly agree      | 0,273  |
| 5     | Neutral           | 0,165  |
| 3     | Slightly disagree | 0,098  |
| 1     | Strongly disagree | 0,059  |

Table 6: Scale 4 – Intensities - Gallop

| Score | Intensity | Weight |
|-------|-----------|--------|
| 3     | Level 1   | 0,067  |
| 5     | Level 2   | 0,124  |
| 6     | Level 3   | 0,270  |
| 8     | Level 4   | 0,537  |

In a similar way the scales for trot were obtained (see Table 7, 8, 9 and 10).

Table 7: Scale 1 – Intensities - Trot

| Score | Intensity           | Weight |
|-------|---------------------|--------|
| 8     | Exceptional         | 0,472  |
| 6     | Exceed Expectations | 0,195  |
| 5     | Good                | 0,183  |
| 3     | Satisfactory        | 0,102  |
| 1     | Poor                | 0,045  |

Table 8: Scale 2 – Intensities - Trot

| Score | Intensity         | Weight |
|-------|-------------------|--------|
| 8     | Absolutely agree  | 0,501  |
| 6     | Partly agree      | 0,256  |
| 5     | Neutral           | 0,105  |
| 3     | Slightly disagree | 0,789  |
| 1     | Strongly disagree | 0,057  |

Table 9: Scale 3 – Intensities - Trot

| Score | Intensity         | Weight |
|-------|-------------------|--------|
| 8     | Absolutely agree  | 0,511  |
| 6     | Partly agree      | 0,227  |
| 5     | Neutral           | 0,120  |
| 3     | Slightly disagree | 0,083  |
| 1     | Strongly disagree | 0,057  |

Table 10: Scale 4 – Intensities - Trot

Table 11: Performance intensity - Gallop

| Gallop      |         |           |          |
|-------------|---------|-----------|----------|
| SubCriteria | Commis. | Officials | Starters |
| C1.1        | 15,57%  | 7,82%     | 4,39%    |
| C1.2        | 12,19%  | 6,96%     | 8,19%    |
| C1.3        | 3,46%   | 2,22%     | 2,33%    |
| C1.4        | 17,93%  | 9,01%     | 10,46%   |
| C2.1        | 1,03%   | 1,78%     | 3,48%    |
| C2.2        | 0,47%   | 1,03%     | 1,35%    |
| C2.3        | 3,17%   | 5,24%     | 6,75%    |
| C2.4        | 1,28%   | 2,56%     | 3,57%    |
| C3.1        | 12,78%  | 10,49%    | 29,56%   |
| C3.2        | 4,65%   | 17,90%    | 7,25%    |
| C3.3        | 4,17%   | 7,53%     | 12,59%   |
| C4.1        | 3,27%   | 4,12%     | 1,25%    |
| C4.2        | 4,09%   | 4,05%     | 1,24%    |
| C4.3        | 8,23%   | 10,80%    | 4,23%    |
| C4.4        | 7,74%   | 8,50%     | 3,38%    |

Table 12: Performance intensity - Trot

| Trot        |         |         |            |          |
|-------------|---------|---------|------------|----------|
| SubCriteria | Presid. | Commis. | J. members | Starters |
| C1.1        | 15,26%  | 6,53%   | 12,68%     | 9,63%    |
| C1.2        | 14,75%  | 11,04%  | 12,16%     | 8,86%    |
| C1.3        | 2,30%   | 3,67%   | 5,10%      | 3,13%    |
| C1.4        | 5,14%   | 14,29%  | 5,17%      | 13,38%   |
| C2.1        | 6,25%   | 11,55%  | 10,89%     | 4,35%    |
| C2.2        | 1,81%   | 3,05%   | 2,44%      | 1,36%    |
| C2.3        | 4,94%   | 11,77%  | 5,32%      | 3,54%    |
| C2.4        | 2,72%   | 5,88%   | 4,42%      | 2,46%    |
| C3.1        | 5,19%   | 6,02%   | 6,63%      | 8,48%    |
| C3.2        | 1,64%   | 8,78%   | 8,63%      | 1,96%    |
| C3.3        | 1,97%   | 8,20%   | 5,61%      | 6,04%    |
| C4.1        | 5,83%   | 1,40%   | 2,81%      | 6,07%    |
| C4.2        | 5,81%   | 0,77%   | 4,06%      | 5,78%    |
| C4.3        | 9,39%   | 2,63%   | 7,46%      | 14,44%   |
| C4.4        | 16,99%  | 4,42%   | 6,62%      | 10,53%   |

In Figures 4 and 5 are shown final weights for subcriteria for each profiles both Gallop and Trot. We can note that regarding:

- GALLOP: the parameter most representative is C1.4 (17,93%) for Commissioners; C3.2 (17,90%) for Officials and C3.1 (29,56%) for Starters.
- TROT: the parameter most representative is C4.4 (16,99%) Presidents; C4.3 (14,44%) for Starters; C1.1 (12,68%) for Junta members and C1.4 for Commissioners (14,29%).

## 5. CONCLUSIONS

Performance appraisal is a performance management mechanism that has broad implications for attitudes and behaviors in organizations. We propose a simple and effective appraisal system that emphasizes continuous professional development enhances a firm's overall performance.

The model proposed based on AHP, definitely, has a positive impact on the proposition 1a, 2a, 2b, 6a and 6c. Furthermore the model presented wants to identify areas in which there is a need for more research.

In fact, we analyzed different aspects but in our opinion it is necessary to differentiate between different forms of justice perceptions. Further research will cover this gap.

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**APPENDIX**

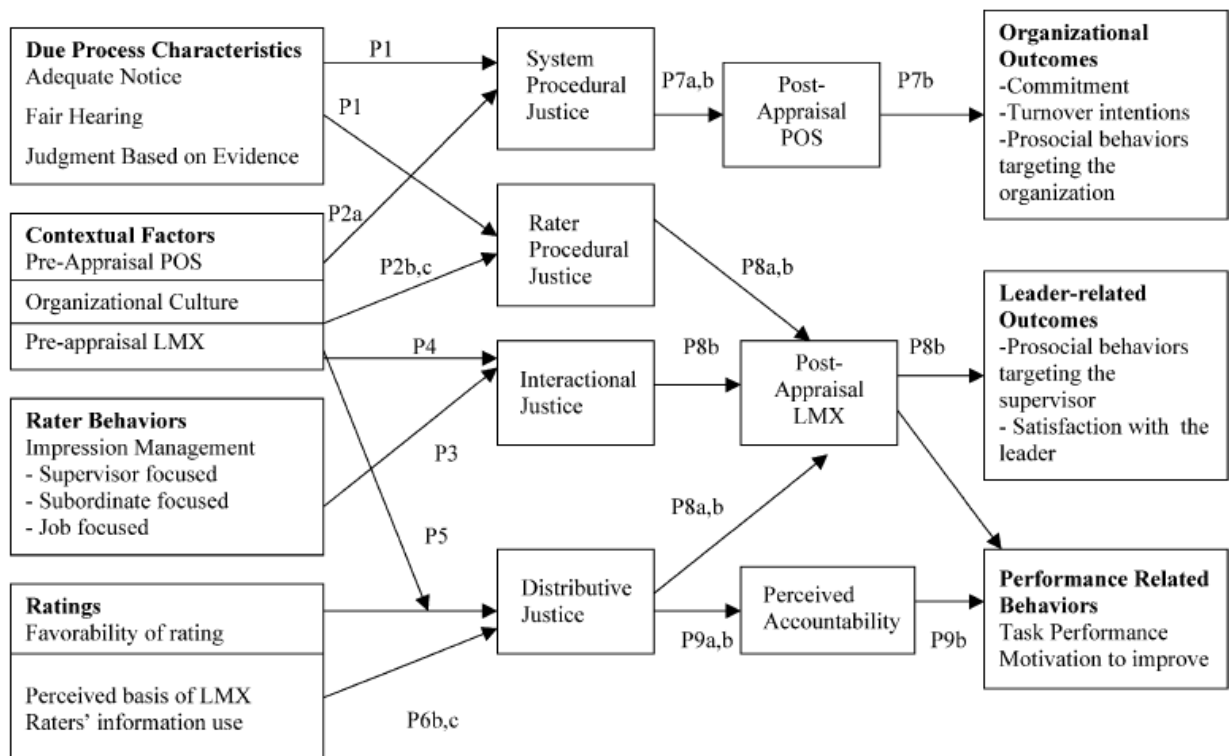


Figure 1: Antecedents and consequences of justice perceptions in performance appraisals (source B. Erdogan, 2002)  
 POS - Perceived organizational support, organizational culture  
 LMX – Leader Member Exchange Quality

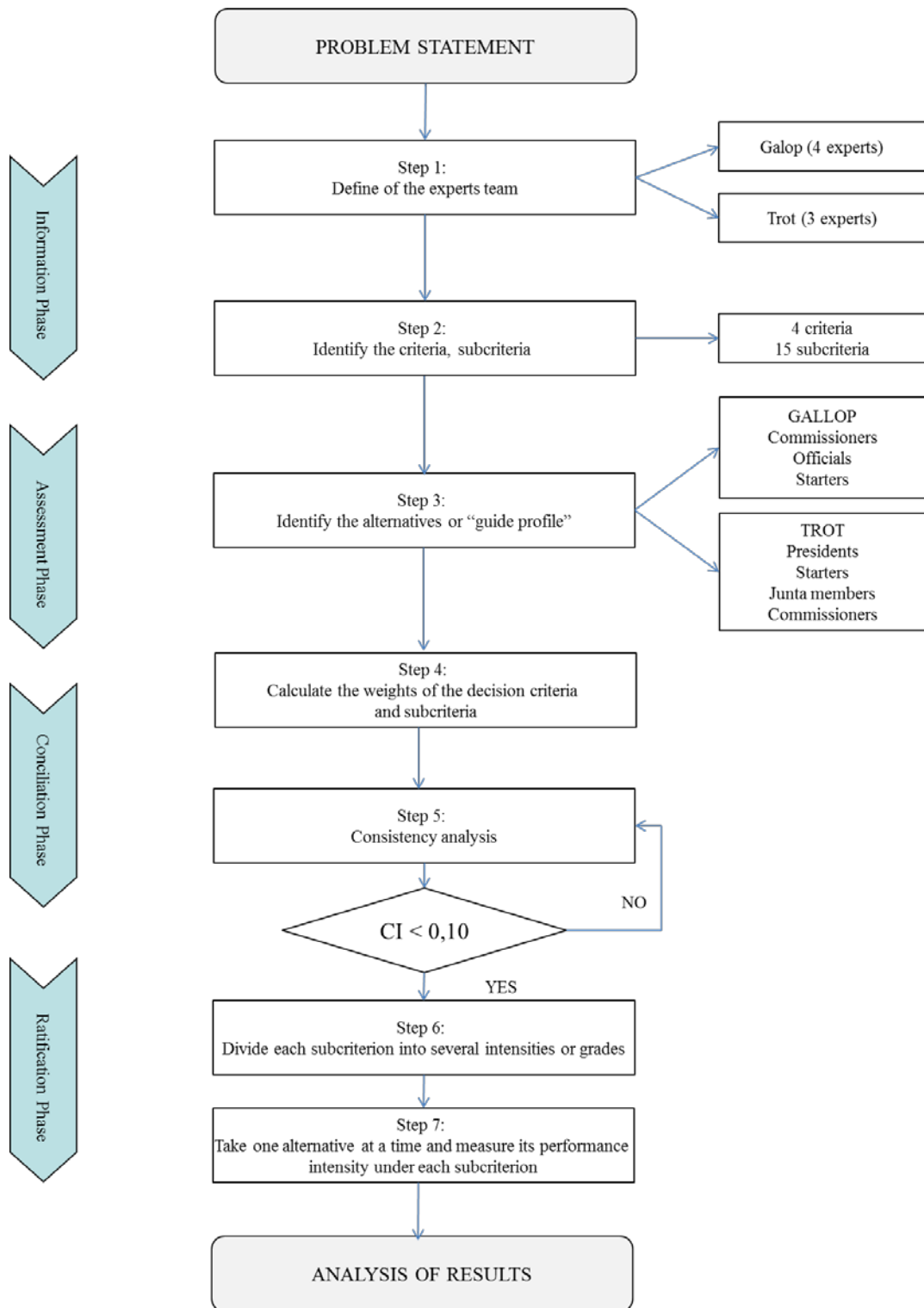


Figure 2: Methodological approach



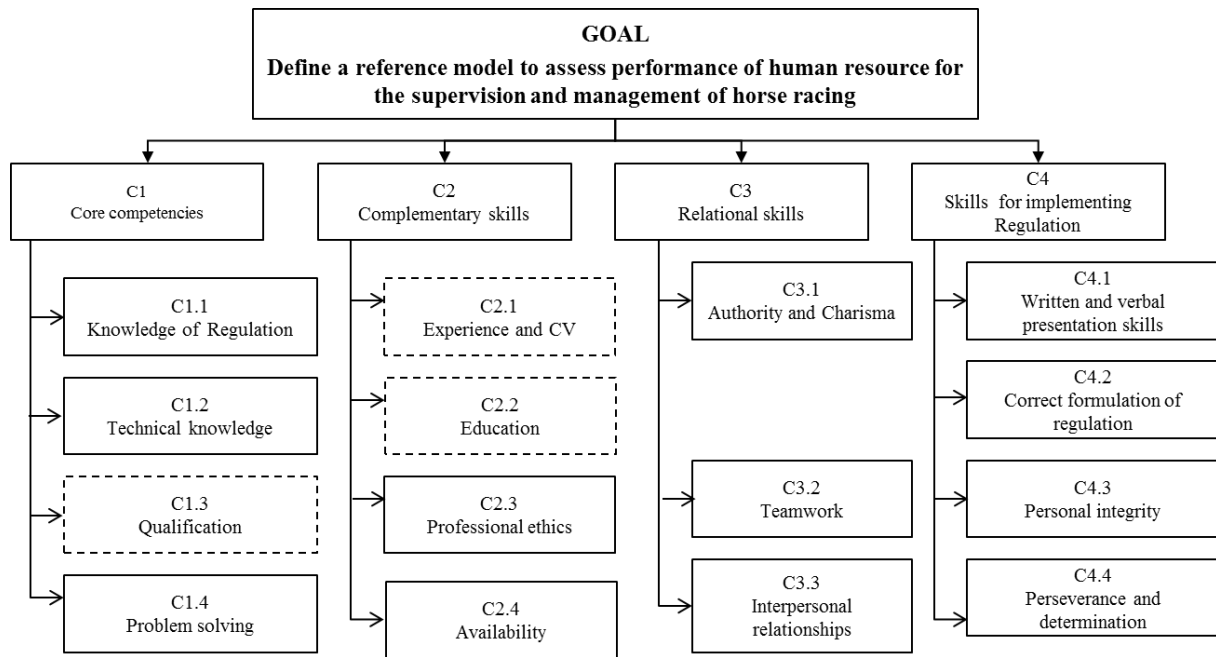


Figure 3: AHP Model

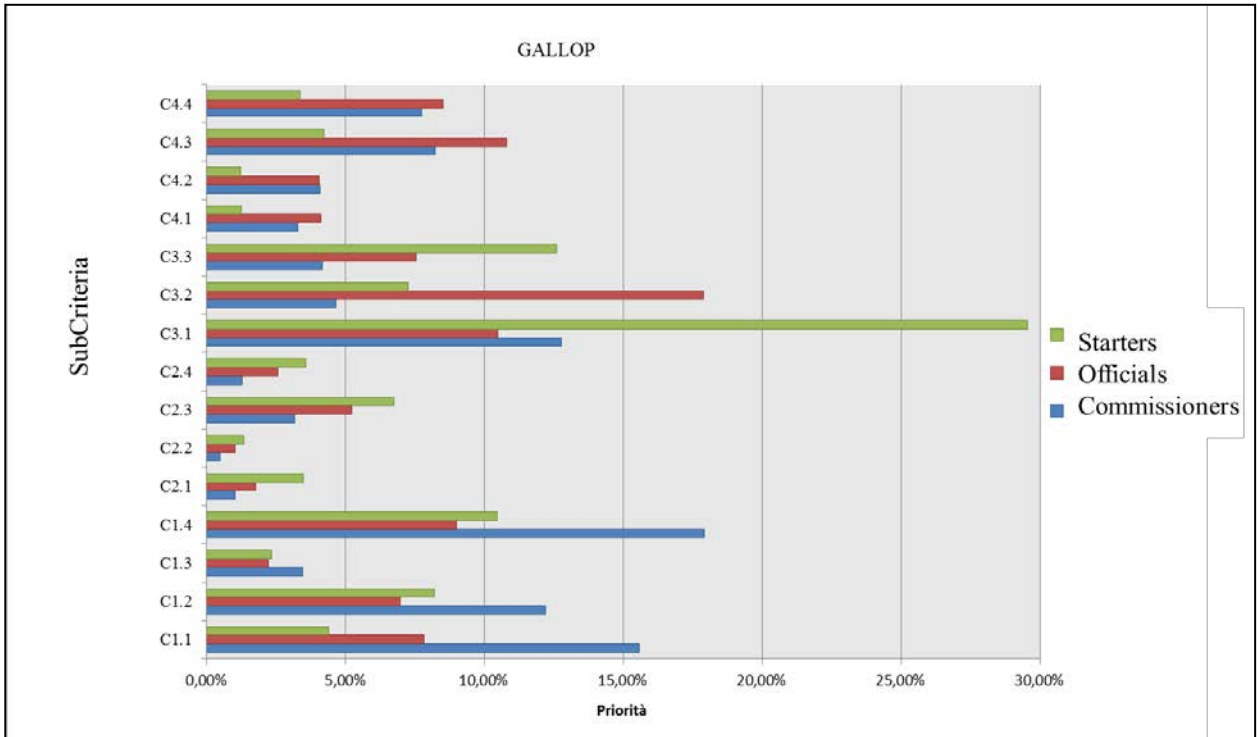


Figure 4: Final weights for subcriteria for each profiles- Gallop

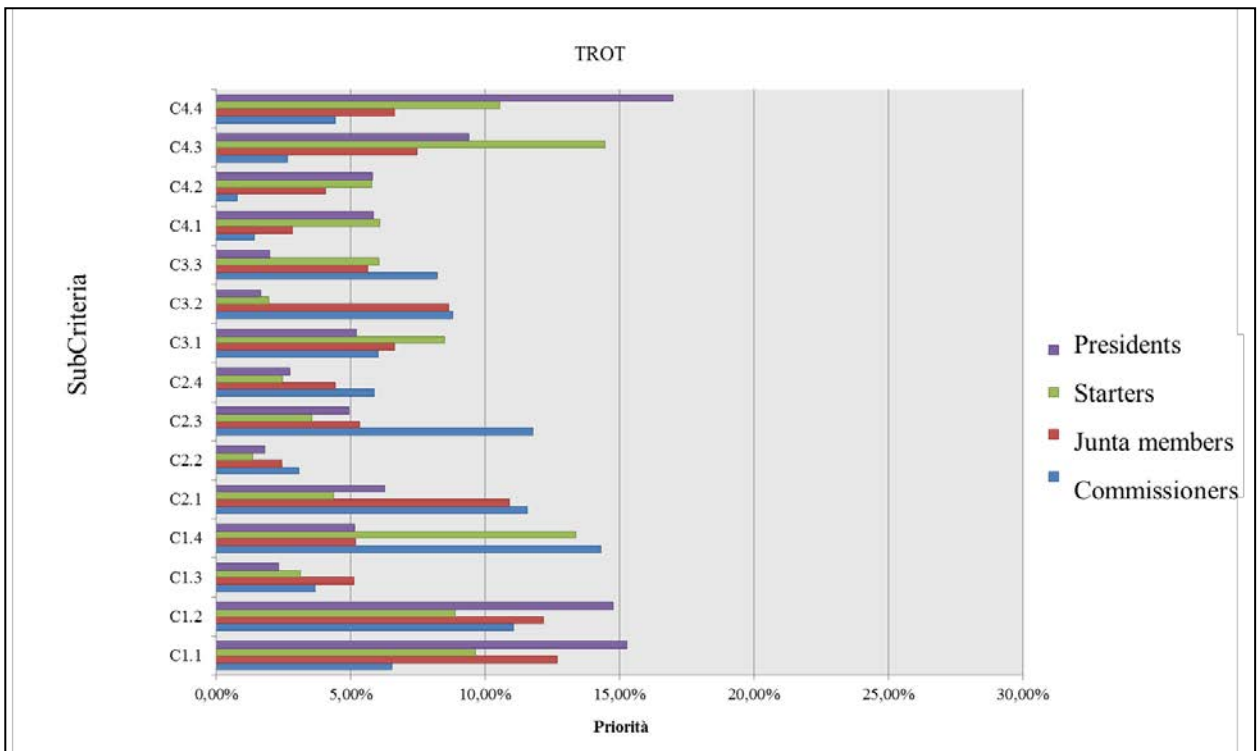


Figure 5: Final weights for subcriteria for each profiles- Trot