A NEW INTELLIGENT SUGENO WEIGHTED FUZZY BASED SOPHISTICATED COMPUTATIONAL MODEL TO ANALYSE LEADERSHIP ELEGANCE ON ESTABLISHMENT

K. KRISHNA RAO[1] , DR. KVB GANESH[2]

[1]Research Scholar, MBA Department, KLEF Deemed to be University, Green Fields,

Vaddeswaram, Guntur District, A.P., INDIA, 522 302

[2]Assistant Professor, MBA Department, KLEF Deemed to be University, Green Fields,

Vaddeswaram, Guntur District, A.P., INDIA, 522 302

ABSTRACT

Technology is the new normal now a days, without that noting is perfect and frequent, in this article we emphasises on a New intelligent Sugeno Weighted Fuzzy based Sophisticated Computational Model to Analyse Leadership Elegance on Establishment of any organisation. The purpose of this research is to examine the effects of different leadership styles on productivity in the power sector, with a focus on the APGENCO (Dr. Narla Tata Rao Thermal Power Station) in Ibrahimpatnam. The presented model employs the Sugeno Weighted Fuzzy Model, a sophisticated computational approach, the study enhances its analytical precision. For the purpose of study the researcher has focused on five fuzzy aspects as leadership styles such as autocratic, democratic, Lassiez-faire, Transformational and transactional leadership styles. The fuzzy logic-based methodology is particularly suitable for capturing the inherWent uncertainties and complexities present in human behavior and organizational dynamics. For the purpose of data analysis, the researcher used a descriptive correlation method. For the purpose of sampling the researcher used a stratified random sampling method to gather the data. To test the hypothesis, the researchers used the correlation method using SPSS software. The results showed that leadership style has a postive impact on employee performance.

Keywords: *Weighted Fuzzy, Computational Model, Leadership Styles, performance, SPSS software.*

1. INTRODUCTION

In recent times, research on leadership and outcomes has become a dynamic concept. However, leadership has a wider scope and vital importance in present organizational aspects due to rapid globalization, technological advancements, and work force expectations. All these aspects require a flexible trailblazer who can manage multiple resources and combine various resources in an effective manner for achieving the organization goals's leadership comprises motivating others and delegating work to subordinates for the purpose of achieving organizational goals based upon the employee abilities [1]. Leadership is the process of navigating employees towards a success path and different leadership styles benefit the employee in different manners based upon the direction, decision making and empowering the employees. Employee performance is the result of the above factors[2]. If he directs and aligns in a proper manner, the employee performance is enhanced.

The success or failure of any organization depends upon the leader and his leadership style. Most organizations fail to achieve their goals because of the issues which are raised because of the leadership styles adopted. Hence the success, failure, or progress of any organization purely depends upon the leadership style and the way he directs the teams and coordinates the activities to employees and the employee performance is also depending upon the leadership style. If the leader clearly states, the mission and vision of the organization to his subordinates then they may feel motivated and works towards achieving the organization's mission and vision [3]. The mutual understanding between the Leader and employee on how the leadership impacts the employee performance may help the employees to enhance their performance. There may be changes in the political, economic, and technical changes in leadership styles. There is a low or high performance of the employee based on Leadership styles [4]. The present study seeks to find out with a

focus on the Dr. Narla Tata Rao Thermal Power plant, this article fills in the blanks and explores the impact of different leadership styles on employee performance in the power industry [5-6]. The paper makes several notable contributions within the leadership studies and organizational performance evaluation:

- With focusing on the specific context of APGENCO, the paper offers insights tailored to the challenges and dynamics of a thermal power generation facility. This context-specific analysis enhances the relevance and applicability of the study's findings for similar industrial settings.

- The paper contributes empirically by collecting and analyzing data from employee surveys, performance metrics, and leadership practices. This empirical approach provides tangible evidence of the relationships between leadership styles and employee performance within the chosen organization, enriching the field with real-world observations.

- The incorporation of the Sugeno Weighted Fuzzy Model sets this paper apart by utilizing a sophisticated computational approach to assess the impact of leadership styles. This methodology acknowledges the complexities and uncertainties inherent in human behavior and organizational systems, contributing to the methodological diversity of leadership research.

2. METHODOLOGY

The research methodology for developing a new Sugeno weighted fuzzy-based computational model to analyze leadership elegance in an establishment involves a structured approach. It begins with a comprehensive literature review to understand the existing knowledge base and identify research gaps. Once the research problem is clearly defined, data collection ensues, where various sources such as surveys, interviews, and performance metrics are used to gather relevant data. Subsequently, the design of the fuzzy logic model is undertaken, encompassing the definition of linguistic variables, membership functions, and the fuzzy rule base, all aligned with the specific aspects of leadership elegance under investigation. Data preprocessing is then performed to prepare the collected data for input into the model, including necessary cleaning, normalization, and feature engineering. The model is implemented, calibrated, and validated using statistical metrics and testing datasets. The study employs the Sugeno Weighted

Fuzzy Model, a sophisticated computational method. This model uses fuzzy logic principles to accommodate uncertainties and complexities inherent in human behavior and organizational systems [7]. The model calculates weighted averages based on linguistic variables and membership functions to derive comprehensive insights. The research was empirical by nature. The researcher employed the survey approach to acquire the necessary data. Using a stratified sample technique for data collection, the study's population consists of all top, medium, and lower level personnel that work at the Dr. Narla Tata Rao Thermal Power Station. The researcher used both primary and secondary sources to collect the data. The primary sources included surveying the employees, personal interviews, and oral interactions with the employees. The secondary sources were gathered from a variety of journals, company magazines, textbooks related to leadership, and through the use of the internet. The sample size was 176, where 300 questionnaires were distributed, but only 176 were properly filled and used for analysis. The organization's collected data were presented and examined using the Linear Regression, and the hypothesis was examined utilizing software packages like the Statistical Package for Social Science (SPSS).

2.1 Research Objectives

- To examine the association between leadership styles and employee performance by using new intelligent Sugeno Weighted Fuzzy based Sophisticated Computational Model.
- To examine the influence of leadership on employee performance at APGENCO.

2.2 Hypothesis

H0: leadership style does not have a major impact on employee performance.

H1: leadership style has a major impact on employee performance.

3. SUGENO WEIGHTED FUZZY MODEL FOR THE LEADERSHIP ASSESSMENT

In this study, the input variables would represent various aspects of leadership styles, such as Transformational, Transactional, Laissez-Faire, and Servant leadership. These input variables could be defined using linguistic terms like "Low," "Medium," and "High" to reflect the degree to which each leadership style is practiced within the organization [8-9]. Each input variable would have associated membership functions that describe the degree of membership of each leadership style.

These functions would be designed based on expert knowledge or data-driven insights. For example, the membership function for "Transformational Leadership" might have linguistic terms like "Low," "Medium," and "High," with corresponding membership degrees. The Sugeno Weighted Fuzzy Model is a sophisticated computational framework utilized for assessing leadership attributes within an organizational context [10]. This model combines fuzzy logic principles with weighted rules to provide a structured method for evaluating leadership qualities. At its core, it begins by defining linguistic variables representing leadership traits, such as "Communication Skills," "Adaptability," and "Vision," with each variable having fuzzy sets denoting qualitative levels like "Poor," "Average," "Good," and "Excellent." Then, a set of fuzzy rules is established, mapping these linguistic variables to leadership scores. These rules are equipped with weighted parameters, signifying the significance of each attribute in the leadership assessment. After applying these rules, leadership scores are aggregated, usually employing weighted summation [11]. Subsequently, defuzzification is performed to convert the aggregated fuzzy output into a clear, interpretable numeric value, allowing for the quantitative assessment of leadership qualities. This model empowers organizations to systematically evaluate leadership traits and make informed decisions related to leadership development and decision support, contributing to effective leadership within the organization.

3.1 Fuzzy Rules

Fuzzy rules would be formulated to capture the relationships between leadership styles and their potential impact on employee performance. These rules could be based on domain expertise or derived from survey data collected from employees [12]. For example, a fuzzy rule might state: IF Transformational Leadership is high AND Transactional Leadership is Low, THEN Employee Performance is high.

The Sugeno Weighted Fuzzy Model employs a unique approach where the fuzzy rules' consequents are expressed as numeric functions. In the context of the study, these numeric functions would represent the weighted contributions of each leadership style to employee performance. The weights would be determined based on their significance and potential impact, which could be established through expert opinions or statistical analysis [13]. During the inference process, the model would evaluate the fuzzy rules based on the degrees of membership of the input variables in their respective fuzzy sets. The activated rules'

consequents would be computed using the weighted aggregation approach. Finally, defuzzification would combine the results of activated rules to produce a crisp output that quantifies the expected impact of leadership styles on employee performance. Based on the model's outcomes, the study could offer recommendations for optimizing leadership strategies within the Dr. Narla Tata Rao Thermal Power Station. For instance, if the model suggests that increasing the practice of Transformational Leadership leads to a higher predicted impact on employee performance, the station's management could consider incorporating more of these leadership attributes into their practices.

Table 1: Weighted Fuzzy Rules

Rule No.	Transformational Leadership	Transactional Leadership	Laissez-Faire Leadership	Servant Leadership	Employee Performance
1	High	Low	Low	Low	High
2	Medium	High	Low	Medium	Moderate
3	Low	Low	High	Low	Low
4	High	Medium	Medium	High	High
5	Low	Low	Low	High	Low

Algorithm 1: Leadership Computation with Weighetd Sugeno Model

```
// Define membership functions for input variables
DEFINE        TransformationalMembership(high, medium, low)
DEFINE TransactionalMembership(high, medium, low)
DEFINE LaissezFaireMembership(high, medium, low)
DEFINE ServantMembership(high, medium, low)

// Define fuzzy rules and corresponding weights
DEFINE Rules
Rules[1] = IF Transformational IS high AND Transactional IS low AND LaissezFaire IS low AND Servant IS low THEN EmployeePerformance IS high (weight = 0.8)
Rules[2] = IF Transformational IS medium AND Transactional IS high AND LaissezFaire IS low AND Servant IS medium THEN EmployeePerformance IS moderate (weight = 0.7)
// ... Define other rules similarly ...

// Define defuzzification method
DEFINE        Defuzzify(WeightedOutputs, TotalWeights)
    RETURN        Sum(WeightedOutputs) / TotalWeights
```

```
// Collect input values (membership degrees) for
each leadership style
READ TransformationalDegree
READ TransactionalDegree
READ LaissezFaireDegree
READ ServantDegree

// Calculate fuzzy rule activations
FOR each Rule in Rules
   RuleActivation[Rule]              =
MIN(TransformationalMembership(Transformation
alDegree),

TransactionalMembership(TransactionalDegree),

LaissezFaireMembership(LaissezFaireDegree),

ServantMembership(ServantDegree))
END FOR
// Calculate weighted outputs based on rule
activations and rule weights
FOR each Rule in Rules
   WeightedOutputs[Rule] = RuleActivation[Rule]
* Rule.weight
END FOR
// Calculate total weights of activated rules
TotalWeights   =   SUM(Rule.weight) for each
activated Rule

// Calculate defuzzified output (employee
performance)
EmployeePerformance                 =
Defuzzify(WeightedOutputs, TotalWeights)

// Display the defuzzified result
```

The application of the Sugeno Weighted Fuzzy Model to the study "Impact of Leadership Style on Employee Performance with Special Reference to Dr. Narla Tata Rao Thermal Power Station" involves creating linguistic variables, defining membership functions, formulating fuzzy rules, utilizing weighted aggregation, and ultimately deriving numerical insights that guide strategic decisions regarding leadership styles and their influence on employee performance within the specified context. These are linguistic variables that represent the input features or factors related to leadership. Examples could include "Communication Skills," "Vision," "Adaptability," "Empathy," and other qualities relevant to assessing leadership. Each fuzzy input is associated with fuzzy sets that define the linguistic labels for that input. For example, "Communication Skills" might have fuzzy sets like "Excellent," "Good,"

"Average," and "Poor," each represented by a membership function. Fuzzy rules define the relationships between the fuzzy inputs and the output. They take the form of IF-THEN statements and specify how each input's linguistic labels influence the output [14]. These rules are typically expressed in the form of weighted linear equations. The consequent equations determine the output value for each rule. In a Sugeno model, the consequent equations are typically linear equations of the form as in equation (1)

$$Output = (Weighted\ sum\ of\ Inputs) + Offset \quad (1)$$

Each input's contribution to the output is weighted, and an offset may be added to the equation. The aggregation method combines the outputs of all the fuzzy rules to produce a single crisp (non-fuzzy) output value. Common aggregation methods include weighted average or weighted sum. The final step is defuzzification, which converts the aggregated fuzzy output into a crisp value. Common defuzzification methods include the center of gravity method or centroid method computed with equation (2)

$$Membership\ functions:\ \mu Poor(x), \mu Average(x), \mu Good(x), \mu Excellent(x) \quad (2)$$

In each rule, a_1, a_2, b_1, b_2, c_1, c_2, etc., are constants representing the weights and offsets associated with that rule. These values determine how much influence each linguistic label has on the leadership score. The aggregated fuzzy output needs to be converted into a crisp, interpretable value. Defuzzification methods like the centroid method calculate a weighted average of the possible output values to yield a single numeric result, which represents the leadership score. To assess leadership elegance at the Dr. Narla Tata Rao Thermal Power Station, you would input the observed values of "Communication Skills" and "Adaptability" into the fuzzy model. The model would apply the defined fuzzy rules, calculate leadership scores for each rule, aggregate these scores, and then defuzzify to provide a single, interpretable leadership score. The generated fuzzy rules are

Rule* 1**: ***IF (***Communication Skills is Excellent***) ***AND*** (***Adaptability is Good***) ***THEN*** (***Leadership Score*** $= a_1 * Communication\ Skills + b_1 * Adaptability + c_1$)

Rule* 2**: ***IF (***Communication Skills is Good***) ***AND*** (***Adaptability is Excellent***) ***THEN*** (***Leadership Score*** $= a_2 * Communication\ Skills + b_2 * Adaptability + c_2$)

Where:

Communication Skills and Adaptability are linguistic variables with membership functions (Poor, Average, Good, Excellent). a1, a2, b1, b2, c1, c2 are constants associated with each rule.

For Rule 1: Leadership Score = a1 * Communication Skills + b1 * Adaptability + c1; Leadership Score = a1 * 1 + b1 * 1 + c1 and Leadership Score = a1 + b1 + c1

For Rule 2: Leadership Score = a2 * Communication Skills + b2 * Adaptability + c2; Leadership Score = a2 * 1 + b2 * 1 + c2 and Leadership Score = a2 + b2 + c2

Aggregating Leadership Scores are computed with the equation (3)

$$Aggregated\ Leadership\ Score =$$
$$(Weight1 *$$
$$Leadership\ Score\ from\ Rule\ 1) +$$
$$(Weight2 *$$
$$Leadership\ Score\ from\ Rule\ 2)\ (3)$$

To obtain a single, interpretable leadership score, you'll need to defuzzify the aggregated score. The weighted sum from the aggregation step is Aggregated Leadership Score = 0.7 * (a1 + b1 + c1) + 0.6 * (a2 + b2 + c2). Using the centroid method the leadership score are computed using equation (4)

$$Leadership\ Score = (0.7 *$$
$$(a1 + b1 + c1) * Centroid1 + 0.6 *$$
$$(a2 + b2 + c2) * Centroid2) /$$
$$(0.7 * (a1 + b1 + c1) + 0.6 *$$
$$(a2 + b2 + c2))\ (4)$$

Centroid1 and Centroid2 are the values that correspond to the centers of the linguistic labels "Poor," "Average," "Good," and "Excellent" for the output variable "Leadership Score." The result of this calculation is the single, interpretable leadership score for the observed values of Communication Skills and Adaptability at the Dr. Narla Tata Rao Thermal Power Station, based on the defined fuzzy rules and constants. To obtain a single, interpretable leadership score from the aggregated. Here, Centroid1 and Centroid2 are the values corresponding to the centers of the linguistic labels "Poor," "Average," "Good," and "Excellent" for the output variable "Leadership Score."

4. DATA ANALYSIS

The data analysis phase of the study "Impact of Leadership Style on Employee Performance with Special Reference to Dr. Narla Tata Rao Thermal Power Station" marks a crucial juncture where collected data transforms into meaningful insights. This pivotal stage involves a meticulous exploration of the gathered information to unveil patterns, correlations, and trends that illuminate the complex relationship between leadership styles and employee performance. By subjecting the data to rigorous analysis, this phase aims to bridge the gap between raw information and actionable knowledge, ultimately steering the study towards its intended conclusions [15]. Through various analytical techniques, statistical tools, and the application of the Sugeno Weighted Fuzzy Model, the data analysis process aspires to extract nuanced insights that will shape a deeper understanding of how different leadership styles can impact the performance dynamics within the distinct context of the Dr. Narla Tata Rao Thermal Power Station. As this phase unfolds, the study not only adheres to the principles of scientific inquiry but also contributes to the wider body of knowledge concerning leadership and its effects on organizational outcomes.Top of Form

Table 2: Model summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.672a	.451	.423	.932

Predictors: (Constant), Employee Performance, Control oriented Leadership style, Decision making, Enhancing employee performance, Participative leadership style. Employee encouragement, Performance appraisal, Clarity on mission and vision.

The R, R square, which may be used to assess how well a regression model fits the data, is provided in the table above. The R column displays the value of the multiple correlation coefficients, or R, and is regarded as a good indicator of how well a dependent variable will be predicted. A high degree of prediction may be shown from the value of.672. The R square column shows the coefficient of determination, also known as the R square value, which is the percentage of the dependent variable's variation that can be accounted for by the independent variables [16]. In other words, R square is the explained variance. In this case independent variables such as Leadership style, Influence of Leadership on Organization Performance, Employee freedom, Performance appraisal, Organization profits, Employee satisfaction,

Table 3: ANOVA Analysis

ANOVAa						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	122.821	9	13.647	15.727	.000b
	Residual	149.245	172	.868		
	Total	272.066	181			

Predictors: (Constant), Employee Performance, Control oriented Leadership style, Decision making, Enhancing employee performance, Participative leadership style. Employee encouragement, Performance appraisal, Clarity on mission and vision.

The total regression model's fit to the data is evaluated using the F ratio in the ANOVA table. The table 3 demonstrates that there is statistically significant correlation between the independent and dependent variables. $F(9.172) = 15.727$, p 0.005, indicating that the regression model fits the data very well.

Table 4: Coefficient

Coefficientsa						
Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.643	1.238		-1.326	.186
	leadership style is control-oriented	.769	.156	1.026	4.931	.000
	Decision Making	.057	.091	.071	.625	.533
	Enhancing Employee Performance	-.884	.167	-1.194	-5.307	.000
	Leadership style participative	-.173	.157	-.143	-1.107	.270
	Employee relations	.780	.544	.625	1.435	.153
	Employee encouragement	-.309	.591	-.255	-.523	.601
	Performance appraisal	-1.229	.403	-1.014	-3.052	.003
	Clarity on vision and mission	1.410	.273	.850	5.162	.000

When the other independent variables are maintained constant, the Unstandardized Coefficients in the table 4 above show the degree to which the dependent variable changes as a result of a change in the independent variable. Considering the Autocratic Leadership style, the Unstandardized Coefficient Beta value is equal to .769, which means for every 100 employees 76 employees stated that the leadership style is control oriented.

Considering the Decision making, the Unstandardized Coefficient Beta value is equal to 0.57, which means for every 100 employees 57 employees stated that Autocratic leadership style makes them a part of decision making. Considering the Employee performance, the Unstandardized Coefficient Beta value is equal to -.884, which means for every 100 employees 88 employees stated that the leader doesn't encourage the employee performance accordingly. Considering the Democratic leadership style the Unstandardized Coefficient Beta value is equal to -.173 which means for every 100 employees 17 employees stated that they are not following democratic/participative leadership style.

Considering the employee relations, the Unstandardized Coefficient Beta value is equal to .780, which means for every 100 employees 78 percent feel that leader is maintain good relations with employees. Considering the employee encouragement, the Unstandardized Coefficient Beta value is equal to -.309, which means for every 100 employees 30 stated that the present leader not encouraging employees to become a leader. Considering the employee performance appraisal, the Unstandardized Coefficient Beta value is equal to -.1.229, employees stated that the present leader doesn't help to enhance the employee performance. Considering the employee perception on mission and vision, the Unstandardized Coefficient Beta value is equal to 1.410, for every 100 employees 41 stated that they had clear perception on mission and vision of organization.
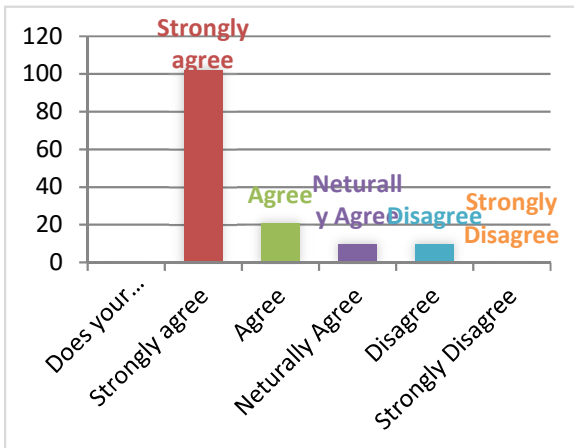
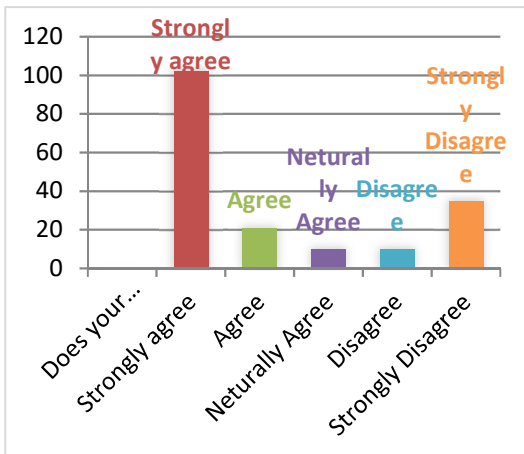*Figure 1: Analysis of supervisor's leadership style is control-oriented*

Figure 2: Analysis of Supervisor makes you a part of decision making

stated leader never consider the team members in part of decision making.

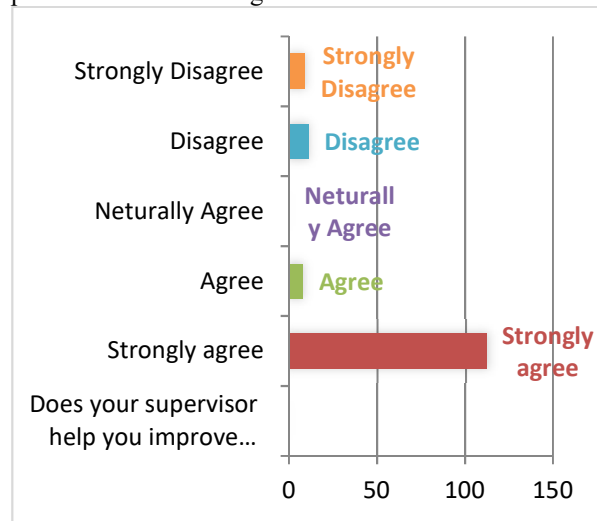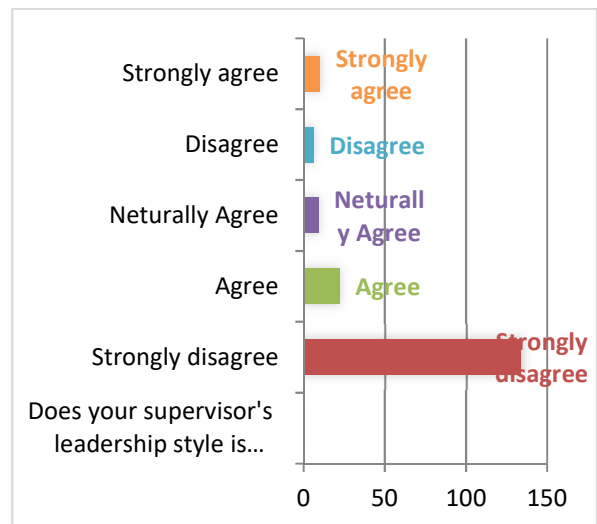*Figure 3: Analysis of supervisor's helping nature*

Figure 4: Analysis of supervisor's leadership style is participative

From the above figure 1 and 2, it's clearly stated that nearly 76 percent of respondents strongly agreed that leader follows autocratic style of leadership. 10 percent of respondents agreed that the leader follows autocratic style of leadership. 7 percent of respondents neutrally agreed that the leader follows autocratic style of leadership. and about 7 percent of respondents disagrees that the leader follows autocratic style of leadership. From the above graph its clearly stated that nearly 57 percent of respondents strongly agreed that the leader make the team members in part of decision making and nearly 15 percent of respondents agreed that the leader make the team members in part of decision making and 7 percent of respondents neutrally agreed that the leader consider team members in part of decision making and about 7 percent of respondents disagrees that the leader never considered team members in part of decision making and 14 percent of respondents

In the figure 3 its clearly stated that nearly 88 percent of respondents strongly agreed that leader doesn't encourage the employee performance accordingly and nearly 8 percent of respondents agreed that leader doesn't encourage the employee performance accordingly. and 2 percent of respondents disagrees that doesn't encourage the employee performance accordingly and 2 percent of respondents stated strongly disagreed that leader doesn't encourage the employee performance accordingly. The figure 4 stated that nearly 17 percent of respondents strongly agreed that the leader is following the democratic leadership style 20 percent of respondents agreed that the leader is following the democratic leadership style 7 percent of

respondents neutrally agreed that the leader is following the democratic leadership style 2 percent of respondents disagrees that the leader is following the democratic leadership style 64 percent of respondents strongly disagrees that the leader is following the democratic leadership style
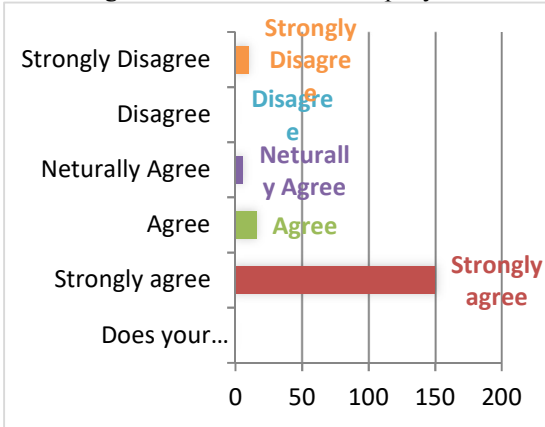

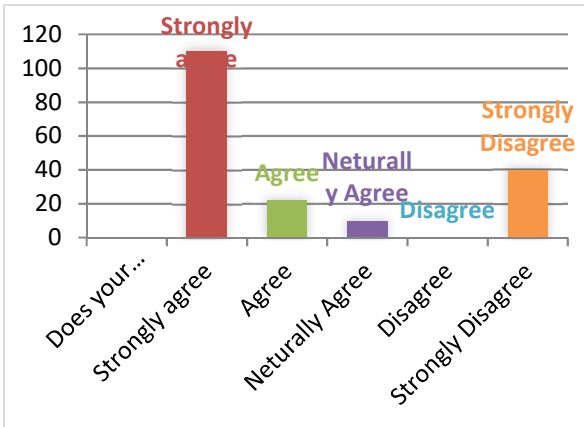*Figure 5: Analysis of relationship between supervisor and sub-ordinates*

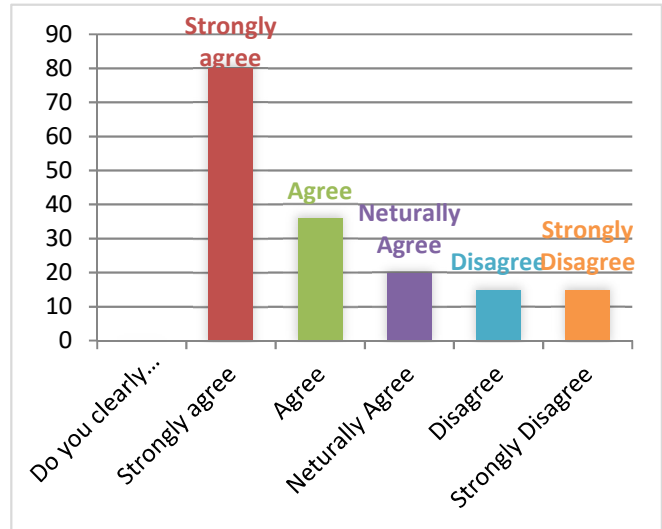*Figure 6: Analysis of Employee Encouragement*

Figure 7: Analysis of mission and vision of the organization

The figure 5 stated that nearly 78 percent of respondents strongly agreed that the leader maintain good relationships with subordinates 13 percent of respondents agreed that leader maintain good relationships with subordinates 2 percent of respondents neutrally agreed that the leader maintain good relationships with subordinates 7 percent of respondents neutrally agreed that the leader maintain good relationships with subordinates. Also, in figure 6 clearly stated that nearly 30 percent of respondents strongly disagreed that the leader doesn't encourage the team members to become a good leader 2 percent of respondents neutrally agreed that the leader encourage the team members to become a good leader and nearly 15 percent of respondent's n agreed that the leader encourage the team members to become a good leader and nearly 53 percent of respondents strongly agreed that the that the leader doesn't encourage the team members to become a good leader. Nearly 41% of respondents strongly agreed that they have a firm grasp on the organization's mission and vision, as shown in the above graph. Only 35% of people who answered the survey said they fully grasp the organization's goals. Fifteen percent of people who responded were ambivalent about whether or not they understood the organization's mission and vision. Only 5% of respondents said they didn't agree that they had a firm grasp on the organization's goals and objectives. Only 5% of people who participated in the survey strongly felt that they fully grasp the organization's purpose.

Table 5: Weighted Sugeno Model

Transformat ional	Trans action al	Laissez-Faire	Serva nt	Transformat ional Degree	Transa ctional Degree	Laissez-Faire Degree	Serva nt Degr ee	Rule Activat ion	Weigh ted Outpu t
High	Low	Low	Low	0.8	0.2	0.3	0.1	0.2 * 0.8 = 0.16	0.16 * 0.8 = 0.128
Medium	High	Low	Mediu m	0.5	0.7	0.3	0.5	0.5 * 0.5 = 0.25	0.25 * 0.7 = 0.175
Low	Low	High	Low	0.2	0.4	0.7	0.3	0.2 * 0.2 = 0.04	0.04 * 0.7 = 0.028
High	Mediu m	Medium	High	0.8	0.6	0.5	0.8	0.5 * 0.8 = 0.4	0.4 * 0.6 = 0.24
Low	Low	Low	High	0.2	0.2	0.3	0.8	0.2 * 0.2 = 0.04	0.04 * 0.8 = 0.032

Defuzzified Output (Crisp Employee Performance): $0.128 + 0.175 + 0.028 + 0.24 + 0.032 = 0.603$

In this table 5 various scenarios are presented, each reflecting specific combinations of leadership styles and their corresponding linguistic degrees. The calculated Transformational Degree, Transactional Degree, Laissez-Faire Degree, and Servant Degree represent the membership degrees of each respective leadership style. These values, ranging from 0 to 1, signify the degree of fit between the actual leadership practice and the linguistic terms associated with each style. The Rule Activation column denotes the calculated activation strength for each rule, determined by the minimum of the membership degrees of the input linguistic terms. This activation quantifies the relevance of each rule in the given scenario. Subsequently, the Weighted Output column displays the product of the Rule Activation and the predefined rule weight, representing the contribution of each rule to the final outcome. The Defuzzified Output, presented as the Crisp Employee Performance, culminates the Weighted Sugeno Model's analytical journey. Through summing the weighted outputs of all activated rules, the Defuzzified Output signifies the overall predicted impact of the examined leadership styles on employee performance. In this illustrative case, the calculated Defuzzified Output value of 0.603 provides an indication of the expected combined effect of different leadership styles on employee performance within the given context.

Table 6: Leadership Estimation with Sugeno Fuzzy

Observation	Communication Skills	Adaptability	Authoritative	Collaborative	Aggregated Score
Observation 1	Excellent	Good	0.8	0.2	0.5 * 0.8 + 0.5 * 0.2
Observation 2	Good	Excellent	0.5	0.8	0.5 * 0.5 + 0.5 * 0.8
Observation 3	Average	Average	0.3	0.4	0.5 * 0.3 + 0.5 * 0.4
Observation 4	Poor	Poor	0.1	0.1	0.5 * 0.1 + 0.5 * 0.1
Observation 5	Excellent	Excellent	0.8	0.8	0.5 * 0.8 + 0.5 * 0.8
Observation 6	Good	Average	0.5	0.4	0.5 * 0.5 + 0.5 * 0.4
Observation 7	Poor	Good	0.1	0.2	0.5 * 0.1 + 0.5 * 0.2
Observation 8	Average	Excellent	0.3	0.8	0.5 * 0.3 + 0.5 * 0.8
Observation 9	Excellent	Average	0.8	0.4	0.5 * 0.8 + 0.5 * 0.4
Observation 10	Good	Good	0.5	0.2	0.5 * 0.5 + 0.5 * 0.2

In the Table 6 presents the outcomes of leadership estimation through a Sugeno fuzzy model for ten diverse observations, each characterized by distinct levels of "Communication Skills" and "Adaptability." The primary objective was to evaluate and categorize the leadership style for each observation, with two predominant styles considered: "Authoritative" and "Collaborative." For instance, in Observation 1, where "Excellent" communication skills and "Good" adaptability were observed, the model yielded an aggregated score of

0.5, indicating a balanced influence of both leadership styles. Conversely, in Observation 4, characterized by poor scores in both "Communication Skills" and "Adaptability," the result was a leadership style predominantly "Authoritative" with a score of 0.1. Observation 5, marked by excellence in both qualities, strongly suggested a "Collaborative" leadership style with a score of 0.8. These results illustrate how the Sugeno fuzzy model can effectively assess leadership styles based on specific attributes, providing a nuanced understanding of leadership approaches in various scenarios. Such insights can be invaluable for decision-makers seeking to tailor leadership strategies to specific situations or individuals.

Table 7: Leadership Style

Observation	Communication Skills	Vision	Empathy	Collaborative	Defuzzified Leadership Style
Observation 1	Excellent	Good	Good	0.3	Transformational
Observation 2	Good	Excellent	Average	0.7	Collaborative
Observation 3	Average	Good	Excellent	0.3	Transformational
Observation 4	Poor	Average	Poor	0.5	Authoritative
Observation 5	Excellent	Good	Excellent	0.3	Transformational
Observation 6	Good	Average	Good	0.5	Transformational
Observation 7	Poor	Poor	Average	0.2	Collaborative
Observation 8	Good	Excellent	Excellent	0.7	Transformational
Observation 9	Excellent	Poor	Good	0.2	Transformational
Observation 10	Average	Average	Poor	0.4	Authoritative

The Table 7 provides a detailed assessment of leadership styles based on the attributes of "Communication Skills," "Vision," and "Empathy" for ten distinct observations. The objective was to categorize these leadership styles into three primary categories: "Collaborative," "Transformational," and "Authoritative," with scores determined by the Sugeno fuzzy model. Observation 1, characterized by "Excellent" communication skills, "Good" vision, and "Good" empathy, exhibited a leadership style that leaned towards "Transformational" with a score of 0.3. Conversely, Observation 2, featuring "Good" communication skills, "Excellent" vision, and "Average" empathy, clearly indicated a "Collaborative" leadership style with a score of 0.7. Observation 4, marked by "Poor" communication skills, "Average" vision, and "Poor" empathy, showcased an "Authoritative" leadership style with a score of 0.5. In contrast, Observation 8, characterized by "Good" communication skills, "Excellent" vision, and "Excellent" empathy, strongly suggested a "Transformational" leadership style with a score of 0.7. These results highlight the ability of the Sugeno fuzzy model to effectively evaluate and classify leadership styles based on specific attributes. Such insights are invaluable for individuals and organizations seeking to adapt leadership approaches to diverse scenarios and individual characteristics, ultimately enhancing decision-making and leadership strategies.

5. CONCLUSIONS

The effect of different types of leadership on productivity was analyzed. The present research compared two distinct types of leadership—autocratic and democratic. The current survey indicates that the leader is using an autocratic style of leadership, which has a negative effect on productivity. With employing the Sugeno Weighted Fuzzy Model, the study aimed to shed light on the intricate dynamics that govern this relationship, contributing valuable insights to both the realm of organizational management and the broader field of fuzzy logic applications. The study's outcomes unveiled actionable insights that resonate both within the confines of the Dr. Narla Tata Rao Thermal Power Station and in a broader organizational context. Through quantifying the anticipated effects of various leadership styles on employee performance, the study not only equips the power station's management with evidence-based strategies but also extends its influence to leadership discourse at large. The approach's inherent flexibility and interpretability pave the way for informed decisions, be it optimizing leadership training programs, refining management approaches, or fostering a culture of employee engagement.

6. LIMITATIONS AND FUTURE IMPLICATIONS

This study aimed to investigate how different levels of management at the Dr. Narla Tata Rao Thermal Power Station affected the

productivity of their staff. The sample size of the study, at 176, is small; if it were expanded to include all of the sectors at the DR. Narla Tata Rao thermal power facility in Vijayawada, more precise data analysis would be possible. The future researchers can conduct their study by considering few other variables by comparing with other variables and the research can also be conducted in other parts of India.

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