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## Enterprise Human Resource Management Model by Artificial Intelligence to Get Befitted in Psychology of Consumers Towards Digital Technology

**<sup>1</sup>Dr. K. Maheswari, <sup>2</sup>Dr. P. William, <sup>3</sup>Dr. Gunjan Sharma, <sup>4</sup>Firas Tayseer Mohammad Ayasrah, <sup>5</sup>Ahmad Y. A. Bani Ahmad, <sup>6</sup>Dr. Gowtham Ramkumar, <sup>7</sup>Dr. Anurag Shrivastava**

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<sup>1</sup>Assistant Professor of Social Work, CDOE, Bharathidasan University, Tiruchirappalli -24. Tamilnadu.maheshranjith06@yahoo.co.in

<sup>2</sup>Dean, Research and Development, Department of Information Technology, Sanjivani College of Engineering, SPPU, Pune, India

<sup>3</sup>Institute of Business Management, GLA University, Mathura

<sup>4</sup>College of Education, Humanities and Science, Al Ain University, Al Ain, UAE

<sup>5</sup>Department of Accounting and Finance Science, Faculty of Business, Middle East University, Amman 11831

<sup>6</sup>Assistant Professor, Department of Commerce, School of Commerce, Finance and Accountancy, Christ University, Bengaluru, Karnataka, India

<sup>7</sup>Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamilnadu, India

### Abstract

As a result of the implementation of artificial intelligence, there is a possibility that the existing organizational structures and management procedures will go through significant transformations (AI). Conventional organizational structures as well as the decision-making processes of companies are being completely upended by AI. A backpropagation neural network (BPNN) that is based on AI digitizing technology is used in the construction of a salary prediction model (SPM), which is then subjected to the Nesterov and Adaptive Moment Estimation (Nadam) approach for the purpose of further enhancing its accuracy. The end output is known by its full title, which is a salary prediction model (SPM). The results of this study have the potential to have a positive impact on the HRM process, the amount of work that human resource managers have to do, and the overall efficiency of professions. According to the findings, the Nadam optimization technique offered the highest degree of optimization performance as well as the fastest convergence. The duration of the training was exactly 186 seconds, and the final score for the expected outcome was 0.75 percent. Further proof of the SPM's validity may be seen in the remarkable learning performance as well as the accuracy rate of up to 79.4% achieved by Nadam's BPNN-based SPM optimization. The outcomes of the research might potentially serve as a guide for the development of data mining-based HRM solutions in the future.

**Keywords:** Digital transformation, Nadam optimization, human resource management, and artificial intelligence are some of the keywords in this article (AI).

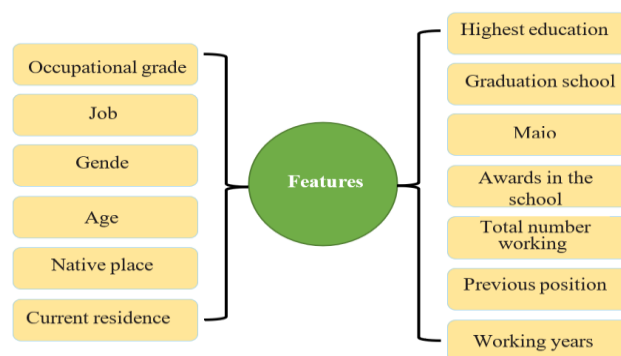
### 1. Introduction

Due to the advancement of AI technologies as an essential component for businesses to maintain their viability and continue to grow in an environment that is consistently undergoing transformation, a new generation of workers has emerged. This trend is expected to continue. People working in this new generation of jobs combine their own intelligence with that of machines. Research in the field of artificial intelligence (AI) is conducted with the intention of creating computer systems that are capable of imitating human cognition and behavior. Artificial intelligence is being employed more and more to assist managers in the mundane, repetitive tasks that are associated with corporate management decision-making. It provides access to a big database and a variety of analytical skills, freeing managers from mundane activities and allowing them to focus on more important responsibilities instead. The term "human resource management" (HRM) may be used to refer, in the context of organizations, either to the policies themselves or to a set of organizational activities that support them. Both interpretations are valid uses of the term. These responsibilities include the development of a business strategy for the management of human resources, the selection and employment of personnel, the provision of training for

said personnel, the monitoring of said personnel's progress, and the management of both their interpersonal connections and their overall performance. It is possible that the use of AI may result in additional financial benefits accruing to the HRM process. For the next few years, one of the most important driving factors will be the implementation of artificial intelligence (AI) technologies that are designed to make human resource management a more efficient field. The challenge that companies and the heads of their HR departments are currently facing is figuring out how to implement corporate HRM while also utilizing digital technologies [1].

In this age of digital information, new growth sectors for employing employees have emerged as a result of the creation of new growth sectors by technologies such as big data and AI. It is possible to reach these new growth areas if the organizational structure is optimized, regular updates and iterations are performed, and people are assigned thoughtfully. If the HRM of the company is unable to keep up with the rate at which the organization is expanding in order to fulfill the recently developed strategic goals of the company, it will be difficult to reap the benefits of technological innovation and development advantages. This will make it more difficult to achieve the company's goals. In point of fact, traditional recruitment is still plagued by problems such as inadequate screening, a lack of adequate job matching, and the loss of technology expertise. Data mining is one strategy that has been proposed by researchers as a way to cut down on the amount of information that a system needs to process. The process of gleaning useful information from vast quantities of data by making use of a wide range of statistical strategies and procedures is known as "data mining."

The applicant's age, level of education, work history, and any other relevant information is taken into consideration during the manual review of the candidate's resume that is part of the traditional hiring process. This helps determine whether or not the candidate satisfies the requirements for the position. In light of the fact that there is always the potential for human mistake throughout this process, applicants are reminded to use sound judgment at all times. There is a salary range associated with every employment, but the department that manages contracts will often take into consideration a number of factors that are both arbitrary and subjective in their nature. Since there is no data to justify the influence of subjective components and limited criteria for objective evaluation, the only kind of analysis that can be applied to the HRM process is a qualitative analysis. This is because a quantitative analysis is not possible. This is the situation that has arisen due to the fact that qualitative analysis is the only kind of analysis that may be employed. Both the procedure of examining applications and the process of calculating an employee's salary are impacted by a wide range of different aspects of the situation. The information from the applicant's resume is utilized to develop a prediction model, which is then used to estimate the applicant's contractual pay by making use of a range of objective evaluation criteria. This process is repeated for each application. The projected pay may serve as a baseline compensation benchmark that is subsequently modified to reflect the actual wage environment. This may take place at some point in the future. The process of calculating pay may be difficult and presents a number of obstacles that must be addressed. As a candidate's curriculum vitae is used to estimate their income, it is essential that the information included within it be accurate in order to have a complete comprehension of the candidate's financial status. The quantity of information that can be retrieved from the features is a direct factor that plays a significant role in determining how accurate the final model will be [2]. The several pieces of information that are used in the process of calculating an estimate of compensation are shown in Figure 1.



**Figure 1: Data characteristics of SPM**

## 2. Review Of Literature

In the context of the digital economy, the purpose of this study is to investigate the possibility of shifts in human resource management brought about as a direct consequence of the progression of digital technology. Specifically, the research will focus on the implications of these shifts. The causes that are affecting the digital revolution in human resource management, as well as the trends and consequences that are directly related to those reasons, are the primary topics that are covered throughout the material of the course. According to the findings of the report, the process of digitally transforming human resource management is driven by five factors: the digital demands of internal customers, the digital innovation of the industry, the difficulties faced by competitors, the governance of digital innovation, and the requirements of the digital era [3]. This article takes a look at some of the most important aspects of the digital revolution taking place in human resource management. These aspects include the digital workplace, digital HRM processes, and digital employee services. The study focuses primarily on the use of cutting-edge digital technology to carry out operations associated with digital human resource management, such as selection, training and development, and assessment. It is important to emphasize that despite the fact that digital transformation offers benefits for the expansion of businesses, its potential effects—such as the manner in which both the old and new human resource management systems are converted, as well as the drawbacks of the new system—cannot be ignored [4].

Artificial intelligence (AI) has the ability to fundamentally alter current organizational structures and management methods. AI is transforming both conventional administrative structures and the way organizations make decisions. There is little doubt that artificial intelligence is having an impact on a wide range of disciplines, including core skills, business processes such as knowledge management, and customer outcomes such as happiness and service quality perceptions. This research has the potential to increase the effectiveness of work, the human resource management (HRM) approach, and the workload of human resource managers. A salary prediction model (SPM) is developed using a backpropagation neural network (BPNN) based on AI digitizing technology, and the model is then tweaked using the Nesterov and Adaptive Moment Estimation (Nadam) approach. The model's validity is then shown by predicting the beginning wages of the applicants based on the information included in their resumes. The Nadam optimization strategy offered the best optimization impact and the quickest convergence time, according to the data. It had a 0.75% final predicted result score and a training duration of 186 seconds. Moreover, Nadam's BPNN-based SPM optimization has good learning performance and an accuracy rate of up to 79.4%, both of which demonstrate the SPM's validity. The findings of this research might offer a path for future data mining-based HRM solutions [5].

The key topics covered in the course content are the factors that are driving the digital revolution in human resource management, as well as the patterns and results that are associated with it. According to the findings of the report, the process of digitally transforming human resource management can be attributed to five different factors: the digital demands of an organization's internal customers; the digital innovation of its industry; the challenges faced by competitors; the governance of digital innovation; and the demands of an increasingly digital era. This article takes a look at some of the most important aspects of the digital revolution taking place in human resource management. These aspects include the digital workplace, digital HRM processes, and digital employee services. The study focuses primarily on the use of cutting-edge digital technology to carry out operations associated with digital human resource management, such as selection, training and development, and assessment. It is important to emphasize that despite the fact that digital transformation offers benefits for the expansion of businesses, its potential effects—such as the manner in which both the old and new human resource management systems are converted, as well as the drawbacks of the new system—cannot be ignored [6].

Personnel resources available (HR). Using the quantitative descriptive analysis of journals and proceedings that are the foundation of the Library of Online Knowledge, it offers a glimpse of the research that utilized AI in the field of HR between the years of 2000 and 2018. The research was conducted between the years of 2000 and 2018. These publications and proceedings are the foundation upon which the Library of Online Knowledge was formed (B-on). The B-on was used in this particular line of investigation. It has been discovered that a total of 32 research articles have been published looking at how artificial intelligence is being applied in the context of human resources. These publications can be accessed here. In order to simplify the study and make it simpler to

understand, the 18 years of research were broken up into three distinct time periods. This was done to improve learning (First decade, Reduction Period and Period of Growth). Additionally, the report brought to light the prevalence of AI applications in fields connected to human resources as well as the breadth of their reach (HR). As a direct result of this, it was found that there are not many research on the application of AI to human resources, despite the fact that its usage is widespread. The nine inferences that can be drawn from the facts presented in this article are likely to serve as a catalyst for the initiation of more research [7].

Our capacity to operate as an organization has been compelled to advance, and as a direct consequence of this, it has developed into an important aspect of our whole business plan. The consequences of digital transformation may cause changes not only in the expectations of consumers but also in the assessments of services and products as well as in customer behavior. A great number of companies are coming to the realization that they need to modify their business models in order to maintain a competitive advantage over their rivals, to keep up with the digital transformation of the markets in which they compete, and to effectively react to shifts in customer behavior. This is the case for a number of reasons. Both before and after the COVID-19 outbreak, there were adjustments made to the statements that several companies and industry leaders made on digital transformation. Before the outbreak, there may have been more of a rush or a desire to thrive quickly. This might have contributed to the situation. The outbreak, on the other hand, proved that the digitalization of information or the blending of online and offline worlds is now necessary for survival. If companies don't do this, they may not be able to stay in business [8].

### **3. Materials**

#### **❖ HRM Model.**

A pattern is not only a collection of rules or guidelines that people may adhere to in order to carry out the instructions that they have been given, but it is also a typical manner of doing anything. HRM model is an acronym that refers to a basic framework for human resource management (HRM) activities that has been created over time by a certain organization or manager group. HRM stands for human resource management. HRM goals, methods, strategies, content, and other elements are covered in detail. They should know the knowledge and method. Subcategories of the HRM model include personality management, position management, performance management, payment management, and the perception, placement, professional, and preservation (5P) mode. The 3P model [9], which stands for human resources management performance assessment, position analysis, and payment distribution, is one of the many names given to the HRM paradigm.

#### **❖ 3P Model of HRM.**

The three major points that make up the core chain of the 3P model of HRM are as follows:

- The findings of the job analysis are used in the process of determining how the duties should be distributed among the employees.
- While establishing performance assessment indicators and programs, it is important to take into consideration the job responsibilities of workers.
- In light of the results of the performance review, clarification is provided on the criteria for salary, perks, and incentives.

Within the context of the 3P management model, the performance evaluation system plays the role of the model's focal point, the job analysis serves as the model's starting point, and the pay distribution system acts as the model's final result. There is a connection between all three. The three-pronged method to managing human resources has a few flaws that need to be addressed.

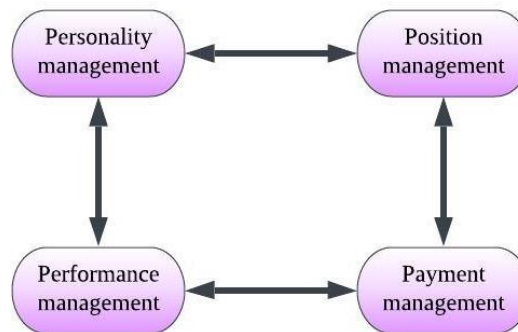
- Companies tend to ignore how human resource management (HRM) influences the expansion of employees, the creativity of businesses, and the creation of new projects.
- Companies build their hiring practices on the requirements of the jobs they provide and then look for people that meet those standards. Even though people are a company's most important strategic resource, positions and people are two key components that cannot be overlooked because of their importance to the organization.

- There is a lack of consideration given to the relationship between the business development strategy and HRM.

The 3P model just links the HRM components horizontally and quickly; the business strategy module is not used to a significant degree in any way by the model. In order to satisfy the requirements that come along with expansion in the modern day, HRM has to establish horizontal alignment throughout its many modules, as well as vertical alignment with company strategy [10].

#### ❖ *4P Model of HRM*

The 3P model served as the foundation for the subsequent creation of the 4P HRM model. You may use one basic concept, two critical ideas, and four important matches to explain it. As far as feasible, the company's strategic plan should serve as a compass and focal point for the activity. Both "people" and "posts" are mentioned in the discussion of the two fundamental topics under consideration in this article. One basic notion and two vital principles underpin each of the four major matches that must be established in order to produce the greatest possible match between persons, between individuals and occupations, between positions and positions, and between individuals and organizations. These matches include those between persons, individuals and occupations, positions and positions, and individuals and organizations. To reach the aim of generating the best possible match between two people, each of these four fundamental matches must be developed. These are the matches that must be created in order to create the best potential match between persons. Figure 2 depicts the 4-P paradigm for human resource management in enterprises [11].

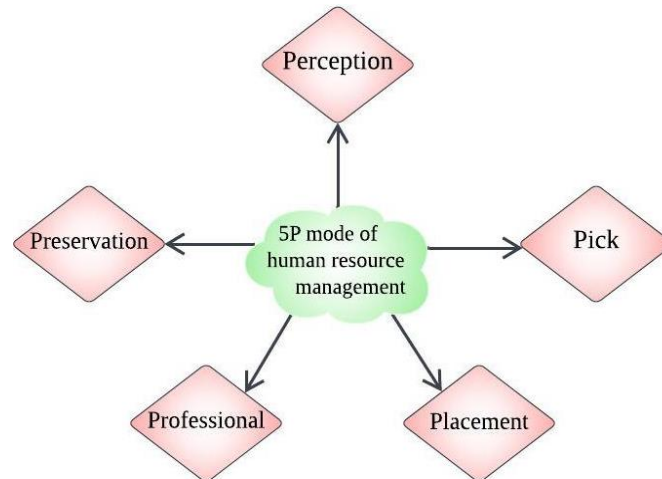


**Figure 2: The 4P model of HRM**

Figure 2 depicts the 4P model of human resource management thinking, which consists of quality management, post management, performance management, and pay management respectively. The process of identifying, examining, categorizing, and evaluating the many positions that are held within an organization is one of the numerous responsibilities that fall within the purview of post management. Analysis of the quality of people is performed through quality management. In order to accomplish this goal, After that, a quality model is developed that takes into account the organizational structure of the firm, the goals of the corporation, and the duties of the employees. The results of this model are then used in an effort to improve the overall quality of the product that is ultimately produced. Performance management seeks to complete the management loop by planning and defining objectives, implementing and supporting performance, assessing and evaluating performance, providing feedback and development, and improving employee work performance. This process also includes the feedback and improvement of employee job performance. This process also includes the feedback and improvement of employee job performance. This process is known as performance management. Pay is elevated to the level of corporate strategy when compensation management is used. Compensation management places a significant focus on both the strategic direction of the company as well as success-sharing [12].

#### ❖ *5P Model of HRM.*

The 5P model of human resource management, which is represented in Figure 3, is comprised of the following five core activities: perception, pick, placement, professional, and preservation.



**Figure 3: The 5P model of HRM**

According to their analysis, the company divides its operations into multiple divisions based on the requirements and responsibilities of the various departments, and that it then chooses candidates for each position based on the qualifications listed in the job description. This information was gleaned from the company's internal operations. "select" refers to the need placed on firms to identify and recruit exceptionally talented individuals as well as to put reliable methods for evaluating talent into practice. The process of getting to know people, accomplishing tasks in an effective manner, and providing staff members with access to opportunities for advancement is referred to as placement. The education of staff members on newly discovered information and technological advancements is one professional method that can be utilized to improve the quality of employees by fostering the growth of their skills. It is vital, in order to reduce the loss of brain power, to create a performance evaluation system as well as a pay incentive program that is founded on scientifically valid notions. The 5P model of human resource management is comprised of the following five primary types of systems: Quality management includes job analysis, recruiting, configuration and use, training and development, assessment and compensation [13].

#### **4. Research Methodology**

The present research used a quantitative approach in addition to a descriptive one in order to investigate the evolution of various applications of artificial intelligence (AI) within the context of the field of human resources (HR). After taking into account a wide range of diverse elements, each of which may or may not have been essential to the investigation's primary objective, we were able to arrive at these conclusions. On the website of the Online Knowledge Library (B-on), four distinct varieties of internet searches were carried out. Each of these search categories has a unique grouping of words and ideas that are connected to one another (Neural network or ANN and Human resources; artificial intelligence or AI or A.I. and Human Resources; artificial intelligence or AI or A.I. and recruitment and selection; artificial intelligence or AI or A.I. and recruitment). While searching for keywords in the English language in academic and scientific publications as well as conference materials between the years 2000 and 2018, the "SU - Subject Terms" filter was used. In order to make the material easier to comprehend, the historical time period that was being discussed was segmented into three distinct chronological milestones that were tied to the use of artificial intelligence in HR.: It is standard practice to refer to the first term, which spanned the years 2000 to 2010, as the "First Decade." This term was in effect from 2000 to 2010. The second phase, which ran from 2011 to 2017, has been referred to by some individuals as the "Reduction Period." Many have been referring to the third term, which started in 2018, as the "Period of Growth" for a while now [14].

##### **❖ Performance Analysis of the Optimized SPM.**

As compared to the performance of existing machine learning regression methods, the improved BPNN-based SPM hybrid strategy performs quite well. Each algorithm was subjected to a total of ten trials, and the following table presents the algorithms that performed the best overall:

**Table 1: Comparison of salary regression forecasting algorithms.**

Algorithm	Training score	Test score
Nadam	0.78	0.78
Linear	0.81	0.77
Polynomial	0.92	0.76
Ridge	0.79	0.77

Using the use of a logistic regression analysis, the training scores of 0.76 and 0.77 were investigated in order to make a projection about the value "Nadam." According to the findings of the logistic regression analysis ( $\chi^2(3) = 4.5, p.212, n = 4$ ), the model does not meet the criteria for statistical significance in its whole.

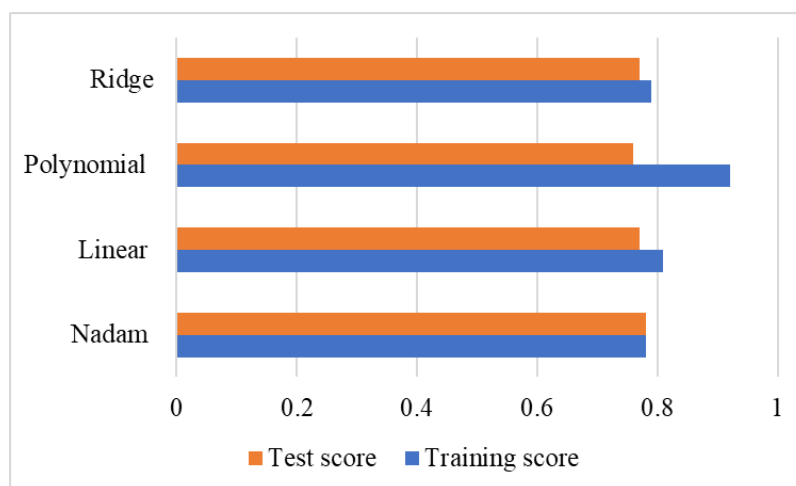


**Figure 4: Statistical Diagram**

A positive value is indicated by the coefficient of the training score, which is 0. This suggests that a higher Training score is associated with a greater possibility that "Nadam" is the variable that is being dependently examined. Nevertheless, given that this influence has a p-value of 1, it cannot be considered statistically significant. If the odds ratio is one, this indicates that there is a one-to-one correspondence between an increase in the variable Training score and an increase in the chance that the dependent variable is "Nadam."

The value  $b = -40.98$  represents the negative coefficient for the variable 0.76. This suggests that the chance of the dependent variable being "Nadam" decreases as the value of the variable gets closer to 0.76. Nevertheless, given that this influence has a p-value of 1, it cannot be considered statistically significant. If the independent variable is 0.76, then there is a 0.76-times increase in the chance that the dependent variable is "Nadam." This corresponds to an odds ratio of 0.

The value  $b = -40.98$  represents the negative coefficient for the variable 0.77. Nevertheless, given that this influence has a p-value of .999, it is not considered to be statistically significant.



**Figure 5: Comparison of salary regression forecasting algorithms.**

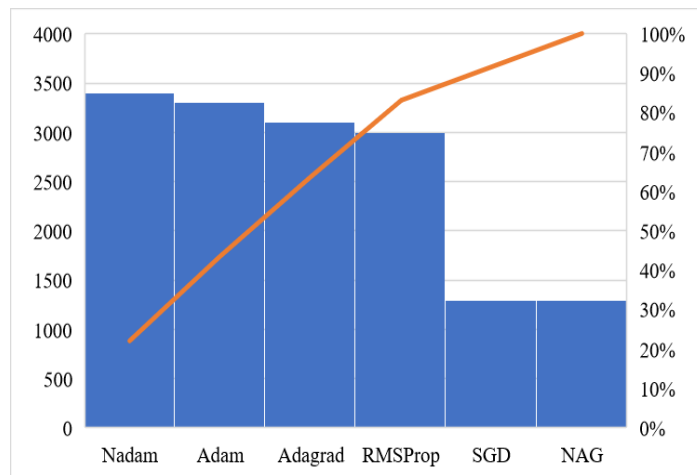
Figure 5 shows the BPNN-based SPM improved by Nadam's hybrid algorithm with several alternative techniques. The training set received a score of 0.77, while the test set had a score of 0.76. These two scores are pretty comparable to one another. This indicates that the BPNN-based SPM is superior to its competitors [15], since it was enhanced utilizing the Nadam hybrid algorithm.

❖ *Performance Comparison of Various Optimization Methods.*

In addition to this, the algorithm operates more effectively and converges at a faster pace. The Nadam hybrid optimization technique arrives to a solution more faster than the Adam hybrid optimization approach does. In order to conduct a more precise analysis of the effectiveness of the various optimization strategies, Table 2 provides a comparison of the training effects of the following optimization strategies:

**Table 2: Training results of various optimization algorithms**

Optimization algorithm	cycle	Test score
SGD	1300	0.739
NAG	1300	0.739
Ad grad	3100	0.76
RMS Prop	3000	0.749
Adam	3300	0.79
Nadam	3400	0.81



**Figure 5: Training results of various optimization algorithms**

In Figure 5, hybrid optimization Adam and Nadam predicted best and trained fastest. This is a comparison of the optimization techniques SGD, NAG, Ad grad, and Respro. This is due to the fact that the methodologies in question incorporate both traditional and cutting-edge optimization methods, which is the reason for the aforementioned outcome. The total amount of time spent training is 192 seconds, and using the Adam optimization technique results in a final prediction score of 0.7502 for each individual. The total amount of time spent training was 186 seconds, and the highest possible score that can be expected using the Nadam optimization method is 0.7504. The Nadam algorithm has the best rate of convergence while also presenting the most opportunity for further development. It makes perfect sense to be able to employ the Nadam approach in order to maximize the performance of the BPNN-based SPM.



## 5. Analysis and Interpretation

The training outcomes of Root-Mean-Square Propagation (RMSP), Stochastic Gradient Descent (SGD), Nesterov Accelerated Gradient (NAG), and Adaptive Gradient (Adagrad) are contrasted with those of Adam and Nadam optimization strategies (RMSProp). The investigation of the varying rates at which various optimization strategies achieve their desired results. These hybrid approaches to optimization As compared to the optimization strategies SGD, NAG, Adagrad, and RMSProp, the update stability and convergence rates of Adam and Nadam are much higher. Adam and Nadam are also more stable. In addition to this, the algorithm operates more effectively and converges at a faster pace. Adam hybrid optimization takes longer than Nadam. To evaluate optimization tactics more accurately, training effects are examined.

**Table 3: Optimization algorithm**

		Optimization algorithm					
		SGD	NAG	Ad grad	RMS Prop	Adam	Nadam
	<b>Frequency</b>	1	1	1	1	1	1
<b>Cycle</b>	<b>Mean</b>	1300	1300	3100	3000	3300	3400
	<b>Minimum</b>	1300	1300	3100	3000	3300	3400
	<b>Maximum</b>	1300	1300	3100	3000	3300	3400
<b>Test score</b>	<b>Mean</b>	0.74	0.74	0.76	0.75	0.79	0.81
	<b>Minimum</b>	0.74	0.74	0.76	0.75	0.79	0.81
	<b>Maximum</b>	0.74	0.74	0.76	0.75	0.79	0.81

### *Two-factor ANOVA*

- A two-factor analysis of variance with measurement repetition was carried out in order to determine whether or not there was a significantly different level of performance between the groups pertaining to the first component, "cycle and Test score" (repeated measurements), with regard to the dependent variable. This was done in order to determine whether or not there was a significant difference.
- a statistically significant difference in the dependent variable between the groups in the second factor optimization procedure.
- There is an interaction between the two components "cycle and Test score" and "Optimization technique" with regard to the dependent variable that is being studied.
- The findings of the two-factor analysis of variance with repeated measurements indicate that there is a significant difference between the groups of the first factor, "cycle and Test score," in connection to the dependent variable, with a p-value of aN. This indicates that the difference is statistically significant.
- There is a significant difference in the relationship of the dependent variable between the groups of the first factor optimization procedure, denoted by the symbol  $p=aN$ ; • With regard to the dependent variable, there is no interaction between the variables Optimization method and "cycle and Test score," denoted by the symbol  $p=1$ .

**Table 4: Hypothesen**

<b>Null hypothesis</b>	<b>Alternative hypothesis</b>
There is no significant difference between the groups of the first factor cycle and Test score (measurement repetition) in relation to the dependent variable.	There is a significant difference between the groups of the first factor cycle and Test score (measurement repetition) in relation to the dependent variable.

There is no significant difference between the groups of the second factor Optimization algorithm in relation to the dependent variable.	There is a significant difference between the groups of the second factor Optimization algorithm in relation to the dependent variable.
There is no interaction effect between the factor cycle and Test score and Optimization algorithm	There is a interaction effect between the factor cycle and Test score and Optimization algorithm

## 6. Result and Discussion

A Pearson correlation was carried out in order to ascertain whether or not there was a connection between cycle and Test score. The results of the Pearson correlation ( $r(4) = 0.77$ ,  $p = .071$ ) indicated that there was no significant association between cycle and test score.

**Table 5: Model**

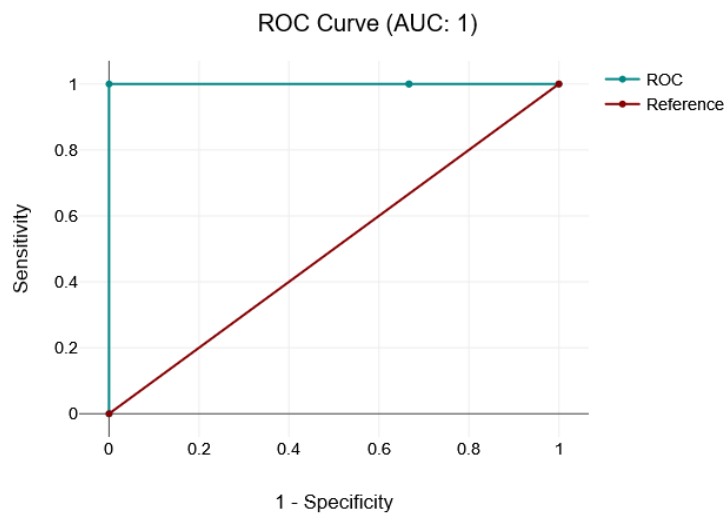
	Unstandardized Coefficients	Standardized Coefficients			
<b>Model</b>	B	Beta	Standard error	T	P
Constant	-232383.65		123634.68	-1.88	.201
<b>Test score (X)</b>	308242.41	9.1	162219.48	1.9	.198
<b>Test score (W')</b>	485899.7	14.34	256738.07	1.89	.199
<b>(X * W')</b>	-982376.1	-22.68	535800.01	-1.83	.208

The relationship between the variables cycle and Test score has a strong positive correlation ( $r=0.77$ ). In this group, there is a strong, positive correlation between cycle and Test score.

**Table 6: Moderation and mediation analysis**

	Coefficient B	Standard error	z	p	Odds Ratio	95% conf. Interval
<b>Training score</b>	0	1516180.33	0	1	1	0 - Infinity
<b>0.76</b>	-40.98	213777.12	0	1	0	0 - Infinity
<b>0.77</b>	-40.98	36520.7	0	.999	0	0 - Infinity
<b>Constant</b>	20.03	1182698.6	0	1		

Initial parameter settings affect the model training output's convergence and maximum value. Merging the weights of the initial connections lowers the state value of each neuron to near zero, making it difficult to reach the fat zone. The situation has improved. During beginning, same-layer neurons cannot swap weights. Hence, the computation's outputs and gradients will remain unchanged, as will the final updates. Meeting the requirements is easy when the connection weight is extremely small and random. When setting settings, connection weights are commonly set to a little random value. Adjustments are possible. This method achieves maximum convergence speed.



**Figure 6: ROC-Curve**

## 7. Conclusion

In this age of digital information, it is now much simpler to track down outstanding people thanks to the development of technologies such as big data and AI. Traditional HRM systems, on the other hand, are unable to examine data linkages or estimate future developments using data that has already been recorded in the system. This is because conventional HRM systems only save data after it has been entered into the system. In order to broaden the HRM system's range of applications and as part of this project, BPNN-based SPM. Experimental simulation evaluates the BPNN-based SPM's functioning after Nadam's hybrid optimization strategy improves the model. The Nadam hybrid algorithm-enhanced BPNN-based SPM scores 0.7732 and 0.7730 on the training and test sets, respectively. This stands in stark contrast to other strategies, which provide less effective outcomes. In addition to this, the Nadam hybrid algorithm that is augmented by the BPNN-based SPM delivers greater results in terms of learning and prediction outputs. As a direct result of this, the results may be helpfully used in practice and serve as a useful reference. In addition to this, the study that is being carried out right now is subject to a variety of limitations. The model that was proposed is only a little bit complicated, but it is not very well developed. The model will have more characteristics derived from the sample data added to it, and its functionality will also be enhanced, with the purpose of achieving a higher degree of precision.

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