A Novel Approach for Effective Campus Recruitment

Rajiv Srivastava, Mangesh Gharote and Girish Palshikar

Abstract  Every year many Information Technology services companies conduct campus recruitment on a large scale. There are many interesting and challenging issues which the managers face while planning this recruitment activity. The managers commonly consider college rankings provided by the external agencies for fresh talent hiring. The colleges may be highly ranked by the external agencies but the college rankings and the realized ‘utility’ through hired graduates from a company’s perspective may differ. For a company, utility of hired graduates is based on the factors such as on-job performance, tenure, attrition, joining ratio. Another related issue is in determining the number of students to be recruited from each college. In this paper, we evaluate the scoring and the ranking schemes for the colleges, using organizational data of the employees. Based on the utility score we propose a recruitment allocation model to determine the number of students to be recruited from each college. The model is solved using water-fill algorithm and tries to maximize the expected talent utility as well as maintain a healthy diversity. We validate our rankings and allocation strategy with domain experts and state our findings.

1 Introduction

Campus recruitment of fresh graduates is an important source of human resource for large services organizations. As per the annual report of a large IT services company, they recruited 24,531 during FY 2012-13 from 371 campuses and 25,334 freshers during FY 2013-14 [8]. Also the applicant to job offer ratio varies from 3:1
to 10:1 during the campus recruitment. A typical campus recruitment drive is a complex task as large, coordinated efforts are involved from multiple teams such as HR, technical and admin. It is an important activity for companies due to ever-increasing competition for quality talent. Thus, campus recruitment provides a number of opportunities for analytics-led decision-making and some are listed as follows:

- Rank colleges in terms of potential to supply high quality
- Negotiate with the selected colleges to obtain favorable dates and slots
- Assign target recruitment numbers to each selected college
- Select interview panels for each selected college
- Plan and schedule campus recruitment tours
- Evaluate effectiveness of campus recruitment campaigns

The approach followed by managers for campus recruitment is intuition based, using common knowledge, and it varies from manager to manager. Most managers consider ratings by the external agencies to rank the colleges. The process of deciding the number of students to be recruited from a college is not well defined. There are ample opportunities to use data analytics and operations research techniques for improving campus recruitment.

1.1 Literature Survey

In our literature review, we have found that a significant number of papers focus on applying analytics and operation research techniques to Human Resource Management (HR) processes, for example, Shih et al. [7] use multi-criteria decision making for consensus building during the selection. Mohanty et al. [6] explore use of techniques such as regression, Linear Programming (LP), Analytic Hierarchy Process for deriving workforce requirements and recruitment targets, placement, promotions, and multi-party appraisal. A large body of work, models the entities, processes from HR domain and provides model based algorithmic procedures for example, Bellone et al. [1] use organization hierarchy and skill requirements to devise procedures for training and job matching. Another direction of work focusses on system architecture for automation to improve the efficiency and quality of HR processes [5] [4]. Although many decision points from HR are analysed in literature, the problem of college ranking and quota determination for campus recruitment are not yet addressed by prior work. The existing literature does not consider a holistic and company-centric perspective to decide the utility gained from a college through campus recruitment. In this paper, we demonstrate the use of analytics to rank the colleges and derive recruitment quota using the optimization technique.
2 Ranking Colleges for Talent Acquisition

The college rankings are available at national and international level. These rankings are ordered lists, based on the academic excellence and reputation. The college may be highly ranked nationally or internationally, but the student even after receiving a job offer may not join the company or may leave with a short tenure ($\leq 1.5$ years). Few companies evaluate colleges by visiting the faculty and departments for infrastructure, once in few years. This practice is very subjective, less agile and bias-prone which needs to be improved. These rankings are not capturing ‘utility’ of a college which is relevant to the company’s talent requirement. There are many facets of college ‘utility’ which a company would consider, for example, performance, growth, attrition, social and voluntary contributions from the acquired talent of a college.

In our study, we analyse the data of 1356 employees from 26 management institutes from India. The data pertaining to students joining ratio, on job performance, tenure and attrition is collected from FY 2009-12. We have used Data Envelopment Analysis (DEA) - Super efficiency model \[2\], weighted ranking method, and expert’s inputs for ranking colleges. In DEA, the colleges are considered as decision making units. To measure the efficiency of each college we assume unitary inputs for all colleges \[9\] and measures namely employee performance, tenure, attrition and joining ratio as output variables. The weighted rankings are weighted sum of output variables where user supplies the weights. The expert ranking is obtained from the campus recruitment team of the company under study. Table 1 shows the correlation among the rankings obtained using different methods. There is a strong correlation between rankings obtained using DEA and the weighted ranking. There is a negative correlation between the expert ranking and the data based ranking. The most likely reason seems to be a subjective assessment of colleges and a poor comprehension of the ‘utility’ measures by the experts. The other weak influencer could be exclusion of few relevant data variables from our model.

<table>
<thead>
<tr>
<th>Methods</th>
<th>DEA</th>
<th>Weighted Rank</th>
<th>Expert ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEA</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weighted Rank</td>
<td>0.78</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Expert ranking</td>
<td>-0.16</td>
<td>-0.2</td>
<td>1</td>
</tr>
</tbody>
</table>

3 Campus Recruitment Resource Allocation Problem

Knowing the rank and rating of the colleges the manager has to decide a target number of the students to recruit from each college. Some obvious strategies would be to recruit as maximum as possible from the ranked colleges or it could be to
divide the target number uniformly across all the colleges. But, there are significant issues with these strategies:

- Recruiting a higher number from top college may reduce total joined employee due to lower offer-joinee ratio and raise attrition
- Recruiting equally from lower ranked colleges may cause overall performance to decrease
- The recommendation must cover first top ‘k’ colleges as well as lower ranked colleges. This is needed to maintain a good rapport and relationship with the adequate set of colleges, to handle future needs as well as to track the changes in the rating of the colleges.
- There is competition from other companies to acquire the ‘Day 1’ slot for campus recruitment in highly ranked as well as upcoming colleges.

Thus, there is a need for a balanced approach in terms of ‘talent utility’ and ‘diversity’ for optimal number of students to be recruited from each ranked college.

### 3.1 Resource Allocation Formulation

Given \( n \) colleges and their rankings \( r_i \), the problem is to determine the number of students to be hired \( x_i \) from \( i^{th} \) college. Let the total number of students to be hired as \( C \), and the maximum limit for college \( i \) is \( C_i \).

A simple LP model will lead to a solution which would allocate maximum number of students from top few colleges. But in practice, the utility of hiring students is not linear. So we introduce a non-linear utility function of logarithmic form \( \log(1 + kx_ir_i) \) to determine the number of students to be recruited. As shown in equation 1, the \( k \) is a parameter for scaling the rating. The resulting convex optimization problem is as shown below.

\[
\text{Maximize } \sum_{i} \log(1 + kx_i r_i)
\]

\[
\text{Subject to } \sum_{i} x_i \leq C
\]

\[
x_i \leq C_i \quad \forall i = 1, \ldots, n
\]

\[
x_i \geq 0 \quad \forall i = 1, \ldots, n
\]

This is a standard resource allocation problem with logarithmic utility. This allocation problem we have solved using ‘water filling algorithm’[3]. The algorithm is as follows:

1. Let \( L=0 \) be the ‘water level’ to start with.
2. For each college \( i \), form ‘barrier level’ \( l_i = 1/kr_i \).
3. Now we gradually raise the water level \( L \).
4. The amount of resource allocated to college $i$ is $x_i = L - l_i$, if $L = l_i$, else $x_i = 0$.

If $L - l_i$ exceeds $C_i$, then $x_i = C_i$.

5. As we continuously raise the level $L$, eventually, we will hit the constraint $\sum_i x_i = C_i$, at which point we stop.

6. The actual solution in terms of the number of hires is obtained by taking integer parts of $x_i$.

We can see that higher the college rating, $r_i$, lower the barrier $l_i$, more the resource allocated to that college. The parameter $k$ is controlling the ‘fairness’ of allocation. If parameter $k$ is set to a high value, then the barrier level $l_i$ will be almost 0 for all the colleges irrespective of their rating. In this case, as the level $L$ rises, all the colleges will get an equal amount of resource. The allocation continues till the college limit $C_i$ is hit or the allocation is complete. On the other hand, if $k$ is set to a low value, then the differences between the colleges based on ratings will be accentuated. The colleges with a low rating will be assigned high barrier level $l_i$ and hence smaller allocation. Thus, the parameter $k$ allows us to decide the amount of importance given to a college rating, where lower value of $k$ means higher importance and vice versa.

Using different values of parameter $k$ in the optimization model, we demonstrate the recruitment allocation schemes in Table 2.

Table 2

<table>
<thead>
<tr>
<th>College</th>
<th>Rating</th>
<th>High $K$ (=1)</th>
<th>Low $K$ (=1/5)</th>
<th>Medium $K$ (=1/3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>College 1</td>
<td>1.71</td>
<td>28</td>
<td>100</td>
<td>81</td>
</tr>
<tr>
<td>College 2</td>
<td>1.60</td>
<td>27</td>
<td>100</td>
<td>76</td>
</tr>
<tr>
<td>College 3</td>
<td>1.56</td>
<td>27</td>
<td>100</td>
<td>74</td>
</tr>
<tr>
<td>College 4</td>
<td>1.53</td>
<td>27</td>
<td>100</td>
<td>72</td>
</tr>
<tr>
<td>College 5</td>
<td>1.52</td>
<td>27</td>
<td>100</td>
<td>72</td>
</tr>
<tr>
<td>College 6</td>
<td>1.12</td>
<td>26</td>
<td>0</td>
<td>42</td>
</tr>
<tr>
<td>College 7</td>
<td>1.05</td>
<td>26</td>
<td>0</td>
<td>35</td>
</tr>
<tr>
<td>College 8</td>
<td>1.01</td>
<td>26</td>
<td>0</td>
<td>31</td>
</tr>
<tr>
<td>College 9</td>
<td>0.92</td>
<td>25</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>College 10</td>
<td>0.90</td>
<td>24</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

4 Result and Discussions

We have validated the effectiveness of analytic ranking approach using performance measures of the employees recruited during 2012-14. The performance measures of top 10 colleges ranked by the experts and our analytics led approach are compared in Table 3. The employees show higher average yearly performance and confirmation score when ranked with analytics led method as compared to the expert ranking. These average measures improve as we include more colleges for comparison.
Table 3 Ranking and selection method comparison. (Data shows the performance of recruited students from top 10 colleges as ranked by various methods.)

<table>
<thead>
<tr>
<th>Method</th>
<th>Average yearly performance score (1-5)</th>
<th>Average confirmation score (1-50)</th>
<th>Average experience (year)</th>
<th>Attrition (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEA</td>
<td>3.71</td>
<td>38.7</td>
<td>1.57</td>
<td>9.1</td>
</tr>
<tr>
<td>Weighted ranking</td>
<td>3.74</td>
<td>37.4</td>
<td>1.68</td>
<td>8.1</td>
</tr>
<tr>
<td>Recruitment Expert</td>
<td>3.68</td>
<td>37.1</td>
<td>1.5</td>
<td>7</td>
</tr>
</tbody>
</table>

From our findings we conclude that past organizational data can be used to rank colleges from a company’s perspective. The analytics led ranking method perform better than expert’s ranking. The quota allocation algorithm provides a flexible and balanced approach for campus recruitment. The analytics led decision making can improve the effectiveness of recruitment process as shown for ranking colleges and recruitment quota allocation.

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References