RESEARCH ARTICLE

PREDICTION of WORKER MOTIVATION with ARTIFICIAL NEURAL NETWORKS and LINEAR MODELING

Akın ERDEMİR[1], Fatih SEYRAN[2*], Tuğrul BATIRER[3]

[1]Suleyman Demirel University Hospital, Isparta, akinerdemir@sdu.edu.tr, ORCID: 0000-0001-9884-6135
[2*]Ministry of Health General Directorate of Management Services, Ankara, fatihseyran@gmail.com,
ORCID: 0000-0001-8546-11458
[3]Ministry of Health Sincan Oral and Dental Health Center, Ankara, tugrulbatirer@gmail.com, ORCID: 0000-0003-0453-159X

ABSTRACT

Organizational justice is a motivation tool that can produce positive results for the organization and employees in working life. The decrease in the perception of justice can cause moral disorders of the employees, may lead them to leave the organization and even to engage in negative behaviors towards the organization. This study was carried out to determine the effect of organizational justice perceived by employees on employee motivation and to predict organizational justice and motivation. The research was carried out with 294 participants working in public institutions serving in Isparta. Firstly, multiple regression analysis was conducted to test the effect of organizational justice on employee motivation. Within the scope of the study, linear modeling and artificial neural networks (ANN) models were also compared in order to contribute to the literature. Multiple regression analysis results showed that interactional and distributive justice had a significant and direct effect on motivation. In addition, it was determined that the highest predictive power was ANN ($R^2 = 0.88$) according to motivation models. As a result of the study, the predictability of the organizational justice phenomenon perceived by the employees and the motivation of the employee has emerged.

Keywords: *Artificial Neural Networks, Employee Motivation, Organizational Justice, Organizational Management*

1. INTRODUCTION

In general, individuals evaluate whether all events around them are fair and react differently when faced with injustice. One of the most important environments in which the idea of justice is evaluated is workplaces where people spend most of their time [1]. At the same time, one of the places where the existence of justice is questioned most is workplaces.

Organizational justice is the sum of transactions and practices among individuals that reveal how rewards and punishments are given to employees in the organization, how they are distributed and

how these decisions are made [2,3]. In a broad sense, organizational justice is the perception of justice in the minds of employees regarding organizational practices In this context, employees are in search of justice on the axis of differentiation, cognition and externality [4].

Studies on organizational justice begin with Adams (1963)'s theory of equality. According to this theory, the achievements and satisfaction levels of the employees are related to the perceived equality or inequality in the workplace [5]. Equity theory includes the benefits of human resources to the organization and the gains they get from the organization [6]. According to the theory; equality is the employee's belief that he or she is treated fairly compared to other employees, while inequality is the employee's belief that he or she is not treated fairly compared to other employees. According to Adams (1963), the employees in the organization compare the gains they have achieved within the organization with the gains obtained by the employees working in different organizations and in the same position. As a result, they develop an attitude towards the managers of the organization and their work. This is about how the employee perceives the climate of justice within the organization [7].

Organizational justice is a motivational tool with valuable results for both the organization and the employees. The decrease in the perception of justice can lead to moral disorders in the employees and may push the employees to leave the organization and even to engage in negative behaviors related to the organization [8,9]. Positive results regarding its motivational effects in working life focused on informational justice as well as interpersonal justice. In this context, it is seen how important organizational justice is in order to ensure the processes of sustainable motivation in employees [4]. The decrease in the perception of justice can lead to moral disorders in the employees and may push the employees to leave the organization and even to engage in negative behaviors related to the organization Directing the effort of the members of the organization to achieve organizational goals and thus transforming them into performance is important in terms of organizational effectiveness and efficiency [10]. Therefore, managers who will control the process with the help of various incentive tools according to the personality traits of the members of the organization also play an important role in work motivation [11].

Studies in the literature to determine the motivation of employees have focused on causality. Especially in these studies conducted in recent years, many analyzes have been put forward on the main factors and relationships that affect employee motivation in general [12-16]. However, in an area where employee motivation is so important, it is necessary to go beyond the retrospective examination of causality and relational dimensions after this situation has arisen. In this context; in addition to the factors affecting employee motivation, a newer approach may be to predict the new situation that may arise as a result of these factors.

This research was conducted to predict the justice and motivation by determining the effect of organizational justice perceived by employees on employee motivation. In this context, it is of great importance to estimate the density of the concepts mentioned as a result of the findings to be obtained. Because planning made in this way can save time, effort and financial resources, especially for organizations.

2. MATERIAL and METHOD

The population of the research consists of the employees of public institutions serving in Isparta. 350 volunteers to participate in the research were selected as a sample and the questionnaire was applied in the period of September-November 2019. 56 of them were not evaluated due to incomplete filling and 294 of the collected questionnaires were analysed. The organizational justice scale [17] developed by Colquitt (2001) and the motivation scale [18] developed by Özdaşlı and Akman (2012) were used in the research.

Three dimensions of organizational justice perception in the research; Perceptions of procedural justice, interactional justice and distributive justice are independent variables, employee motivation is the dependent variable of the research. While creating the variables, the data that will enter the analysis were obtained by taking the averages of the questions related to motivation (22 items), procedural justice (7 items), interactional justice (9 items) and distributive justice (4 items) based on the cumulative totals.

Normality tests were carried out to decide which analysis types to use within the scope of the research, and the relevant results are given in Table 1. According to Sposito et al., (1983), skewness and kurtosis values are between +3 and -3, indicating that the data are normally distributed [19]. Based on this information in the literature, the normal distribution of the data was determined for all subscales [20]. The findings were evaluated at the 95% confidence interval and at the 5% significance level.

Table 1. Normality test results.

Variables	Skewness	Kurtosis
Motivation	0,067	-0,992
Interpersonal justice	0,238	0,142
Procedural justice	0,714	0,745
Distributive justice	0,533	-0,094

3. RESULTS and DISCUSSION

3.1. Linear Modeling

In the first part of the study, multivariate regression analysis was performed to understand the effect of independent variables (organizational justice dimensions) on the dependent variable (employees' perception of motivation). In addition, it was evaluated whether there was a multicollinearity between the independent variables.

As seen in Table 2, VIF (variance inflation factor) values were found to be less than 10 and tolerance values greater than 0.10, and it was seen that there was no linear connection problem [21].

Table 2. Linear connection analysis results.

Variables	Tolerance	VIF

Interpersonal justice	0,728	1,374
Procedural justice	0,784	1,276
Distributive justice	0,840	1,190

3.2. The Relationship Between Organizational Justice and Employee Motivation

As a result of the analysis, organizational justice with interactional, procedural and distributive origin explains 40% of the motivation perception of the employees.

ANOVA analysis (Table 3.) shows that at least one of our dependent variables has a significant effect on the dependent variable (p= 0.000).

Table 3. Results on employee motivation perceptions of interpersonal, procedural, and distributive organizational justice.

ANOVA	F	Sig.
Regression	15,932	0,000

The coefficients analysis we conducted to understand which independent variable has a significant effect on the motivation perception of the employees is given in Table 4. This table explains that the interactional justice and distributive justice dimensions have an effect on the motivation of the employees through linear models.

Table 4. Analysis of the coefficients of employee motivation perception of interpersonal, procedural and distributive organizational justice.

Variables	B	T test	Sig.
Constant	8,030	1,726	0,085
Interpersonal justice	1,423	9,361	0,000
Procedural justice	0,285	1,413	0,159
Distributive justice	1,092	3,517	0,001

3.3. Artificial Neural Networks Analysis

After the regression analysis, the modeling phase was started with artificial neural networks (ANN). ANN is a mathematical modeling method inspired by the functioning of the human brain. Learning process in artificial neural networks is carried out using examples. During learning, the user is given input and output information, and rules are set. These models are obtained with some computer software that exemplifies the principle of communication between neurons in human brain cells [22]. In order to determine the relationship between the variables, organizational justice with interactional, procedural and distributive origins was chosen as the input variable and the motivation variable as the output. Of the 294 data sets, 250 were randomly selected as training and 44 as test data sets.

In the literature, it is stated that the performance and accuracy of these networks will increase thanks to some normalization methods applied according to ANN data [23-26]. In this context, various normalization methods are used by researchers to solve problems, and the d_Min-Max method is

mostly preferred (Equation 1). With d_Min-Max normalization, the data is scaled in the range of 0-1. In this way, the negative effects of extremely large and small data on the model are reduced [27-29].

$$x_{norm} = \frac{x_i - x_{min}}{x_{max} - x_{min}} \tag{1}$$

x_{norm} = Normalized data
x_i = Input value
x_{min} = The smallest number in the input set
x_{max} = The largest number in the input set

It has been observed that various ANN structures emerge as a result of some rules about learning according to the activation functions and the way neurons are connected to each other. It is understood that these basically mentioned structures are divided into 3 different classes. These; It can be summarized as feedforward neural networks, feedback neural networks and radial-based neural networks [23,24]. The feedforward ANN structure was used for the models created, and the Levenberg-Marquardt learning algorithm, which is one of the supervised learning algorithms, was preferred for the learning of the network. The Levenberg-Marquardt algorithm is the result of the speed of the Newton method and the robustness of the gradient decreasing method. This algorithm is the fastest among back propagation algorithms [25,26]. In practice, this learning algorithm was preferred because it is suitable for the type of problem and also because it is fast and has low learning errors [27]. The graphs of the artificial neural network model created with the training data are presented in Figure 1.
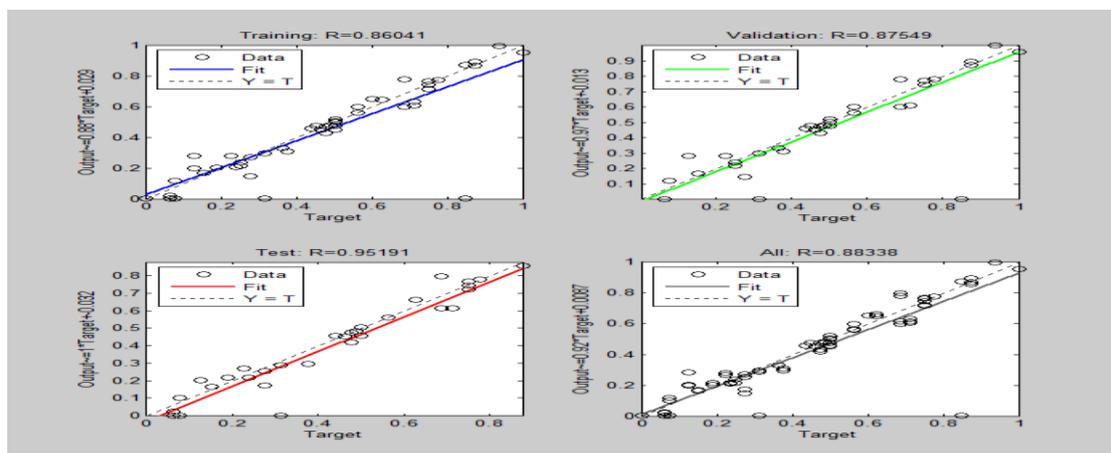

Figure 1. Neural network structure and training graph.

Considering the motivation estimation for the ANN model with the test data set, it is understood that the resulting predictive power of this model is remarkably high. ($R^2 = 0.88$). The relationship between actual and predicted motivation according to ANN is shown in Figure 2.
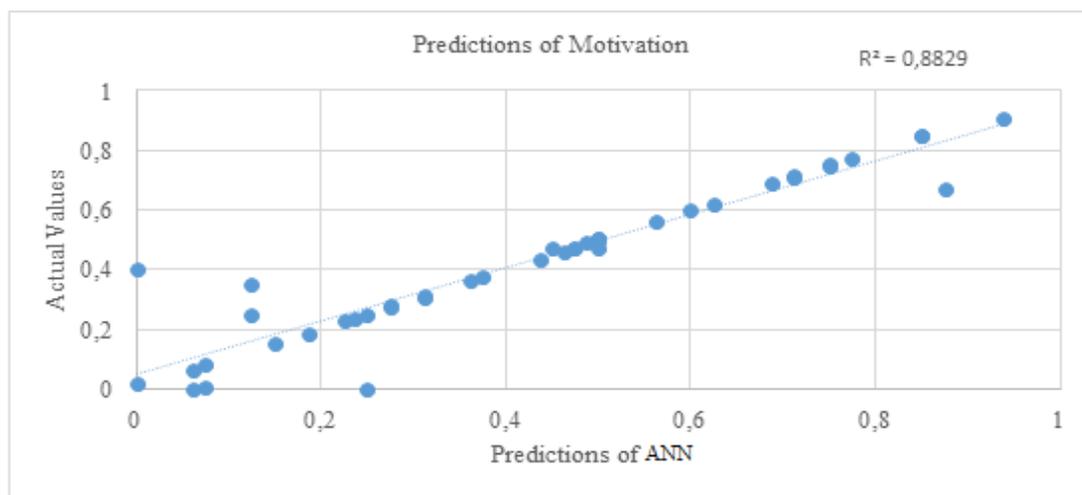
Figure 2. Actual and predicted motivation relationship according to ANN.

4. CONCLUSION

In this research, the effect of organizational justice perceived by employees on employee motivation was determined and focused on the predictability of justice and motivation.

The results of multiple regression analysis obtained in this study show that interactional and distributive justice have a significant and direct effect on employee motivation. According to this; employee motivation increases or decreases depending on the result of the perception of justice in the minds of employees regarding organizational practices. In addition, as a result of the analyzes made with the ANN model to predict the motivation of the employees, it was determined that the predictive power of this model was quite high ($R^2 = 0.88$). According to the results of the analysis, the fact that the predictive power of the ANN model is quite high and reliable is also important in terms of showing a more innovative approach for similar studies. It is understood that the findings obtained thanks to these new analysis methods contain more valuable results in terms of predictability.

Turunç and Tabak (2009) investigated the effects of organizational justice factors (procedural, distributive and interactional justice) on motivation, and in this context, the relationships between the variables were examined with the help of the structural equation model. As a result of the analysis, it was determined that interactional justice and distributive justice positively and significantly affect motivation in parallel with this study[28]. Karanika-Murray and Cox (2010) determined the applicability of neural networks as a result of their study to model the effect of job characteristics on employee health outcomes. According to the same study, linear approaches were found to be effective in this process [29]. According to Erenler-Tekmen et al. (2020) evaluated whether conflicts have an effect on workplace bullying using linear and fuzzy logic methods. As a result of the study in question, according to the results of multiple regression analysis; It has been determined that there is a

significant and direct effect of task and relationship conflict on the behavior of being exposed to workplace bullying. However, within the scope of the same research results, fuzzy logic qualitative comparison analysis (fsQCA) showed that only relationship-based conflict was effective on workplace bullying [30].

It can be said that the sense of justice in people is generally evaluated within the framework of a universal ethical understanding. Every person can demand justice both for himself and for his environment. Because we witness that individuals who think that their rights are violated from time to time in social life may experience conflict, get angry, upset or demoralized. However, individuals will want their rights not to be usurped not only in social life but also in business life. Almost every employee will want their job to be respected by their employers and colleagues. In this way, employees can feel more motivated. But let's consider the opposite. Can an employee who thinks he/she is not treated fairly be motivated in business life? In this context; we should focus on a predictability for the positive behaviors that are expected to emerge in working life.

In today's innovation world, predictability gains importance for the ever-changing business life. Thanks to artificial intelligence studies, possible risks are estimated especially in the service and production sectors and it is desired to prevent them. Moreover, in the light of feasibility and efficiency analyzes, an intense effort is made for the most effective results. In addition, intellectual capital, which is an inevitable resource for all sectors, maintains its importance. Considering all these, it would be appropriate to make predictions about the performance and productivity of the employees.

As a result of this estimation study made with linear modeling, the predictability of the organizational justice phenomenon perceived by the employees and the motivation of the employee has emerged. As a result; thanks to this research, the predictability of the organizational justice phenomenon perceived by the employees and the motivation of the employee has emerged.

As can be seen from this study; it can be said that the perception that employees are treated fairly has a triggering importance in terms of their own work motivation. Thanks to these estimates, when it is aimed to increase the motivation of the employees in the organizations, it can be recommended to make the employees feel that they are treated more fairly and to carry out organizational studies to increase this level. In addition, it may be recommended to diversify the size and scope of similar estimation studies for researchers working in this field.

ACKNOWLEDGEMENT

REFERENCES

[1] Mueller, C.W., and Wynn T., (2000), The degree to which justice is valued in the workplace, Social Justice Research, 13(1):1–24.

[2] Folger, R., and Cropanzano R., (1998), Organizational justice and human resource management, Thousand Oaks / California: SAGE Publications.

[3] Colquitt, J.A., Lepine J., and Wesson M., (2018), Organizational behavior: Improving performance and commitment in the workplace (6th Edition), New York: McGraw-Hill Education.

[4] Colquitt, J.A., (2012), Organizational justice, In: Kozlowski, S. W. (Ed.), The Oxford handbook of organizational psychology, Vol 1., New York: Oxford University Press, pp.526–547.

[5] Adams, J.S., (1963), Towards an understanding of inequity. Journal of Abnormal and Social Psychology, 67(5):422–436.

[6] Lambert, E., (2003), The impact of organizational justice on correctional staff, Journal of Criminal Justice, 31(2):155–168.

[7] Chen, W., and Lee Y., (2022), Revisiting proficiency pairing in collaborative writing from an equity theory perspective: Voices from high-proficiency efl learners, SAGE Open. April:1–11.

[8] Folger, R., (1993), Justice, motivation, and performance beyond role requirements, Employee Responsibilities and Rights Journal, 6(3):239–248.

[9] Usmani, S., and Jamal S., (2013), Impact of distributive justice, procedural justice, interactional justice, temporal justice, spatial justice on job satisfaction of banking employees, Review of Integrative Business and Economics Research, 2(1):351–383.

[10] Bucăța, G., and Rizescu A., (2022), Change management: a way of enhancing organizational efficiency, Journal of Defense Resources Management, (1):166–173.

[11] Singh, S., Mahapatra M., and Kumar N., (2022), Empowering leadership and organizational culture: Collective influence on employee flourishing, International Journal of Health Sciences, 6(S1):2983–2993.

[12] Lenka L., Miloš H., Radovan S., and Zdeněk C., (2021), Motivational preferences within job positions are different: empirical study from the Czech transport and logistics enterprises, Economic Research-Ekonomska Istraživanja, 34(1):2387–2407.

[13] Tortia EC., Gago M., Degavre F., and Poledrini S., (2022), Worker involvement and performance in Italian social enterprises: The role of motivations, gender and workload,

Sustainability, 14(2):1–20.

[14] Mbachu C., Etiaba E., Ebenso B., Ogu U., Onwujekwe O., Uzochukwu B., Manzano A., and Mirzoev T., (2022), Village health worker motivation for better performance in a maternal and child health programme in Nigeria: A realist evaluation, Journal of Health Services Research and Policy, 27(3):222–31.

[15] Pandya S., Hamal M., Abuya T., Kintu R., Mwanga D., Warren CE., and Agarval S., (2022), Understanding factors that support community health worker motivation, job satisfaction, and performance in three ugandan districts: Opportunities for strengthening Uganda's community health worker program. International Journal of Health Policy and Management, x(x):1–9. doi; 10.34172/IJHPM.2022.6219

[16] Deussom R., Mwarey D., Bayu M., Abdullah SS., and Marcus R., (2022), Systematic review of performance-enhancing health worker supervision approaches in low- and middle-income countries, Human Resources for Health, 20(1):1–12.

[17] Colquitt, J.A., (2001), On the dimensionality of organizational justice: A construct validation of a measure, Journal of Applied Psychology, 86(3):386–400.

[18] Özdaşlı, K., and Akman H., (2012), The diversification of gender and organizational statute in internal and external motivations: The research on the engineers and the technicians in Türk Telekomünikasyon a.ş., Suleyman Demirel University The Journal of Visionary, 4(7):73–81.

[19] Sposito, V. A., Hand, M. L., and Skarpness B., (1983), On the efficiency of using the sample kurtosis in selecting optimal estimators, Communications in Statistics-Simulation and Computation, 12(3):265–272.

[20] Groeneveld, R.A., and Meeden G., (1984), Measuring skewness and kurtosis, Journal of the Royal Statistical Society: Series D (The Statistician), 33(4):391–399.

[21] Marquaridt, D.W., (1970), Generalized inverses, ridge regression, biased linear estimation, and nonlinear estimation, Technometrics, 12(3):591–612.

[22] Aghbashlo, M., Hosseinpour S., and Mujumdar A.S., (2015), Application of artificial neural networks (ANNs) in drying technology: A comprehensive review, Drying Technology, 33(12):1397–1462.

[23] Kuzugüdenli, E., (2022), Relationship between the productivity of Pinus brutia Ten and site characters, the Taurus Mountains, Turkey, Journal of Mountain Science, 19(3):662–672.

[24] Kuzugüdenli, E., and Kaya, C., (2020), Relations between the productivity of Turkish red pine in Mersin region and some topographic factors, Journal of Multidisciplinary Engineering Science and Technology, 7(11): 13011–13014.

[25] Levenberg, K., (1944), A Method for the solution of certain non-linear problems in least squares. Quarterly of Applied Mathematics, 2(2):164–168.

[26] Marquardt, D., (1963), An algorithm for least-squares estimation of nonlinear parameters, SIAM Journal on Applied Mathematics, 11(2):431–441.

[27] Öztemel, E., (2016), Yapay sinir ağları, İstanbul: Papatya Bilim.

[28] Turunç, Ö., and Tabak A., (2009), The role of procedural justice, distributive justice, interactional justice and instrinsic motivation on increasing job performance, The Journal of Defense Sciences, 8(1):15–35.

[29] Karanika-Murray, M., and Cox T., (2010), The use of artificial neural networks and   multiple linear regression in modelling work-health relationships: Translating theory into analytical practice, European Journal of Work and Organizational Psychology, 19(4):461–486.

[30] Erenler-Tekmen, E., Özkan-Canbolat E., and Sağlam F., (2020), Evaluation of analyzing workplace bullying from conflict perspective by linear and fuzzy logic methods, Çankırı Karatekin University Journal of the Faculty of Economics and Administrative Sciences, 10(1):349–370.