Employee Performance Evaluation in an Indonesian Metal Casting Manufacturer using an Integrated MCDM Approach

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Abstract — The purpose of this study is to evaluate employee performance in a pipe fittings manufacturer situated in the region of Yogyakarta, Indonesia, using multi-criteria decision-making (MCDM) techniques. The manufacturer has currently conducted a performance evaluation; however, there have been two drawbacks in the current system assessment. Firstly, the current method cannot determine the priority of criteria. Secondly, personal judgment has also influenced the employee rankings, and therefore this allows ambiguity on evaluation. In this study, a hybrid BWM-Fuzzy TOPSIS is introduced to more realistically evaluate performance involving 15 employees. BWM is used to determine the weight of the criteria, while Fuzzy TOPSIS is for ranking employees’ performance. By simulating the formulated min-max optimization models, the optimal criteria weights from the highest to the lowest one are employee morale (M), job effectiveness (E), and job productivity (P), respectively. The global weight at the highest priority is employee loyalty (M2), and the lowest priority is job accuracy (P3). This research has evaluated employee performance in the company in a more structured and reliable way. It is because it can specifically rank the best performer to the worst performer, while in the current method, there have been nine out of 15 employees who cannot be ranked due to similar total value. For further study, a sensitivity analysis can be carried out by simulating various scenarios to bring more information for the decision-makers when dealing with a particular situation.

Keywords — employee evaluation, multi-criteria decision-making, Best-Worst Method, Fuzzy TOPSIS

I. INTRODUCTION

Employee performance evaluation is an inseparable part of an organization’s success. The evaluation — also known as performance assessment, performance evaluation, or performance management — is a scientific approach to assess and evaluate employee’s contribution to the organization according to the task assigned to each member [1, 2]. As human resources have been the critical assets for organizations, employee performance evaluation would help an organization determine employees’ targets to achieve an organization’s future goals and increase an organization’s competitiveness [3]. Accordingly, it is essential to encourage high-performing employees through the evaluation process, identifying competencies, establishing effective management and accomplishments, and delivering instructions [4]. Besides, sorts of human resource decisions can be made by using employee performance evaluation such as identifying talents, reward and punishment — pay raises, promotions, demotions, and terminations, reviewing job, and determining employee’s educational or training needs ([1], [5], [6]). Hence, the right human resource decisions are effectively determined through the right employee performance evaluation [6].

Recent studies on employee performance evaluation have been carried out using multi-criteria decision-making (MCDM)
techniques as considering multiple criteria. The issue was often deemed a complicated problem [7]. Several MCDM methods have been selected to solve employee evaluation problem, particularly for selecting the best candidate, such as analytical hierarchy process (AHP), technique for order preference by similarity to ideal solution (TOPSIS), modified AHP and TOPSIS with fuzzy sets, best-worst method (BWM) and preference ranking organization method for enrichment evaluation (PROMETHEE) ([8], [9]), and many other MCDM approaches such as Choquet Integral [10], FADM and FQD [11], and Bayesian belief network [7]. Meanwhile, AHP, TOPSIS, and an integrated these two methods extended to fuzzy sets were frequently combined. The two distinct MCDM methods were selected to determine the criteria weights, such as AHP and Fuzzy AHP. In contrast, another method - TOPSIS, Fuzzy TOPSIS, and PROMETHEE - was used for ranking employees ([6], [8], [12]). AHP is an MCDM method that has been widely selected by previous studies in the first-stage decision-making to calculate criteria weights since solving the complex employee evaluation decision-making problem into a hierarchical structure which is more logically organized with simple mathematical calculation and computation ([15], [6]). Further, AHP also has a high level of consistency and accuracy in calculating criteria weights [8]. Although there are limitations to traditional AHP in overcoming ambiguity and vagueness of decision maker’s opinion, a modified AHP with a fuzzy set has been developed and implemented to provide a more accurate decision-making judgment ([17], [12]). Meanwhile, the TOPSIS method is often taken to obtain performance scores for each candidate as it ranks alternatives based on the shortest distance from the positive-ideal solution and the farthest distance from the negative ideal solution [12]. In this study, a hybrid BWM and Fuzzy TOPSIS is introduced to evaluate employee performance in an Indonesian manufacturing company applying BWM to determine the weights of evaluation criteria and Fuzzy TOPSIS to rank employees’ performance.

In this study, an integrated BWM – TOPSIS is selected since these two methods have a similar principle towards maximum value, which is called the best criterion on BWM and ideal positive value on TOPSIS. The BWM method was firstly developed by Rezaei [13] in which the method initially requires the best and the worst criteria identified by the decision-makers (DMs). Then, a maximin problem is formulated and solved to obtain the optimal criteria weight. Meanwhile, Fuzzy TOPSIS, an extended TOPSIS with a fuzzy set, is applied to rank employees as accommodating both positive factor that maximizes benefits and negative factor that minimizes benefits of all alternatives, and making the evaluation to become more realistic [6]. Although integration of these two methods has been carried out in some previous studies, such as supplier selection and organization performance assessment with green aspects ([14], [15], [16]), the topic of evaluating employee performance using a hybrid BWM – Fuzzy TOPSIS is still broad-explored. For this reason, this study will apply BWM and Fuzzy TOPSIS for employee assessment in a manufacturing company since these methods represent the company’s situation. In the case demonstrated, the criteria weights determination using BWM is more preferred than using other methods, such as AHP, since the BWM may not only simplify the decision-making process using a hierarchical structure and a pairwise comparison with a Likert scale as applied in AHP, but also this method will produce optimal criteria weights through the min-max optimization model solved.

In this study, a hybrid BWM – Fuzzy TOPSIS is applied to evaluate employee performance demonstrated in a metal casting manufacturer producing pipe fittings in the province of Yogyakarta, Indonesia. The company’s human resource department has currently identified criteria and sub-criteria used in the existing evaluation system. However, there have been two weaknesses found in the current evaluation: first, it has not been determined both criteria and sub-criteria weights comparing priority criteria and non-priority criteria of evaluation; second, the subjective perspective has majorly put on employees’ rank. Consequently, several employees have been assessed to have the same overall score, and in this situation, the company cannot distinguish who is given a higher score. Therefore, concerning the issue, this study improves the company’s evaluation method using BWM and Fuzzy TOPSIS. The BWM is selected to determine the criteria weights, while Fuzzy TOPSIS for ranking employees.

II. METHODOLOGY

The study on employee performance carried out in this research is divided into three main stages, which are: (1) identifying criteria and sub-criteria to evaluate employee; (2) determining weights for each criterion using BWM; and (3) obtaining employees’ rank using Fuzzy TOPSIS. Initially, the decision-makers (DMs) design a hierarchical structure of decision-making comprising of goal, evaluation criteria, and sub-criteria. The defined criteria and sub-criteria will then be calculated using a BWM optimization model to obtain the optimal global weight for each criterion. Lastly, Fuzzy TOPSIS will rank employees based on the scores dataset taking into account the factors’ optimal weight determined by BWM.

1) The BWM to determine optimal weights: After a decision-making hierarchy has been structured that contains several criteria, the DMs determine the best criterion and the worst criterion of the performance evaluation factors. Subsequently, the preferences will be determined through a pairwise comparison of the best criterion over all the other criteria which produces the best-to-others (BO) vector, \( A_B = (a_{B1}, a_{B2}, \ldots, a_{Bn}) \), where \( a_{Bj} \) indicates the preference of the best criterion \( B \) over criterion \( j \) dan a pairwise comparison of all the criteria over the worst criterion producing others-to-worst (OW) vector, \( A_W = (a_{W1}, a_{W2}, \ldots, a_{Wn})^T \), where \( a_{Wj} \) indicates the preference of the criterion \( j \) over the worst criterion \( W \). The preferences producing BO and OW vector use a Likert scale with a numeric scale between 1 and 9. The
BWM’s last stage is to formulate the min-max optimization models, equation (1) - (6), in which the model is then solved to obtain the optimal weight.

\[
\begin{align*}
\min_{\mathbf{w}} & \left\{ \frac{w_j - a_{Bj}}{w_j^* - a_{Bj}} \right\} \\
\text{Subject to:} & \\
\sum_j w_j &= 1 \\
0 & \leq w_j, \text{ for all } j
\end{align*}
\]

\[
\begin{align*}
\min_{\mathbf{a}} & \left\{ \frac{w_j - a_{Bj}}{w_j^* - a_{Bj}} \right\} \\
\text{Subject to:} & \\
\sum_j w_j &= 1 \\
0 & \leq w_j, \text{ for all } j
\end{align*}
\]

2) The Fuzzy TOPSIS to calculate employees’ performance:

The employees’ performance rank is calculated using Fuzzy TOPSIS considering BWM’s optimal weights. Firstly, the performance score in every factor is collected and then converted into a triangular fuzzy number \( \hat{A} \) defined by a triplet \((l, m, u)\) where \( l \) and \( u \) are the lower and upper bound, \( m \) is the most possible value of the fuzzy number \( \hat{A} \), and \( l \leq m \leq u \) [11]. In this study, the Fuzzy TOPSIS’s rank takes the triangular fuzzy scale, as can be seen in Table I.

| No. | Fuzzy Language       | Triangular Fuzzy Scale |
|-----|----------------------|------------------------|
| 1   | Very low (VL)        | (0, 0.12, 0.2)         |
| 2   | Low (L)              | (0.3, 2, 5/2)          |
| 3   | Medium (M)           | (0.7, 4, 9/2)          |
| 4   | High (H)             | (1.1, 6, 13/2)         |
| 5   | Very high (VH)       | (1.5, 8, 17/2)         |
| 6   | Excellent (E)        | (1.9, 10, 21/2)        |

Table I. Fuzzy Numbers

Secondly, the normalized fuzzy decision matrix is calculated using equation (7) for beneficial criteria and equation (8) for non-beneficial criteria or so-called cost criteria in which the minimum value is desired.

\[
\begin{align*}
\hat{r}_{ij} &= \left( \frac{b_{ij} - a_{ij}}{u_{ij} - a_{ij}} \right) \text{ and } c_i^* = \max \{c_i\} \\
\hat{r}_{ij} &= \left( \frac{b_{ij} - a_{ij}}{v_{ij} - a_{ij}} \right) \text{ and } a_i^* = \min \{a_i\}
\end{align*}
\]

Thirdly, the weighted normalized fuzzy decision matrix is calculated using equation (9), where every element in the matrix in which performance score for all factors is multiplied by the BWM’s criteria or sub-criteria weights.

\[
v_{ij} = r_{ij} \times w_j = w_j(a_{ij}, b_{ij}, c_i)
\]

Fourthly, the fuzzy positive ideal solution (FPIS), \( A^+ = (v_1^+, v_2^+, ..., v_n^+) \), where \( v_j^+ = \max_i \{v_{ij}\} \), and the fuzzy negative ideal solution (FNIS), \( A^- = (v_1^-, v_2^-, ..., v_n^-) \), where \( v_j^- = \min_i \{v_{ij}\} \), are obtained to calculate the distance \( d_i^+ \) from FPIS, equation (11), and \( d_i^- \) from FNIS, equation (12).

\[
d(x, y) = \sqrt{\sum_{i=1}^{n} \left( (x_i - y_i) \right)^2 } \]

\[
d_i^+ = \sum_{j=1}^{n} d(v_{ij}, v_{ij}^+) \text{, } i = 1 \ldots m \]

\[
d_i^- = \sum_{j=1}^{n} d(v_{ij}, v_{ij}^-) \text{, } i = 1 \ldots m
\]

The closeness coefficient value, \( C_{Ci} \), is finally calculated for every alternative using equation (13). The \( C_{Ci} \) value indicates employees’ overall performance scores. While the final scores are obtained, the employee ranking can be executed by sorting the first rank employee to the lowest rank.

\[
C_{Ci} = \frac{d_i^-}{d_i^- + d_i^+} \text{, } i = 1 \ldots m
\]

III. RESULT AND DISCUSSION

A. Defining The Hierarchical Structure

The hierarchical structure assists the DMs to simplify the decision-making process in order to be easier to understand. In this study, the structure deploys the evaluation factors into three structural levels: level 0 indicates the decision-making goal, level 1 includes evaluation criteria, and level 2 is sub-criteria, as illustrated in Figure 1.

The evaluation criteria and sub-criteria formulated involve three DMs from the company. They are the head of quality control, the head of the production, and the head of printing, while the formulation process has been executed using the Delphi method. The three DMs have been working in the company for between 15 and 20 years so that the evaluation factors can be considered accountable. As a result, it is identified nine sub-criteria which are classified into three evaluation criteria, namely employee morale (M), job effectiveness (E), and job productivity (P). The description for each factor is shown in Table II.

![Figure 1. The hierarchical structure of the evaluation](image-url)
B. Calculating Criteria and Sub-criteria Weights

In this step, the DMs identified the best and the worst factors for criteria and sub-criteria. Then, pairwise comparisons are taken to determine the best criterion’s preference over all the other criteria producing BO vector and the preference of all criteria over the worst criterion producing OW vector. The BO vector and the OW vector for criteria comparisons as follows:

\[ \{a_{B1}, a_{B2}, a_{B3}\}_C = \{1,3,4\}, \{w_1, w_2, w_3\}_C = \{4,2,1\} \]

Based on the BO and the OW vector, the DMs have determined that the best and the worst criterion are employee morale (M) and job productivity (P). Besides, the BO and the OW vector obtained for all sub-criteria M1 to M3 (parts of employee morale criterion, M), E1 to E3 (parts of job effectiveness criterion, E), and P1 to P3 (parts of job productivity criterion, P) as are as follows:

\[
\begin{align*}
\{a_{B1}, a_{B2}, a_{B3}\}_M &= \{3,1,5\}, \{w_1, w_2, w_3\}_M = \{2,5,1\} \\
\{a_{B1}, a_{B2}, a_{B3}\}_E &= \{3,1,4\}, \{w_1, w_2, w_3\}_E = \{2,4,1\} \\
\{a_{B1}, a_{B2}, a_{B3}\}_P &= \{2,1,3\}, \{w_1, w_2, w_3\}_P = \{2,3,1\}
\end{align*}
\]

To obtain the optimal weights, an optimization model is built. The optimization model is developed for criteria and all sub-criteria within a criterion. The optimization model for criteria referring the criteria’ BO – OW vectors indicated in equation (16) – (21).

\[
\min \xi \tag{16}
\]

Subject to:

\[
\begin{align*}
& w_M - 3w_E \leq \xi \\
& w_M - 4w_P \leq \xi \\
& w_E - 2w_P \leq \xi \\
& w_M + w_E + w_P = 1 \\
& w_M \geq 0, w_E \geq 0, w_P \geq 0
\end{align*}
\]

Three optimization models can be built in the same manner by referring to the BO – OW vector for sub-criteria within the criterion. Optimization models for criteria and sub-criteria are subsequently solved so that the optimal weights are obtained as shown in weighting vectors as follows:

\[
\begin{align*}
& w^C = \{w^M, w^E, w^P\} = \{0.628, 0.228, 0.143\} \\
& w^M = \{w^M_1, w^M_2, w^M_3\} = \{0.225, 0.650, 0.125\} \\
& w^E = \{w^E_1, w^E_2, w^E_3\} = \{0.228, 0.628, 0.143\} \\
& w^P = \{w^P_1, w^P_2, w^P_3\} = \{0.292, 0.542, 0.167\}
\end{align*}
\]

Lastly, global weights are calculated by multiplying criterion weight and each sub-criterion weight. For instance, the global weight for employee discipline (M1), employee loyalty (M2), and teamwork (M3) are obtained by multiplying the local weight of each sub-criterion and the employee morale (M) weight. This also applies to the sub-criteria E1 to E3 and P1 to P3. The final result for all optimal weights as shown in Table III.

It can be seen that the three criteria with the highest priority are employee loyalty (M2), responsibility (E2), and employee discipline (M1), with the weight of 0.409, 0.144, and 0.141, respectively. Meanwhile, job accuracy (P3) is the lowest criterion. It indicates that the organization considers employee morale (M) as the top priority since it is a fundamental factor for assessment. Although responsibility (E2) belongs to job effectiveness (E), some have opined that the factor can be defined as morale.

### Table II

**The Description for Each Evaluation Factor**

| Criteria          | Description                                      | Sub-criteria | Explanation                                      |
|-------------------|--------------------------------------------------|--------------|--------------------------------------------------|
| Employee Morale (M) | The attitudes of employees as individuals or groups in their working environment to carry out the job properly | Self-discipline (M1) | The ability of employees to comply with the company’s regulations |
|                   |                                                  | Employee loyalty (M2) | An employee’s act to bring full-consistent support to the company |
|                   |                                                  | Teamwork (M3) | The willingness and ability of employees to work in a team to complete the task |
| Job Effectiveness (E) | The ability to complete the right task according to the instructions | Comprehension (E1) | The level of employee’s understanding of the instructions given |
|                   |                                                  | Responsibility (E2) | The desire to complete the task correctly without transferring the task to other workers |
|                   |                                                  | Proactiveness (E3) | Understand what to do next to solve problems and create improvement |
| Job Productivity (P) | The ability of workers to produce results beyond the assigned task | Punctuality (P1) | The ability to complete the task on time |
|                   |                                                  | Result outputs (P2) | The ability to complete the task that meets results determined by the company |
|                   |                                                  | Job accuracy (P3) | Precision and accuracy in providing task results |

### Table III

**Final Weight of All Criteria Obtained Using BWM**

| Criteria          | Sub-criteria | Local Weight | Global Weight | Global Ranking |
|-------------------|--------------|--------------|---------------|----------------|
| Employee Morale   | M1           | 0.225        | 0.141         | 3              |
|                   | M2           | 0.650        | 0.409         | 1              |
|                   | M3           | 0.125        | 0.079         | 4              |
| Job Effectiveness | E1           | 0.229        | 0.052         | 6              |
|                   | E2           | 0.629        | 0.144         | 2              |
|                   | E3           | 0.143        | 0.033         | 8              |
| Job Productivity  | P1           | 0.292        | 0.042         | 7              |
|                   | P2           | 0.542        | 0.077         | 5              |
C. Ranking Employees

After optimal weights have been determined for all factors, the 15 employees in the metal casting division are evaluated. The initial performance scores are as follows:

| Factor | Employee 1 | Employee 2 | Employee 3 | Employee 4 | Employee 5 | Employee 6 | Employee 7 | Employee 8 | Employee 9 | Employee 10 | Employee 11 | Employee 12 | Employee 13 | Employee 14 | Employee 15 |
|--------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| GIY    | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   |
| PON    | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   |
| SUP    | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   |
| TRS    | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   | 8.5, 9.9   |

The initial performance scores for each employee are then normalized and weighted to provide a final ranking.

Table IV provides the employees' scores for every factor that have been extended to a fuzzy scale referring to Table I and the optimal weights for the nine factors obtained in Table III.
Then, the weighted normalized fuzzy evaluation matrix is calculated using equation (9). In Table V, the FPIS and FNIS values are also calculated for each factor's three fuzzy numbers. For instance, FPIS value for $M_1$ (0.127, 0.134, 0.141) where 0.127 is the maximum lower bound among all the $l$ values, and 0.141 is the maximum upper bound among all the $u$ values in $M_1$. The FNIS values are also obtained using the same principle as in FPIS, while the FNIS takes the minimum values.

Finally, the overall performance scores are computed using equation (13), in which the $CC_i$ value represents the weight of the $i$th factor. Table VI compares the final rank between two evaluation methods: employee evaluation delivered by the company or current evaluation system and the evaluation developed using the BWM – Fuzzy TOPSIS. Both methods apply the same initial performance data where the assessment is undertaken by the company compute score per factor to produce the total performance score.

It can be seen that there were significant differences between the current evaluation and the developed evaluation using MCDM. The evaluation system developed using BWM, and Fuzzy TOPSIS can rank accurately and precisely. A consistent result. In the current evaluation, some cases of high-performance employees were categorized into the low-performed group and otherwise. For instance, employee SLA was the 7th rank in developed evaluation, whereas in the current evaluation, it was placed 12th. Meanwhile, in the current system, employee SLA has the same performance value as employee GIY, 8.600, which in the developed environment, GIY was the 13th. Another example is that SUW and TRI, who were ranked 12th and 10th in the developed system were ranked 9th and 6th in the current system. Further, six employees in the current system are equivalent to the 9th and 6th ranks, including three employees with a value of 8.650 and three employees with a value of 8.700. This indicates that the assessment carried out by the company may be unfair for several employees. In this case, SUW and TRI are employees who benefit from the current system, whereas SLA receives a negative impact. In other words, the current assessment cannot represent the actual condition, and therefore it is irrelevant when used for deep human development purposes such as remuneration and retention. In contrast, this study's evaluation method enables to place employees appropriately in a real setting.

Despite the significant differences, particularly in a mid-level result, both methods show similar results for top and bottom groups. For instance, both methods produce the same results for the three employees with the highest performance score: AGI, PON, SRA, and the three employees with the lowest performance score, namely KAR, ANS, and GIY. This describes that regardless of the factor weight, these employees are assessed objectively based on the fundamental factors' performance. Meanwhile, the ambiguity of judgment will occur for employees placed in the secondary line-up who have slight

|     | $M_1$ | $M_2$ | $M_3$ | $E_1$ | $E_2$ | $E_3$ | $P_1$ | $P_2$ | $P_3$ |
|-----|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| TRI | 0.119 | 0.344 | 0.070 | 0.044 | 0.129 | 0.029 | 0.035 | 0.086 | 0.020 |
|     | 0.127 | 0.366 | 0.074 | 0.047 | 0.129 | 0.029 | 0.035 | 0.066 | 0.021 |
|     | 0.134 | 0.387 | 0.079 | 0.049 | 0.144 | 0.031 | 0.040 | 0.074 | 0.022 |
| USM | 0.119 | 0.366 | 0.070 | 0.044 | 0.129 | 0.024 | 0.035 | 0.066 | 0.021 |
|     | 0.127 | 0.387 | 0.074 | 0.047 | 0.136 | 0.026 | 0.038 | 0.070 | 0.022 |
|     | 0.134 | 0.409 | 0.079 | 0.049 | 0.144 | 0.028 | 0.040 | 0.074 | 0.024 |
| FPIS| 0.127 | 0.366 | 0.070 | 0.047 | 0.129 | 0.029 | 0.038 | 0.070 | 0.021 |
|     | 0.134 | 0.387 | 0.074 | 0.049 | 0.136 | 0.031 | 0.040 | 0.074 | 0.022 |
|     | 0.141 | 0.409 | 0.079 | 0.052 | 0.144 | 0.033 | 0.042 | 0.077 | 0.024 |
| FNIS| 0.112 | 0.301 | 0.062 | 0.038 | 0.129 | 0.023 | 0.035 | 0.066 | 0.020 |
|     | 0.119 | 0.323 | 0.066 | 0.041 | 0.136 | 0.024 | 0.038 | 0.070 | 0.021 |
|     | 0.127 | 0.344 | 0.070 | 0.044 | 0.144 | 0.026 | 0.040 | 0.074 | 0.022 |

GIY 0.061 0.049 0.447 13 8.600 12
KAR 0.085 0.024 0.221 14 8.200 15
MJI 0.042 0.068 0.617 11 8.650 9
MIS 0.018 0.082 0.839 5 8.700 6
PON 0.007 0.102 0.934 2 8.950 1
SRA 0.009 0.101 0.919 3 8.900 3
SLA 0.025 0.085 0.771 7 8.600 12
SUP 0.015 0.095 0.866 4 8.850 4
SUW 0.042 0.067 0.615 12 8.650 9
TAR 0.038 0.072 0.655 8 8.750 5
TRI 0.039 0.071 0.643 9 8.650 9
TRI 0.041 0.069 0.630 10 8.700 6
USM 0.021 0.089 0.608 6 8.700 6

The employee evaluation using MCDM approaches also presents the consistent result. In the current evaluation, some cases of high-performance employees were categorized into the low-performed group and otherwise. For instance, employee SLA was the 7th rank in developed evaluation, whereas in the current evaluation, it was placed 12th. Meanwhile, in the current system, employee SLA has the same performance value as employee GIY, 8.600, which in the developed environment, GIY was the 13th. Another example is that SUW and TRI, who were ranked 12th and 10th in the developed system were ranked 9th and 6th in the current system. Further, six employees in the current system are equivalent to the 9th and 6th ranks, including three employees with a value of 8.650 and three employees with a value of 8.700. This indicates that the assessment carried out by the company may be unfair for several employees. In this case, SUW and TRI are employees who benefit from the current system, whereas SLA receives a negative impact. In other words, the current assessment cannot represent the actual condition, and therefore it is irrelevant when used for deep human development purposes such as remuneration and retention. In contrast, this study's evaluation method enables to place employees appropriately in a real setting.

### Table VI

|     | BWM and F-TOPSIS | Current Ranks |
|-----|-----------------|---------------|
|     | d(+), d(-) | d(+), d(-) | CCI Rank | Score | Ranks |
| AGI | 0.007 | 0.103 | 0.938 | 1 | 8.950 | 1 |
|     | 0.087 | 0.023 | 0.211 | 15 | 8.450 | 14 |

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differences for each factor. Finally, the employee evaluation decision-making process developed in this study brings at least two considerable impacts to the manufacturer: (1) this method can evaluate employee performance more realistically, and (2) with the same dataset, this method results a more accurate evaluation in a more structured way.

IV. CONCLUSION

To conclude, this study encourages practitioners to consider MCDM in a large-scale employee evaluation, and for scholars, this study provides another integration of MCDM methods for further development. A hybrid MCDM on employee performance evaluation demonstrated through a case study can determine the criteria weight and rank employees more effectively. The BWM for determining criteria weights describes that the factors classified as employee morale (M) should be prioritized. The employee ranking using Fuzzy TOPSIS produces rigorous rank by taking into account the employees’ excellences profile.

Since this research has limitations, the sensitivity analysis can be added by inviting the DMs to change evaluation parameters with several scenarios. This will bring useful insights, especially for practitioners when dealing with a unique situation. Besides, the criteria weight computation can also be extended to a fuzzy set so that the weighted fuzzy evaluation matrix will be calculated using fuzzy weights and fuzzy scale for performance.

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