A Performance Model for FMCG Sector Employees Using Linguistic Fuzzy Multi Criteria Group Decision Making

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Abstract

Objectives: To propose a model for ranking the performance of the employees of FMCG sector. Methods/Statistical Analysis: In this paper, authors have used Min Max Method. The data for 100 employees have been generated for identifying the performance of employees through linguistic theory model. The main factors which affect the performance of the employee can be mainly categorized in four sections: job performance, job capacities, job behavior and personal. For each performance criterion the linguistic values has been assigned. Then the relative importance of linguistic variables is calculated. Findings: The major step in the decision making process is to establish a fuzzy association relation between a precise category and every employee’s performance for that group. Considering the significance allocated to each criterion set the highest value for that grouping, the association relation is established by taking the complement of the category set importance. This complement produces a smallest performance value assigned to all employees as per the category. At the end, combined the performances of the employee across all groups in order to achieve a complete assessment by applying the min function to the set. Author got the results that 80 employees needed training in job performance as they have overall rating 0.2; whereas 16 employees needed training in job capacities as they have overall rating 0.40 and 4 employees can be promoted as they have overall rating 0.41 which is highest. Applications/Improvements: The proposed approach of fuzzy evaluation methodology can be used for other sectors like evaluation of students, evaluation of product or quality assessment of software, teacher or supplier evaluation with small modifications.

Keywords: Fast Moving Consumer Goods (FMCG), Fuzzy Numbers, Fuzzy MCDM, Linguistic Variables

1. Introduction

Products which have a small shell life and rapid revenue generation trend and comparatively low price are known as Fast Moving Consumer Goods (FMCG). FMCG Products are those that get traded in the time span of one year. These products are bought by the customers in less quantity as per the requirement of the individual or family. The frequency of buying or purchasing of these items is more as they belong to fulfil our daily needs. The cost of the products is not very high. These products can include perishable and nonperishable items, long lasting and non-durable things. Examples of FMCG mainly contains a large variety of items which are often bought by consumers such as food items like dairy products, fruits and vegetables and health and beauty items like cosmetics, perfumes, soap and detergents, cleaning preparations etc. and plastic goods, glassware and paper products are treated as non-durable items. FMCG may also include items belonging to pharmaceutical sector, Electronics Sector like MP3 players, Laptops or Notebooks, digital cameras and GPS Systems, Television, Music System, Refrigerators, Washing Machines etc. and Package and processed food sector like soft drinks and chocolate bars. The FMCG industry mainly involves operation in the departments of Production, Sales and Marketing, Human resources, Finance and IT and Research along with Supply Chain. Indian market FMCG leaders are Hindustan Unilever Ltd., ITC (Indian Tobacco Company), Nestle India, Asian Paints (India), Britannia Industries, Procter
FMCG is an industry which is highly dynamic and innovative. FMCG is products that are sold rapidly and at reasonably low price. It includes non-durable goods such as soft drinks, toiletries, pharmaceutical products, toys, packaged and processed foods and chocolates and several other consumables.

To become successful in FMCG sector, firm requires deep and clear understanding of the purchaser, strong trademarks, strong and extensive circulation system, packaging knowledge and strong sales and marketing knowledge.

Every FMCG business is different but certain functions are common to all which work together to ensure the company's success and sustainability. Business setup will vary between every firm but the following business areas need to be worked upon.

- **Sales**: It deals with sales, customer development, Account Management, sales and planning strategies.
- **Marketing**: It mainly involves promotion of products by working with local and global teams. Brand building, marketing strategy and working with R & D for finding suitable target audience.
- **Research and Development (R & D)**: It ensures a constant innovation and implementation of new strategies to keep the brand at top. Working in new technologies and category development play an important role.
- **Information Services/Information Technology**: It mainly deals in delivering secure, global, robust information systems. Designing and analyzing systems, risk management and identifying new trends and technologies play an important role.
- **Finance**: It mainly works on all aspects of finance management. It mainly relates in measuring performance to deliver maximum value and results. Tax planning and forecasting and advising on brand development and pricing play an important role.
- **Supply chain**: This involves handling every aspect of supply from the stage of raw materials to finished products for consumer on shelf. Distribution, manufacturing and driving cost reduction plays an important role.
- **Human Resources**: It mainly involves hiring of new talent. They also play an important role in growing careers once employees are on-board or on payment-roll.

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**2. Performance Management & Employee Development**

In today's era, evaluation has become an important measure of our lives. There exist various categories of evaluation. Depending on areas or domains, evaluation is simple as it is based on measurable characteristics while in some it is complicated. Employee evaluation is based on various compound criteria's which are based on the typical competencies of the employee.

Competencies are the summary of the knowledge, skills, abilities, attitudes and values necessary for individual progress and self-assertion of every member of society. The competency model is always created in relation of the work for a given working role. It reflects the competency composition that is necessary for carrying out a particular type of work. The evaluation includes qualitative criteria that are part of the competency model for any given role. The evaluation against the quantitative criteria is taken from the employee's personal record (education, experience, certifications, etc.).

As performance of employee is directly proportional to the performance of the firm hence firms are now giving more attention to employee performance and skills in the industry and management research domain.

The success or failure of an organization depends on the accumulated performance outputs of all the employees. So to monitor and achieve the best performance output from each and every employee is the work allocated to every department manager. The Human resources department is initiating, supporting and tracking the performance management process, but the process is conducted by managers with their teams.

Performance management is the continuous, collective two way association between employee and their superior. This relationship is focused on organized planning of work, setting of expectations, providing the accurate and precise opinion and establishment of shared understanding. All this is for the purpose of developing employee’s aptitude and ability to complete the everyday job and to grow within the position and in the firm. The performance management is the method where the employee is generating worth for the company and opening for individual growth. From the perspective of the company, performance management is the prospect to identify contributions and accomplishments of staffs. The
The company is rewarding the employee for the achievements, through the compensation package.  

The purpose of using the mechanisms of linguistic fuzzy modelling is, on the one hand, a precise mathematic data processing that eliminates unwanted subjective impact, and, on the other hand, the natural expression of the expertly defined imprecise assessments using regular language. Thus to evaluate the performance of FMCG must have a model which gives correct and accurate and reliable judgment about employees and make both an organization and employee more accountable.

2.1 Application areas of LFMCDM 
LFMCDM can be applied in various areas like Performance Evaluation, Selection of location for material distribution, Future Sales Prediction or Forecast prediction, Measuring success possibility of knowledge management, Quality Enhancement, Infrastructure Management Enhancement, Improving decision making and efficiency, Risk prediction, Improving decision making and efficiency, Prioritizing design requirements for software project or marketing application for sustainability, Manufacturing Resource planning, Data Mining, Pattern recognition and behavior judgment. Among all application areas authors have focused on performance evaluation.

2.2 Performance Evaluation 
In sales department, LFMCDM can be applied for measuring performance evaluation process. The performance of an employee, supplier, and customer satisfaction can be measured. The performance measuring of employee will help an organization to decide which employee needs promotion, which employees need training for improving their weakness and which employees need to be given lay-off. Similarly selection of supplier can tell that which need to retain and which need to stop from supplying goods. This will help an organization to identify the best employees or suppliers and to increase the productivity of an organization with achieving an optimization.

In marketing department, LFMCDM can be applied for measuring the performance of marketing strategy planned to improve the sales of an organization. In IT department, it can be used for measuring the performance of IT strategy planned by an organization.

3. Fuzzy Number and Linguistic Variables Basics 
Originally introduced fuzzy set theory later defined the decision-making methods in fuzzy environments. A large number of studies have shown that with uncertain fuzzy problems can be solved by applying fuzzy set theory. The study also involves use of fuzzy decision-making theory, bearing in mind the involvement of fuzzy subjective judgement during the evaluation process.

It is very difficult for conventional quantification to express reasonably those situations that are explicitly multifaceted or hard to define; thus the idea of a linguistic variable is essential in such situations. A linguistic variable is a variable whose values are words or sentences in a natural or artificial language.

In this paper, authors have used Min Max Method. (Authors have used “∧” and “∨” to denote min and max function). The Mathematical Formation of Min-Max Method is

3.1 Definition 
Let a set E be fixed. An Intuitionistic fuzzy set or IFS A in E is an object having the form A = {< x, µA(x), γA(x) > / x € E} where the functions µA : E → [0,1] and γA : E → [0,1] define the degree of membership and degree of non-membership respectively of the element x ∈ E to the set A, which is a subset of E, and for every x ∈ E, 0 ≤ µA(x) + γA(x) ≤ 1. The amount πA(x) = 1 - (µA(x) + γA(x)) is called the hesitation part, which may cater to either membership value or non-membership value or both.

3.2 Definition
If A and B are two IFS on the set E, then A ⊂ B if and only if ∀ x ∈ E, [µA(x) ≤ µB(x) and γA(x) ≥ γB(x)] A ⊃ B if B ⊂ A, A = B if ∀ x ∈ E, [µA(x) ≤ µB(x) and γA(x) ≥ γB(x)], A = {< x, µA(x), γA(x) > / x € E}

A ∩ B = {< x, min(µA(x), µB(x)), max(γA(x), γB(x)) > / x € E}

A ∪ B = {< x, max(µA(x), µB(x)), min(γA(x), γB(x)) > / x € E}
Obviously every fuzzy set has the form \( \{< x, \mu_{\text{A}}(x), \mu_{\text{B}}(x)> / x \in \text{E}\} \)

### 3.3 Definition

Let \( Q(\text{X à Y}) \) and \( R(\text{Y à Z}) \) be two IFR. The max-min max composition \( \mu_{\text{max-min-max}} \) is the intuitionistic fuzzy relation from \( \text{X} \) to \( \text{Z} \), defined by the membership function

\[
\mu_{\text{max-min-max}}(x,z) = \vee (\mu_{\text{Q}}(x,y) \land \mu_{\text{R}}(y,z))
\]

and the non-membership function

\[
\downarrow_{\text{max-min-max}}(x,z) = \vee (\downarrow_{\text{Q}}(x,y) \land \mu_{\text{R}}(y,z)) \quad \forall (x,z) \in \text{X x Z} \text{ and } \forall y \in \text{Y}.
\]

### 4. Case Study Illustration

The research study analyses the performance of employees in different FMCG Sectors. The result will help the organization to decide which employees can be promoted, which need training to improve the weakness which they possess and identified by evaluation model or which need to be given lay off as they are not suitable for current job\(^{18,19}\).

The main factors which affect the performance of the employee can be mainly categorized in four sections job performance, job capacities and job behavior and personal which are discussed independently.

- **Job Performance**: As name suggest it involves the elements which affects the performance of the job and which test the skills of employee's for problem solving and decision making, best use of resource, achieving the job objectives.

- **Job Capacities**: As name suggest it involves the elements which requires the factors affecting the capability of job like distribution and planning of, leadership skills and supervisory skills, ability to quick understanding.

- **Job Behavior**: As name suggest it involves the elements which mainly deals with the behavior of job to be done like creating team work spirit, motivating and guiding employees, positive impact on others

- **Personal**: As name suggest it involves the elements which deals with the personality of the employee like personality, communication skills, self-control.

Under these four categories different variable and fixed parameters can be considered which are as follows

For evaluation against the qualitative criteria, the evaluators have at their disposal a non-uniform five-element linguistic fuzzy scale. The above factors are scaled by higher authorities according to the linguistic grading for each factor with the values “not acceptable”, “poor”, “average”, “above average” and “outstanding”. The importance of the linguistic variables helps us in handling both tangible and intangible factors instead of numerical values and improves succession planning\(^{20,21}\).

![Figure 1. The hierarchical structure for project manager for selection of employee (Categorization of Criteria considered for Employee Performance)\(^{22}\).](image)

### 5. Data Collection and Analysis: [Refer Figure 1. for Criteria List]

The data for 100 employees have been generated for identifying the performance of employees through linguistic theory model. For each performance criteria the linguistic values has been assigned. Then the relative importance of linguistic variables is calculated. After finalizing the linguistic importance all linguistic values were converted to numerical values.

All performance factors considered for evaluation of employee performance were categorized in four different categories like “job performance”, “job capacities”, “job behavior” and “personal” qualities of employee.

In the process of evaluation job performance has the highest importance or weightage as it directly related with the performance or quality of job followed by job capacities followed by job behavior and at last the personal characteristics of an employee.

A) Steps for calculating the relative importance (RI) for linguistic variables
As there are five different values of linguistic variable namely “outstanding”, “above average”, “average”, “poor” and “not acceptable”. Outstanding is the best value or complete dedication so the ranking for outstanding is 5 and for above average is 4 and so on (please refer Table 1). Now to calculate relative importance of the categories we divide ranking given to the categories by total no of categories. After calculation relative importance is given below.

### Table 1. Calculation of Relative Importance

| Sr. No | Category      | Ranking | Relative Importance |
|--------|---------------|---------|---------------------|
| 1      | Outstanding   | 5       | 5/5=1               |
| 2      | Above average | 4       | 4/5=0.8             |
| 3      | Average       | 3       | 3/5=0.6             |
| 4      | Poor          | 2       | 2/5=0.4             |
| 5      | Not Acceptable| 1       | 1/5=0.2             |

**B) Steps for calculating the relative importance of the different categories**

- According to the criteria importance ranking has been associated to each criterion as follows (please refer Table 2).

### Table 2. Importance of Ranking

| Sr. No | Category     | Ranking |
|--------|--------------|---------|
| 1      | Job Performance | 4       |
| 2      | Job Capacities | 2       |
| 3      | Job Behavior  | 1       |
| 4      | Personal      | 0.5     |

- Count performance factors belong to each category.
- Multiply the count and ranking associated with that category.
- Count all the performance factors across all four categories which help to measure the performance of employee.
- At the end calculate the percentage for each category. Once the relative importance for the criteria is finalized,
- Calculate “1-RI”.
  - Now apply fuzzy min-max principle to 1-relative importance and each ranking values for employee and then apply min of all the factors from the resultant set. The minimum value obtained will be considered as the final evaluation score for that employee.

After repeating the steps for all 100 employees, the final result is shown below.

### Table 3. Importance of criteria

| Criteria            | Naming Convention | Relative Importance |
|---------------------|-------------------|---------------------|
| Job Performance     | C1                | 0.88                |
| Job Capacities      | C2                | 0.59                |
| Job Behavior        | C3                | 0.25                |
| Personal            | C4                | 0.11                |

### Table 4. Importance of linguistics variables

| Relative Importance | Naming Conventions | Linguistics Variables |
|---------------------|--------------------|-----------------------|
| 0.2                 | Na                 | Not Acceptable        |
| 0.4                 | P                  | Poor                  |
| 0.6                 | A                  | Average               |
| 0.8                 | Aa                 | Above Average         |
| 1                   | O                  | Outstanding           |

### Table 5. Typical Sample Model for Five Employees (employee performance rating)

| Category Type | Criteria | E1 | E2 | E3 | E4 | E5 |
|---------------|----------|----|----|----|----|----|
| Job behavior  | C3       | Na | O  | A  | P  | Aa |
|               | C5       | O  | Na | P  | Na | Aa |
|               | C7       | P  | Na | Na | A  | A  |
|               | C11      | Aa | Aa | O  | Na | Aa |
|               | C14      | O  | A  | A  | Na | P  |
|               | C24      | O  | Aa | Aa | O  | Na |
|               | C8       | A  | O  | Na | A  | Na |
|               | C9       | O  | Na | Aa | P  | P  |
|               | C19      | Na | Na | A  | Aa | O  |
|               | C20      | Aa | O  | O  | Aa | Na |
|               | C23      | O  | Aa | A  | Aa | P  |
|               | C25      | A  | Aa | O  | A  | Aa |
|               | C26      | P  | P  | P  | Na | P  |
|               | C27      | P  | O  | Aa | P  | O  |
|               | C4       | O  | O  | Na | O  | Aa |
|               | C15      | O  | P  | P  | P  | Aa |
|               | C16      | A  | O  | P  | Na | Aa |
|               | C17      | Na | O  | Aa | A  | Aa |
|               | C18      | Aa | Aa | A  | A  | A  |
|               | C21      | P  | A  | O  | O  | O  |
|               | C22      | O  | A  | A  | Aa | Aa |
|               | C21      | Aa | O  | A  | O  | Na |
|               | C20      | O  | P  | P  | Na | P  |
|               | C13      | P  | Na | Aa | Na | P  |
Table 6. Employee membership grades

| Category | Criteria | E1 | E2 | E3 | E4 | E5 |
|----------|----------|----|----|----|----|----|
| Job behavior | C3 | 0.2 | 1 | 0.6 | 1 | 0.8 |
| | C5 | 1 | 0.2 | 0.4 | 0.6 | 0.8 |
| | C7 | 0.4 | 0.2 | 0.2 | 1 | 0.6 |
| | C11 | 0.8 | 0.8 | 1 | 0.8 | 0.8 |
| | C14 | 1 | 0.6 | 0.6 | 0.4 | 0.4 |
| | C24 | 1 | 0.8 | 0.8 | 0.4 | 0.2 |
| Job capacity | C8 | 0.6 | 1 | 0.2 | 0.6 | 0.2 |
| | C9 | 1 | 0.2 | 0.8 | 0.2 | 0.4 |
| | C19 | 0.2 | 0.2 | 0.6 | 0.6 | 1 |
| | C20 | 0.8 | 1 | 1 | 0.8 | 0.2 |
| | C23 | 1 | 0.8 | 0.6 | 1 | 0.4 |
| | C25 | 0.6 | 0.8 | 1 | 0.2 | 0.8 |
| | C26 | 0.4 | 0.4 | 0.4 | 0.6 | 0.4 |
| | C27 | 0.4 | 1 | 0.8 | 1 | 1 |
| Job performance | C4 | 1 | 1 | 0.2 | 1 | 0.8 |
| | C15 | 1 | 0.4 | 0.4 | 0.6 | 0.8 |
| | C16 | 0.6 | 1 | 0.4 | 0.6 | 0.8 |
| | C17 | 0.2 | 1 | 0.8 | 0.4 | 0.6 |
| | C18 | 0.6 | 0.8 | 0.8 | 0.8 | 0.4 |
| | C21 | 0.4 | 0.6 | 1 | 0.4 | 1 |
| | C22 | 1 | 0.6 | 0.6 | 0.6 | 0.8 |
| Personal | C1 | 0.8 | 1 | 0.6 | 0.8 | 0.2 |
| | C2 | 1 | 0.4 | 0.4 | 0.4 | 0.8 |
| | C6 | 0.2 | 0.6 | 0.8 | 0.6 | 0.6 |
| | C10 | 0.6 | 0.4 | 0.2 | 0.4 | 0.6 |
| | C12 | 0.2 | 0.6 | 0.6 | 0.6 | 0.6 |
| | C13 | 0.4 | 0.2 | 0.8 | 0.6 | 0.4 |

Calculation by using min-max method

The major step in the decision making process is to create a fuzzy association relation between a precise category and every employee’s performance for that criteria group. Assuming that the significance allocated to each criteria set is the highest value for that grouping the association relation is established is by taking the complement of the category set importance. This complement produces a smallest performance value assigned to all employees as per the category. (The calculation is shown considering the criteria value in serial order i.e. from C1, C2, C3… C26, and C27)

The function max is applied to every employee’s set, i.e.

\[ \{0.89, 0.89, 0.75, 0.12, 0.09, 0.75, 0.89, 0.75, 0.41, 0.41, 0.09, 0.75, 0.89, 0.75, 0.12, 0.09, 0.75, 0.89, 0.75, 0.41, 0.41, 0.12, 0.09, 0.75, 0.41, 0.41\} \]

// calculating max from 1-relative importance and ranking of an employee.

\[ \{0.08, 1, 0.75, 1, 0.89, 0.75, 0.61, 0.89, 0.89, 0.89, 0.89, 0.11, 0.06, 0.20, 0.75, 0.41, 0.08, 0.41, 0.1, 0.1, 0.6, 0.41, 0.41\} \]

// calculating minimum from all the values of criteria obtained from max function.

The last step is to combine performances of the employee across all groupings in order to achieve a complete assessment. This is done by applying the min function to the set resulting from the above phase.

\[ =0.20 \text{ (Refer Table 7)} \]

Table 7. Final Rating Score of Employee

| Employee | Score |
|----------|-------|
| E1       | 0.20  |
| E2       | 0.40  |
| E3       | 0.20  |
| E4       | 0.20  |
| E5       | 0.41  |

6. Result Analysis and Discussion

By analyzing the overall ratings of employees, it is easy for an organization to decide which employees provide the promotions and for which employees provide the training to improve their weakness and which employees give layoff if needed.

Table 8. Final Result

| Sr. No | Overall Rating | Count |
|--------|----------------|-------|
| 1      | 0.41           | 04    |
| 2      | 0.40           | 16    |
| 3      | 0.20           | 80    |

7. Conclusion

The 80 employees needed training in job performance as they have overall rating 0.2 whereas 16 employees needed training in job capacities as they have overall rating 0.40 and 4 employees can be promoted as they have overall rating 0.41 which is highest.

Thus by applying linguistic variable values to the criteria we can analyze qualitative as well as quantitative data without any uncertainty and with more accuracy
which will help to improve the performance of the employee in turn improving the performance of the organization.

Thus performance analysis of employee by using linguistic evaluation makes the organization and employee both more accountable.

**Future Scope** The proposed approach of fuzzy evaluation methodology can be used for various other sectors like evaluation of students, evaluation of product or quality assessment of software, teacher evaluation or supplier evaluation with small modifications.

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