FUDMA Journal of Sciences (FJS)
ISSN online: 2616-1370
ISSN print: 2645 - 2944
Vol. 8 No. 3, June, (Special Issue) 2024, pp 169 - 177
DOI: https://doi.org/10.33003/fjs-2024-0803-2507

DEVELOPMENT OF SOFTWARE AGENT-BASED PERFORMANCE EVALUATION MODEL

[*1]Bako Sadauki, [2]Alimi Olasunkanmi Maruf and [1]Danlami Gabi

[1]Department of Computer Science, Faculty of Science, Kebbi State University of Science and Technology Aliero, Nigeria
[2]Department of Computer Science, Faculty of Computing, Air Force Institute of Technology, Kaduna Nigeria

*Corresponding authors' email: sadaukibako@gmail.com

ABSTRACT

Agent-based performance evaluation systems help an organisation's predetermined uniform appraisal score weights but have some deficiencies, like difficulty in simulation tests, amongst others. The purpose of this study is to design computer-based systems for the effective performance evaluation of employees in an organization. The regression model was applied, and the results reveal that employee appraisal elements "must be objectives" and "tools for development" have a statistically significant positive influence on performance evaluation. This implies that an increase in "must-be objectives" and "tools for development" will correspondingly lead to an improvement in performance evaluation. Besides, the Artificial Neural Network (ANN) outperformed the other computer-based systems as it had an error bias of negligible value of 0.001. Meanwhile, in comparing the empirical data analysis results to the simulation, it is observed that the estimated parameter values of the regression model align with the findings, hence enhancing the precision of the model in achieving a steady state of the Ordinary Differential Equation (ODE). Additionally, the computer-based models are a good fit for the data, and the introduction of the three models shows better precision for performance evaluation in an organization. Therefore, the organisation should equip itself with the required knowledge base in computer-based systems to connect the real-life situation of predicting effective and unbiased performance evaluation.

Keywords: Agent-Based Performance Evaluation, Computer-Based Systems, ANN, Simulation

INTRODUCTION

The primary purpose of assessment is to acknowledge and incentivize employees who demonstrate exceptional performance, identify areas in need of improvement for both individual staff members and the organization as a whole, and offer recommendations in cases where staff negligence cannot be resolved (Mone et al., 2018). Despite the compelling reasons that should motivate organizations to establish an assessment system, it has been observed that many organizations undermine the effectiveness of such systems due to excessive human interpretations and biases. Many individuals refrain from installing these performance systems as a result of financial constraints. Deficits in certain organizations' performance processes often compromise the effectiveness of performance evaluations. These deficiencies encompass a lack of credibility, a lack of clarity on the specific aspects of the evaluated work, and the absence of standardized criteria for measuring performance (Markus et al., 2021). According to El-Haj et al. (2019), the performance evaluation process in many organizations tends to exhibit biases, rely on manual methods, lack clarity, and suffer from incompleteness. Many organizations lack intelligent mechanisms for evaluating their workers, resulting in the use of manual processes that introduce subjectivity into the appraisal process (Sewell and Wilkinson, 2019). A study of prominent American organizations revealed that 40% of managers admitted to falsifying or manipulating performance data.

Gordon (2016) attributed this behavior to their perception that the evaluation process lacked meaningful value due to flawed management within their respective organizations. It is critical to implement an appraisal system that effectively monitors and evaluates individual employees' targets, accomplishments, and projects. Without such a system in place, the appraisal process relies heavily on subjective human judgment and personal attributes when assessing staff performance. The evaluation of an employee involves determining a score that accurately reflects their performance level for each quality, rather than solely focusing on their competence and task accomplishments. Automation of the procedure is necessary. The fulfillment of job responsibilities and the effective execution of those responsibilities primarily determine employee performance. Managers conduct periodic evaluations of their employees' performance, typically on an annual or quarterly basis, to facilitate the identification and recommendation of areas for improvement (Bojang, 2023). A proficient appraisal and performance system should include consistent feedback that clarifies employees' strengths and areas for improvement, enabling the development of suitable support strategies and facilitating decision-making on issues like compensation and recommendations (Shet et al., 2019). As a result, the assessment of performance, commonly referred to as performance evaluation (PE), plays a crucial role in improving job output, fostering motivation among employees, and increasing their level of involvement. Performance evaluation (PE) also provides a basis for increasing monthly compensation and assists organizations in formulating employee succession and promotion strategies (Najam Ul Hassan and Siddiqui, 2020).

Numerous studies have explored different agent-based performance evaluation methods for assessing employee appraisals within organizations (Abar et al., 2017; Coakley et al., 2012; Macal & North, 2009). Gbadebo and Adebayo (2017) proposed a model for an agent-based performance evaluation system that utilizes an organization's predetermined uniform appraisal score weights. This system's design entails managing staff-work information and automating the scoring process. The study created the prototype of the suggested concept using the NetBeans IDE, Hypertext Markup Language (HTML), MySQL, the MySQL DB connection, Apache, and PhpMyAdmin. The study simulated and executed the prototype of the suggested system to demonstrate its accuracy and effectiveness in eliminating

bias through automated and intelligent staff information collection. However, this particular study aims to enhance the existing literature by incorporating a data-driven computer-based system, specifically simulation, regression, and artificial neural network (ANN) models. This integration will not only allow for employee review and feedback but will also facilitate the connection between reality and the existing gaps identified in previous studies that did not introduce all three computer-based systems in performance evaluation. Consequently, this research will contribute significantly to the current body of knowledge in the field of computer science.

Computer-based applications designed to manage employee appraisals are susceptible to human biases due to the involvement of employers and managers in various aspects of the appraisal process. These include assigning scores, reviewing feedback reports, and transmitting them to employees, among other responsibilities. The imperative to eliminate bias and prevent the unfair denial of advancement opportunities for employees necessitates the implementation of an intelligent performance evaluation system, as well as eliminating the difficulty encountered in simulation tests in previous studies (Obunadike et al., 2018). This study introduced Python programming and SPSS software as enhanced computer-based systems, which have proven to enable predictive modelling over the years (Adebanjo et al., 2023). The Python programming language excels in simulating, developing predictive models, and visualizing the shortcomings of agent-based models. This is especially true in simulation tests and predictive models that face challenges. Therefore, this study significantly contributes by integrating predictive modelling techniques such as artificial neural networks (ANN), regression, and simulation. This integrated approach enables effective performance evaluation through a questionnaire survey, connecting real-life situations beyond mere simulation. Consequently, this study aims to develop a simulation-based regression model using Python programming and SPSS agent software to evaluate organisational performance. The study uses these computer-based tools to reduce bias in employee appraisals and guarantee merit-based promotion awards.

MATERIALS AND METHODS

This section is a research methodology that adopts a systematic approach that covers the research philosophy, research approach, methodological choices, research strategy, approach to system development, implementation decisions, and models.

Research Philosophy

A data-driven computer-based approach requires a practical philosophy. This is essential in this research design to provide a realistic solution to the problem identified and satisfy the research objectives. Research philosophy is the understanding of how information about a topic is obtained, presented, and examined to yield insightful information. Pragmatism research philosophy is adopted in this study because it provides a critical investigation of the issue associated with effective performance evaluation of employees in an organization and also finds a solution to the identified issue. It reflects the researchers' presumptions and has an impact on the study methodologies they use. It offers general guidelines for designing, carrying out, analysing, and interpreting research projects and their results to gain an understanding of reality.

Research Approach

This study is more appropriate for the design of the computer-based models suitable to enhance effective performance evaluation of employees in an organization. It is therefore ethical to regard this study as abductive because it focuses on the reasoning method in which descriptions of a real-life incident are created and frequentative tested moving frequently between the existing literature and real-world evidence.

Methodological Choices

This study adopts a mixed method because it combines elements of qualitative and quantitative research to answer the research question. The qualitative approach is the questionnaire dissemination to investigate the effective appraisal performance evaluation of employee appraisal in an organization while the quantitative method will be used for the analysis of the data collected through investigation to determine the application of the computer-based system for effective performance appraisal via relevant stakeholders.

Research Strategy

A survey research study approach is adopted in this research study which is justified by thorough evaluation of the existing models with the engagement of the relevant stakeholders like the experienced senior managers, employees in computing department and employers of an organization in Nigeria. The stakeholder responses which represent their experience will be employed for the analysis of this project.

Approach to System Development

The approach to the system development of this project is agile methodology because it breaks the process into the phases of planning (such as the introduction, research questions, objectives and review of related literature), execution stages which includes the data collection process, analysis and discussion and the user's evaluation to satisfy this project deliverable.

Sample Size Determination, Data Collection and Analysis

A sample size of 400 was found using the formula for calculating the minimal sample size required to estimate a population proportion, assuming random sampling from a sufficiently big population: $n = P(1 - P) Z^2/d^2$

Where Z is the Z-tabulated at 95% confidence from Z-table = 1.96, P = 0.5, and d = 0.05.

Substituting the value into the formula, we have n = 384. Therefore, to have better precision, the sample size was increased by administering 420 questions to the target stakeholders such as experienced senior managers, employees and employers of an organization in Nigeria using a purposive sampling technique and 400 of the completed questionnaires were returned within a designated period of 50 days.

The primary data gathered using the survey questionnaire to randomly chosen stakeholders without bias or coercion according to the ethical culture of research in this study were analysed using quantitative research methods like simulation, regression and ANN models. The measurement method used to assess the respondents' responses is the 5-Likert scale, on which 1 indicates strongly disagree, 2 indicates disagree, 3 indicates neutrality, 4 indicates agreement, and 5 indicates strongly agree. The reliability of the survey instruments will also be carried out using Cronbach's alpha and the validity of the construct items to ascertain it measures what it is designed to measure.

Implementation Decision
The implementation decision entails the tools and techniques adopted for this research study.

Tools and Techniques (Justification)
Computer-based applications designed to manage employee appraisals are susceptible to human biases due to the involvement of employers and managers in various aspects of the appraisal process. These include assigning scores, reviewing feedback reports, and transmitting them to employees, among other responsibilities. The imperative to eliminate bias and prevent the unfair denial of advancement opportunities for employees necessitates the implementation of an intelligent performance evaluation system. This study introduced Python programming and SPSS software as enhanced computer-based systems, which have proven to enable predictive modelling over the years. Computer-based models such as simulation, regression and ANN were applied in this study to predict the effective performance evaluation of employee appraisals in an organization. Python programming and SPSS software were the agent-based tools used in this study. The Python programming language is considered appropriate for the application of simulation models and the visualisation of datasets because of the structures, libraries, and easy-learning syntax that make it unique in data science compared to the R language, which has more complex syntax and is not a moderately user-friendly tool. We also enhanced this project by using SPSS software to fit ANN and regression models to the study.

Models
This section presents the specifications of the models applied in this study.

Computer-Based Operationalized Model
The regression model can be represented mathematically as follow.

$$Y = \beta_0 + \beta_1 CAP + \beta_2 MBO + \beta_3 STR + \beta_4 TFD + \beta_5 EF + \beta_6 AP + \mu \quad (1)$$

Where Y is the dependent variable = Performance evaluation (PE) and the independent variables are stated as follows:
X1: A clear appraisal process (CAP)
X2: The standard must be objectives (MBO)
X3: The appraisal should be subject to a review (STR)
X4: The appraisal must be a tool for development (TFD)
X5: The appraisal must give room for employee feedback (EF)
X6: The appraisal should be an action plan (AP)
The β_0 is the intercept or the constant term and β_1 to β_6 are the coefficient estimate of the independent variables. The μ is the error term that takes care of the all-unaccounted factors in the model while t is the given period in days.
The model coefficient of determination (R-squared), R^2 is a measure of the variability in the outcome or dependent variable explained by the predictor variables. R^2 is help to determine the adequacy of the model and also suggest the suitability of the regressors or predictor variables.

Simulation Model
The simulation as shown in figure 3.1 is simply the imitation of real-life process or operation over a period of time and the regression model can be simulated using the ordinary differential equation (ODE) as follow:

$$\frac{dPE}{dt} = \alpha 0 + \alpha 1 CAP + \alpha 2 MBO + \alpha 3 STR + \alpha 4 TFD + \alpha 5 EF + \alpha 6 AP \quad (2)$$

Therefore, there's a need to apply partial differential equation using python programming to estimate the parameters of the model since it is more than one independent variable according to Li (2021).

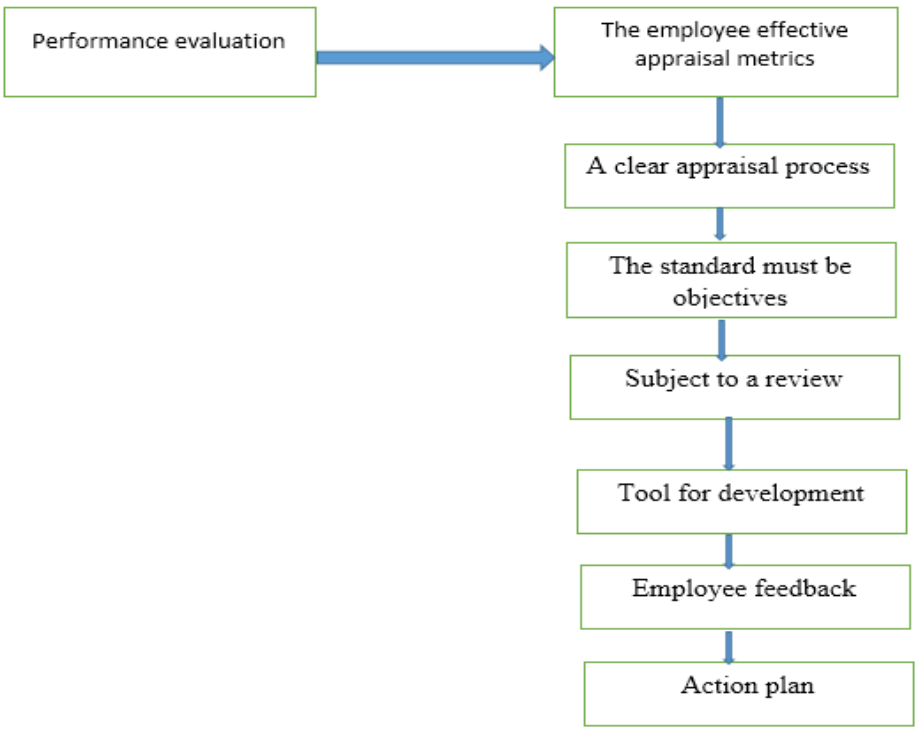

Figure 1: The Model Structure

Figure 1 illustrated the constitutes such as the dependent variable, like performance evaluation and independent variables such as the appraisal elements which includes a clear appraisal process, the standard must be objectives, the appraisal should be subject to a review, the appraisal must be a tool for development, the appraisal must give room for employee feedback, and the appraisal should be an action plan.

Artificial Neural Network (ANN)

This study employs data-driven computer-based system to model performance evaluation by utilizing an artificial neural network. This approach is a pragmatic methodology that effectively models the input variables, the two hidden layers, and the output variable, which pertains to performance evaluation. In this particular scenario, the utilization of an artificial neural network for the purpose of determining or predicting performance evaluation of employee's appraisal in an organization is highly suitable. In addition to serving as an alternative to regression analysis, it is regarded as a superior tool for the purpose of predictive analytics.

The independent variables, their corresponding weights, and the intercept term for each neuron are combined linearly to form the equation for the neural network. This is how the neural network equation appears:

$Z = B_o + B_1X_1 + B_2X_2 + \ldots + B_nX_n \ldots\ldots\ldots\ldots$ (3)

Where Z is the output variable of ANN model.

B_i, are the weights or the beta coefficients

X_i, are the independent variables or the inputs, and

Intercept = B_0

Usually in practice, there are three steps to perform in any artificial neural network:

i. We take the input variables and the above linear combination equation of $Z = B_0 + B_1X_1 + B_2X_2 + \ldots + B_nX_n$ to compute the output or the predicted Y values, called the Y_{pred}.
ii. Calculate the loss or the error term. The error term is the deviation of the actual values from the predicted values.
iii. Minimize the loss function or the error term.

Performance Evaluation Metrics

Metrics for performance evaluation are crucial for determining how well predictive models like simulation, regression, and artificial neural networks (ANN) predict performance outcomes and how accurate they are.

The Mean Squared Error (MSE), which measures the average squared difference between the target variable's actual and forecasted values, is one commonly used in statistic. Better predictive performance is indicated by lower MSE values, which serve as a gauge of the model's accuracy. Researchers can ascertain the relative efficacy of each model in capturing the underlying patterns and dynamics of performance evaluation by comparing MSE values across various models and scenarios. Furthermore, MSE makes it possible to compare the performance of the model over time or between other datasets, which helps researchers find areas for development and improve their predictive models for increased precision and dependability when evaluating employee performance in organisational settings.

Beta is a performance evaluation metrics for examination of the appraisal elements on performance.

Standard Error indicates the error margin.

Sig. (Significance) is the probability value that indicate the elements that contribute significantly to performance.

RESULTS AND DISCUSSION

Simulation Results

Table 1: Model Parameter Values in Simulation

Variables	Simulation Model parameters	Parameter estimate
Performance evaluation		
Clear appraisal process	α1	-0.03
Must be objectives	α2	0.15
Subject to a review	α3	0.02
Tool for development	α4	0.14
Employee feedback	α5	0.17
Action plan	α6	-0.05

Source: Author's computation via Python programming language

Table 1 shows that for a unit increase in the clear appraisal process and action plan, the performance evaluation will decline by 0.03 and 0.05 respectively. More so, for a unit increase in the "Must be objectives", "Subject to a review", "Tool for development" and" Employee feedback", there will be a corresponding increase or rise in the evaluation performance by 0.15, 0.02, 0.14 and 0.17 respectively.

Figure 1 shows the response of the performance evaluation to the period (t) of the coefficient of "Clear appraisal process" (α1) and the other independent variables such as "Must be objectives" (α2), the "Subject to a review" (α3), the "Tool for development" (α4), the "Employee feedback" (α5) and the "Action plan" (α6) converging around 0.5 which satisfies the steady state of the ordinary differential equation (ODE) and this also suggest that the simulation of the parameter estimate values is valid.

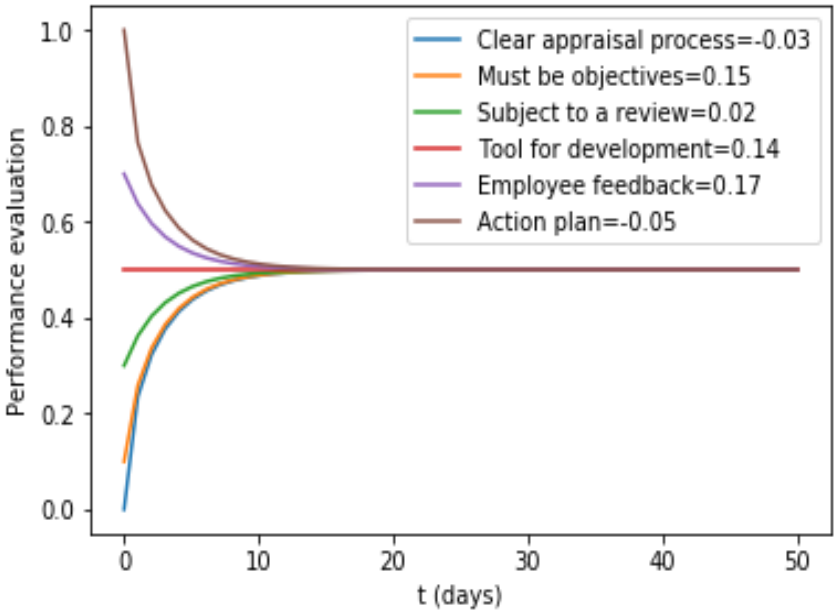

Figure 2: Simulation Graph

Table 2: Regression Model Estimate

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	.046	.602		.076	.939
	Clear appraisal process	-.029	.176	-.035	-.163	.871
	Must be objectives	.218	.042	.259	5.173	.000
	Subject to a review	.015	.030	.017	.511	.609
	Tool for development	.541	.043	.554	12.595	.000
	Employee feedback	.192	.177	.191	1.081	.280
	Action plan	-.040	.115	-.036	-.353	.725
	Overall model	P = 0.000, R-squared = 0.641	Mean square error (MSE) =3.76			

Source: Author's computation using SPSS Software version 26.

Table 2 presents the coefficient estimate for the employee appraisal elements of "must be objectives" and "tool for development," indicating a statistically significant positive influence on performance evaluation. This implies that an increase in "must be objectives" and "tool for development" will correspondingly lead to an improvement in performance evaluation. The regression model as a whole has statistical significance, indicating a notable linear association between performance evaluation and the variables of employee appraisal. This finding implies that the model demonstrates a strong alignment with the data, indicating its appropriateness for predicting future performance evaluations of employee appraisals in an organization.

Moreover, the coefficient of determination, denoted as R-squared, is equal to 0.641. This value signifies that about 64.1% of the variability observed in performance evaluation can be explained by the employee appraisal elements. Additionally, the R-squared value beyond 60% suggests that the regression model employed is adequate.

Table 3: Artificial Neural Network (ANN)
Independent Variable Importance

	Importance	Normalized Importance
Clear appraisal process	0.135	53.4%
Must be objectives	0.133	52.7%
Subject to a review	0.135	53.6%
Tool for development	0.252	100.0%
Employee feedback	0.189	75.0%
Action plan	0.155	61.4%
Error rate	0.001	

Case Processing Summary

		N	Percent
Sample	Training	271	67.8%
	Testing	129	32.3%
Valid		400	100.0%
Excluded		0	
Total		400	

Table 3 demonstrates the estimate of the ANN model and it reveals the contributions of the employee appraisal elements to performance evaluation which indicates that the tool for development demonstrated the highest contribution with 100% importance, followed by the employee feedback with 75% importance. Comparing the three computer-based models, it is apparent that the tool for development shows a positive contribution in all and this indicates a high level of precision with the integration of the three models. The error bias of ANN is minimal with a value of 0.001 compared with the regression mean square error of 3.76 which implies that ANN outperformed the regression model. The training test sample of the ANN is 67.8% which is above the testing and this is ideal as the training dataset is expected to be above the testing.

Figure 3 demonstrates the contribution of the employee appraisal elements to their normalized importance.

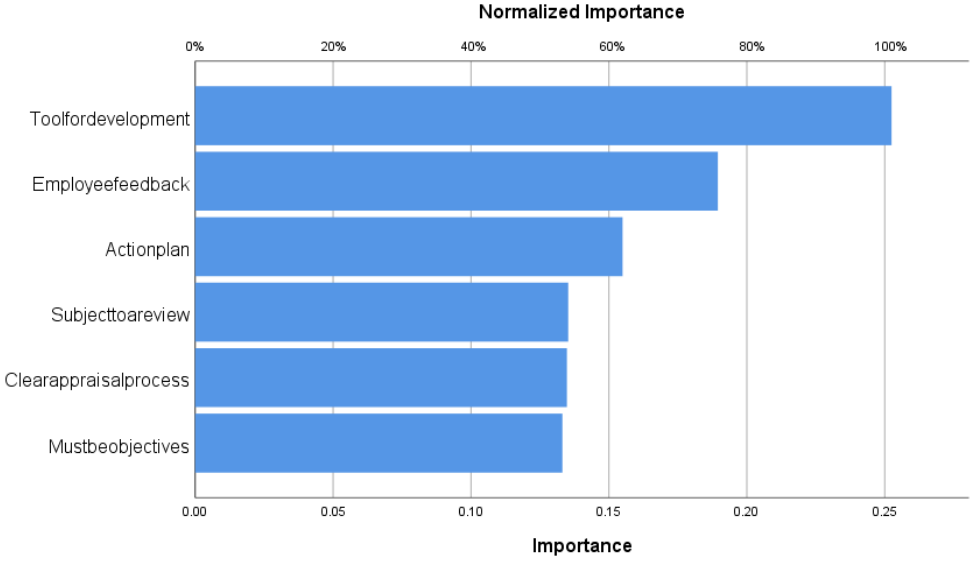

Figure 3: Independent variables contribution Plot of the ANN

Figure 4 demonstrated the interaction activity or interconnectivity between the performance evaluation and employee appraisal metrics. Therefore, the tool for development indicates the highest clustering activities among the other employee appraisal metrics.

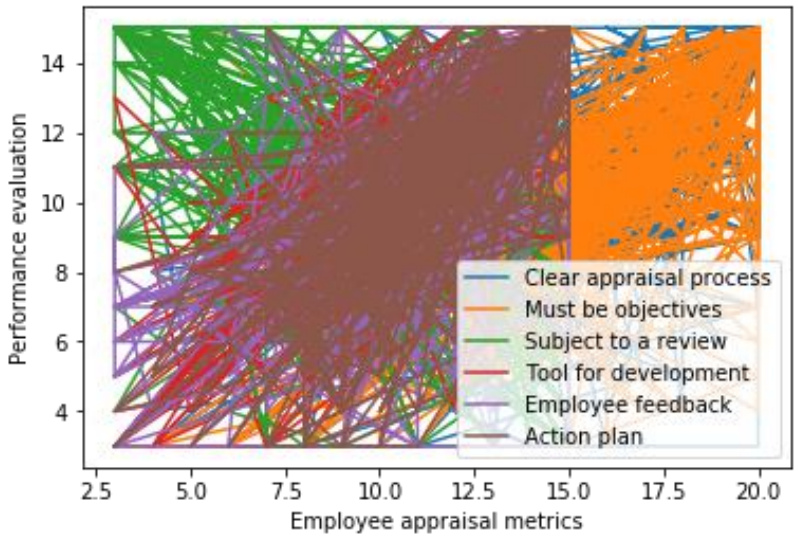

Figure 4: Visualization of the interactive activity between the performance evaluation and employee appraisal metrics.

Evaluation

Table 4: Reliability Test Using Cronbach's Alpha

Variables	Alpha	No of Items
Clear appraisal process (CAP)	**0.905**	**4**
The appraisal process should not be bias		
It should be transparent		
Employee training should be incorporated		
The process should reward employee that merit it		
Must be objectives (MBO)	**0.837**	**4**
The objective should be well defined		
It should be reviewed		
Employee should be sensitized to uphold the value		
The process should be applied for organization growth		
Subject to a review (STR)	**0.799**	**3**
The review should be continuous		
The process should be reviewed without bias		
It should give room for improvement		
Tool for development (TFD)	**0.889**	**3**
It should instigate employee skill development		
It should be a means for learning and development		
Employee training should be encouraged		
Employee feedback (EF)	**0.915**	**3**
Employee feedback promote the organization value		
It indicates need for necessary improvement		
Assess the growth of the organization		
Action plan (AP)	**0.768**	**3**
The appraisal should provide reliable AP		
It should be trustworthy		
It should be real		
Performance evaluation (PE)	**0.913**	**3**
It evaluates employee appraisal		
It guarantees reflection of true process		
It is adequate for employee improvement		

Source: Author's computation using SPSS software

Table 4 shows the reliability test using Cronbach's Alpha and the result indicates a high level of internal consistency as the Alpha value for each of the variables is above the 0.6 threshold and this suggests that the research instrument for the data collection of the items that constitute performance evaluation of the employee appraisal element or metrics is good.

Table 5: Evaluation of computer-based systems for effective performance appraisal via relevant stakeholder

The computer-based systems implemented performed well			
		Frequency	**Percent**
	Strongly disagree	17	4.3
	Disagree	17	4.3
	Neutral	21	5.3
	Agree	22	5.5
	Strongly agree	323	80.8
The computer-based systems prediction of the performance evaluation is accurate and reliable			
	Strongly disagree	5	1.3
	Disagree	5	1.3
	Neutral	25	6.3
	Agree	40	10.0
	Strongly agree	325	81.3
The integration of the computer-based systems demonstrated a high level of precision			
	Strongly disagree	25	6.3
	Disagree	21	5.3
	Neutral	37	9.3
	Agree	15	3.8
	Strongly agree	302	75.5

Source: Author's computation using SPSS software

Table 5 shows the user's evaluation of computer-based systems for effective performance appraisal via relevant stakeholders which reveal that 323 representing 80.8% of the target stakeholders based on their experience strongly agree that the computer-based systems implemented performed well which represents the majority. Table 5 also shows that 325 representing 81.3% of the targeted stakeholders strongly agree that the computer-based systems prediction of the performance evaluation is accurate and reliable and it also reveals that 302 representing 75.5% of the targeted stakeholders strongly agree that the integration of the computer-based systems demonstrated a high level of precision which also represent the majority.

Discussion

Table 1 illustrates that a one-unit rise in both the clear appraisal process and action plan is associated with a decrease in performance evaluation by 0.03 and 0.05, respectively. Furthermore, it can be observed that an increase of one unit in the variables "must be objectives," "subject to a review", "tool for development", and "employee feedback" is associated with an increase in evaluation performance by 0.15, 0.02, 0.14, and 0.17, respectively.

Figure 2 displays the relationship between the performance evaluation response and the coefficient of the "clear appraisal process" (α1), as well as other independent variables including "must be objectives" (α2), "subject to a review" (α3), "tool for development" (α4), "employee feedback" (α5), and "action plan" (α6). The convergence of these variables around 0.5 indicates that the steady state of the ordinary differential equation (ODE) is satisfied. This observation further supports the validity of the simulated parameter estimate values.

The coefficient estimates for the employee assessment elements "must be objectives" and "tool for development" is presented in Table 2. The results indicate a statistically significant beneficial influence on performance evaluation. This suggests that a rise in the emphasis on "must-be objectives" and the recognition of performance evaluation as a "tool for development" will result in a proportional enhancement in performance evaluation. The whole regression model has statistical significance, suggesting a significant linear relationship between performance evaluation and employee appraisal variables. The aforementioned discovery suggests that the model has a strong correlation with the data, indicating its suitability for forecasting future performance evaluations of employee appraisals within an organization.

In addition, the coefficient of determination, commonly represented as R-squared, has a value of 0.641. The aforementioned value indicates that approximately 64.1% of the variance observed in performance evaluation may be accounted for by the factors of employee appraisal. Moreover, the R-squared value exceeding 60% indicates that the utilized regression model is satisfactory.

Table 3 presents the estimated results of the Artificial Neural Network (ANN) model, illustrating the impact of various employee appraisal elements on performance evaluation. The findings indicate that the development tool has the highest contribution, with a significant importance score of 100%. Employee feedback follows, showcasing a significant importance score of 75%. Upon comparing the three computer-based models, it becomes evident that the tool for development exhibits a favorable impact across all aspects, indicating a notable level of accuracy in the integration of these three models. The error bias of the artificial neural network (ANN) has a negligible value of 0.001, but the mean square error of the regression model is 3.76. This discrepancy suggests that the ANN demonstrates superior performance compared to the regression model.

When comparing the results of the empirical data analysis with the simulation, we observe that the estimated parameter values of the regression model match the findings of the simulation model parameters, thereby improving the model's precision in achieving a steady state of the ordinary differential equation (ODE). Figure 4 illustrates the correlation and interdependence between performance evaluation and employee appraisal metrics. It shows that the instrument for development exhibits the most prominent clustering activity compared to other employee appraisal indicators. Table 5 presents the user's assessment of computer-based systems for facilitating effective performance appraisal as perceived by relevant stakeholders. The findings indicate that out of the total target stakeholders, 323 individuals, accounting for 80.8% of the sample, strongly agreed that the implemented computer-based systems performed satisfactorily. This indicates a majority consensus among the stakeholders. According to Table 5, a significant majority of the targeted stakeholders (325 individuals, or 81.3%) strongly agree that the computer-based systems' prediction of performance evaluation is both accurate and reliable. Additionally, a majority of the targeted stakeholders (302 individuals, or 75.5%) strongly agree that the integration of computer-based systems exhibits a high level of precision. This also outperformed the agent-based performance evaluation system in Gbadebo and Adebayo (2017), which aligns with the justification that computer-based applications designed to manage employee appraisals are susceptible to human biases due to the involvement of employers and managers in various aspects of the appraisal process. These include assigning scores, reviewing feedback reports, and transmitting them to employees, among other responsibilities. The imperative to eliminate bias and prevent the unfair denial of advancement opportunities for employees necessitates the implementation of an intelligent performance evaluation system that conforms to the criticism in the work of El-Haj et al. (2019).

CONCLUSION

The overall conclusion is that the introduction of the three models (such as simulation, regression, and Artificial Neural Network) provides better precision for an organization's performance evaluation. The artificial neural network (ANN) and regression modes are therefore computer-based models that incorporate information with accuracy and certainty that connects the real-life situation, which contributes greatly by bridging the gap in the literature regarding the difficulties encountered in the simulation tests and other biased agent-based performance systems adopted in the previous studies.

REFERENCES

Abar, S., Theodoropoulos, G.K., Lemarinier, P., O'Hare, G.M.P. (2017). Agent based modelling and simulation tools: a review of the state-of-art software. Comput Sci Rev, 24:13–33

Adebanjo, S.A., & Banchani, E. (2023). Application of Different Python Libraries for Visualisation of Female Genital Mutilation. International Journal of Data Science, 4(2):67-83. https://doi.org/10.18517/ijods.4.2.67-83.2023

Bojang, S. (2023). *The Implementation of SMART plan Performance management system to improve human resource performance: obstacles and challenges (A case study of*

InSIST Global) (Bachelor's thesis, FAKULTAS EKONOMI DAN BISNIS UIN JAKARTA). https://repository.uinjkt.ac.id/dspace/bitstream/123456789/72726/1/11190810000146_SAFFIATOU%20BOJANG.pdf

Coakley, S., Gheorghe, M., Holcombe, M., Chin, S., Worth, D., & Greenough, C. (2012). Exploitation of high-performance computing in the FLAME agent-based simulation framework, high performance computing and communication 2012. In: IEEE 9th International Conference on Embedded Software and Systems (HPCC-ICESS), 583–545.

El-Haj, M., Rayson, P., Walker, M., Young, S., & Simaki, V. (2019). In search of meaning: Lessons, resources and next steps for computational analysis of financial discourse. *Journal of Business Finance & Accounting*, *46*(3-4), 265-306. https://onlinelibrary.wiley.com/doi/full/10.1111/jbfa.12378

Gbadebo, A.O., & Adebayo, A.O. (2017). An Agent-Based Performance Evaluation sytem. International Journal of computer, 27(1):28-38. https://ijcjournal.org/index.php/InternationalJournalOfComputer/article/view/1041/462

Gordon, S. (2016). Leveraging information technology for effective performance appraisal in the Nigerian public service. SDMIMD Journal of Management, 7(2), 21-38. https://www.researchgate.net/publication/309519087_Leveraging_Information_Technology_for_Effective_Performance_Appraisal_in_the_Nigerian_Public_Service

Markus, A. F., Kors, J. A., & Rijnbeek, P. R. (2021). The role of explainability in creating trustworthy artificial intelligence for health care: a comprehensive survey of the terminology, design choices, and evaluation strategies. *Journal of biomedical informatics*, *113*, 103655. https://www.sciencedirect.com/science/article/pii/S1532046420302835

Macal, C.M., & North, M.J. (2009) Agent-based modeling and simulation. In: Proceedings of the 2009 Winter Simulation Conference (WSC), 86–98.

Mone E., London M., & Mone E. M. (2018). *Employee engagement through effective performance management: A practical guide for managers*. Routledge. https://doi.org/10.4324/9781315626529

Najam Ul Hassan, S., & Siddiqui, D. A. (2020). Impact of effective succession planning practices on employee retention: exploring the mediating roles. https://doi.org/10.2139/ssrn.3556924

Obunadike, G.N., Chukwuchebe, O.H., & Dima, R.M. (2018). SIMULATION BASED APPRAISAL STUDY OF OSPF AND EIGRP FOR EFFECTIVE COMMUNICATION NETWORK. FUDMA Journal of Sciences 2(1):89-98

Shet, S. V., Patil, S. V., & Chandawarkar, M. R. (2019). Competency based superior performance and organizational effectiveness. *International Journal of Productivity and Performance Management*, *68*(4), 753-773. https://doi.org/10.1108/IJPPM-03-2018-0128