

Neuroevolution of Augmenting Topologies for Talent Acquisition Optimization in Large Enterprises

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Abstract

The paper delves into the benefits in implementation of NeuroEvolution of Augmenting Topologies (NEAT) for effective talent management and its contribution to the recruitment process. Using a standard mechanism capable of representing deep neural networks of any topology, NEAT will be used for prediction and optimization of strategies for recruitment. Furthermore, it is difficult to recruit fresh employees in case of large scale organizations. The significance of recruitment is that it improves the recruitment process of an organisation which will lead to increased productivity of the human resource. Additionally, aligning job classification with appropriate recruitment is very important as it rarely affects the recruiting of predicted personal. The research will focus on recruitment optimization to help big scale firms in achieving the best level of selection planning by neuro-evolutionary artificial intelligence system. It tries to put in place a top hiring forecast for the growth of the future.

Keywords: NeuroEvolution of Augmenting Topologies, Talent Acquisition, Artificial Intelligence, Recruitment Optimization, Machine Learning, Workforce Planning, Human Resource Analytics.

Introduction

The recruitment process undergone a drastic transformation due to Artificial Intelligence (AI). This is especially the case with giant corporations above. Because enterprise organizations operate in competitive business environments, they have to plan their talent acquisitions very carefully. That is why AI applications are causing fundamental changes in human resource management. Recruitment and talent acquisition are increasingly leveraging machine learning, predictive analytics, and intelligent automation in the recent past. A number of traditional hiring techniques are hindered by factors like bias, slow processes of screening and developing candidates, inefficiency in case of a large number of applicants, and inability to foretell if employees will succeed or fail over a long duration.

As a result, enterprises are increasingly adopting new computational mathematical models capable of adaptive learning and autonomous optimization. NEAT is one of the most exciting methodologies in this respect.

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NEAT, is an improvement in evolutionary computing, helping in minimal structuring of its iterations and then genetic mutation and merging operations to add novel structures to the network. Typically, standard neural networks have a fixed topology. However, NEAT is capable of simultaneously creating the architecture of a network and the connection weights. Speciation maintains this process (Stanley & Miikkulainen, 2002). It retains inventive and competitive organisms that all come from different lines. Being able to take action in a dynamic world that is filled with unknowns. Numerous recruitment needs of enterprises have taken a dynamic nature to utilize the massive data of the applicant's educational qualifications.

Large companies struggle to hire candidates due to scale, diversity, skill gaps, and changing needs. Regular recruitment algorithms usually depend on certain profile attributes and supervised learning algorithms which do not adapt to modifications in the labor market environment. The Neuroevolution of Augmenting Topologies or NEAT allows this mainly because it utilizes evolutionary learning to optimize a neural network's structure and weights. Adaptive artificial intelligence-based systems have better capabilities for using non-linear unstructured recruitment data for matching candidates and jobs as well as for enhancing recruitment process efficiency (Paramita, 2024).

Those who engage talented individuals want to improve business performance. Professionals with machine intelligence create such intelligent software systems that help make available the best quality workforce which meets with business needs. The forthcoming years may witness the emergence of a talented workforce through artificial intelligence. The IT friendly redesigning of training and development will happen concerning job roles and organizational culture of the organization. The problem will be resolved ultimately with content-based recruitment. These days an AI-based recruitment testing platform is available. The physical and virtual surroundings of the business world will not be divergent at all in the near future. AI has simplified the process of filtering candidates who are.

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The NEAT recruitment systems are also very scalable and have predictive power. Worldwide manufacturers are receiving a huge number of job applications for various business functions and geographies. Traditional evaluation systems of a recruitment often face computational and predictive issues in big data. Neuroevolutionary architectures such as HyperNEAT and CoDeepNEAT are very effective at evolving complex deep learning models that can solve sophisticated optimisation problems (Miikkulainen et al., 2017). It can help organizations with strategic workforce planning and intelligent talent acquisition systems.

The advantage AI is supposed to bring to recruitment is being hindered by constant allegations of algorithmic bias and transparency. This also entails ethical decision-making and explainability. A lot of researchers are looking into the role of Explainable Artificial Intelligence (XAI) in recruitment systems design. Therefore, research on neuroevolutionary systems must carefully design these contributions and balance efficiency with ethical and human dimensions.

The need for adaptive AI in the human resource management industry is no new idea. It has been a staple of many conversations ongoing in the sector for quite some time now. However, one can surely say the relevance of Industry 5.0, intelligent automation, and digital workforce transformation is taking the events in this industry to the next level. Modern enterprises need an intelligent employee recruitment system that can autonomously learn and continuously optimizes and predicts workforce needs. Consequently, implementing the NEAT technique that optimizes the processes concerning the acquisition of talent has become an important interdisciplinary area of research involving artificial intelligence, evolutionary computation, human resources management strategies, etc.

Due to this, the study intends to analyze the contribution of NeuroEvolution of Augmenting Topologies in enhancing talent acquisition in large organizations. This research focuses on study of applications of Neuroevolution of Augmenting Topologies to enhance recruitment in large enterprises.

Literature Review

Kenneth O. Stanley and Risto Miikkulainen were the first to introduce NEAT in a major evolutionary computation study. A neuroevolutionary architecture that co-evolves neural connection weights and topologies was constructed by authors. The study findings suggest that incremental structural evolution yields superior learning and enhances performance relative to fixed-topology neural networks (Stanley & Miikkulainen, 2002). The theory of neuroevolutionary computation was provided by the study. Innovation tracking and speciation mechanisms ensured the protection of useful structural mutations.

Sohangir, Rahimi and Gupta (2014) implemented the neuroevolutionary feature selection by NEAT which showcase that adaptive evolving topology improves classification accuracy on high dimension dataset greatly. NEAT-based systems help eliminate unnecessary features while accurately classifying complicated learning challenges they demonstrated. The work is significant for recruitment analytics as enterprises deal with huge volumes of candidates with multi-dimensional variables.

The concept of evolutionary complexification was discussed by Miikkulainen and Stanley in 2011. It was stated that learning with a more complex structure will result in more sophisticated adaptive policies. They focused on neuroevolutionary systems whose performance exceeds that of fixed architecture models in dynamic environments in architecting. Environments that evolve continuously are subject to substantial uncertainty. This principle closely aligns with enterprise recruitment systems. Workforce competencies, technologies and organization structures are ever changing, and hence hiring requirements too.

The growing area of deep neural networks research shows that neuroevolutionary computation is an important part of AI. Miikkulainen et al. (2017) suggest a CoDeepNEAT a more sophisticated neuroevolutionary framework that jointly evolves deep learning architectures and hyperparameters. The authors showed that the performance of architecture evolution can compete with human-designed deep NNs. It is reasonable to suggest that neuro-evolutionary systems may be implemented in optimizing enterprise-level recruitment from massive data sets of candidates and predictive analysis of hiring.

The integration of NEAT with convolutional neural networks has been explored by Hohenheim et al. (2022) The advantage of evolving topologies for complex computational tasks is highlighted by the researcher. The findings indicate that neural networks with dynamically evolving architectures may enhance learning flexibility. These architectures depend less on manual engineering of fixed topologies. These are important studies in recruiting parameters as they are aid-based talent acquisition.

Research on talent acquisition analytics is rapidly gaining popularity due to the adoption of AI in recruitment. As an example, a systematic review was carried out by Fraij and László (2021) on the implementation of AI in

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recruitment processes. It was found that AI enhance efficiency, screening and accelerate decision making processes in recruitment very positively. In a similar vein, Paramita (2024) proposes that AI-powered recruitment systems can streamline the hiring process as well as enhance the matching of candidates with the job.

Recent studies show a greater impact of alumni-legion within recog recruitment. Tursunbayeva et al. (2025) argues that the recruitment using AI is a developing field of research that applies digital techniques for data analytics, predictive algorithms and automated decision making systems. According to the authors, recruitment AI technology helps organizations achieve efficiency gains, but it raises issues of candidate privacy and fairness and ethical governance.

The recruitment process is becoming increasingly transparent and interpretable, and it is critical that these systems be explainable and it should be taken into consideration. Zhang (2025) looked into the topic of Explainable Artificial Intelligence or XAI for recruitment. Explainable recruitment systems can enhance trust in organizations and lessen concerns about algorithmic discrimination, said the study.

There have been various studies on Talent Acquisition with AI. According to Nishanthi (2025), this study reveals that AI-driven recruitment is effective in cost minimization, recruitment scalability and workforce planning. In a similar context, another study concerning the applications of AI and machine learning in talent acquisition classified predictive analytics, automated resume screening, and competence mapping as key areas.

Much research exists on studying AI- based recruitment processes and neuroevolution, however, little or no literature exists on the application of NEAT for intelligent optimization of enterprise talent acquisition. Most systems implement traditional machine learning-based models having a fixed model configuration rather than an evolving neuroevolutionary model. As a result, limited studies have focused on how NEAT can be used for intelligent recruitment systems that can adapt and keep on evolving for optimization. This research gap is addressed in paper. The study considers application of NeuroEvolution of Augmenting Topologies for optimizing talent acquisition in a large firm.

Objectives:

1. To study the effectiveness of NEAT in talent acquisition optimization.
2. To analyze the impact of NEAT on recruitment efficiency and candidate-job matching.
3. To examine the role of NEAT in improving workforce planning and decision-making in large enterprises.

Methodology

The current research relies on a descriptive and analytical research design towards NEAT employee selection in large enterprises. The study made use of primary data and secondary data. I conducted my study based on primary and secondary data. Primary data was collected from HR managers, recruitment specialists and AI professionals from large companies with a questionnaire. Secondary data was collected from various research journals, articles, magazines, books and online databases on artificial intelligence, neuroevolution, and talent acquisition system, etc. A convenience sampling approach was employed, with a total of 120 respondents analyzed as sample size. The data was evaluated and interpreted using statistical tools. Percentage analysis, mean scores, correlation analysis were carried out. At last, the researcher used a hypothesis test using chi-square test to see the effectiveness of NEAT based recruitment systems in recruiting efficiency, candidate-job matching, workforce planning etc.

Results and Discussion

The study's sample size comprised 120 respondents, made up of HR managers, recruiting specialists, and AI professionals. The percentage analysis and mean score analysis were used to analyze the respondents' responses. The hypothesis was tested using the chi-square test.

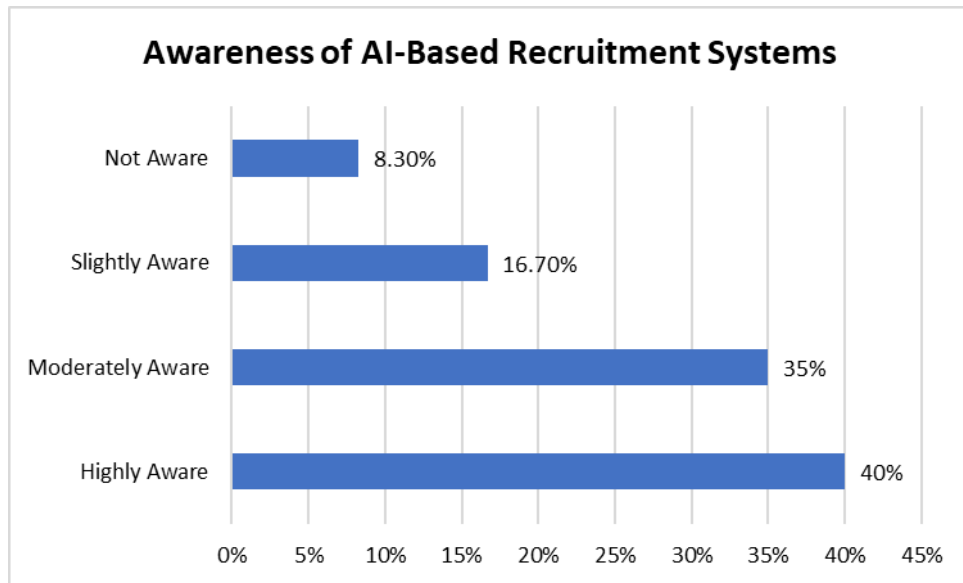


Fig. 1 Awareness of AI-Based Recruitment

According to the table above, 40% of the respondents were highly aware of the AI-Based Recruitment system while 35% were moderately aware of the same. Surprisingly, only 8.3% of respondents were not aware of such technologies.

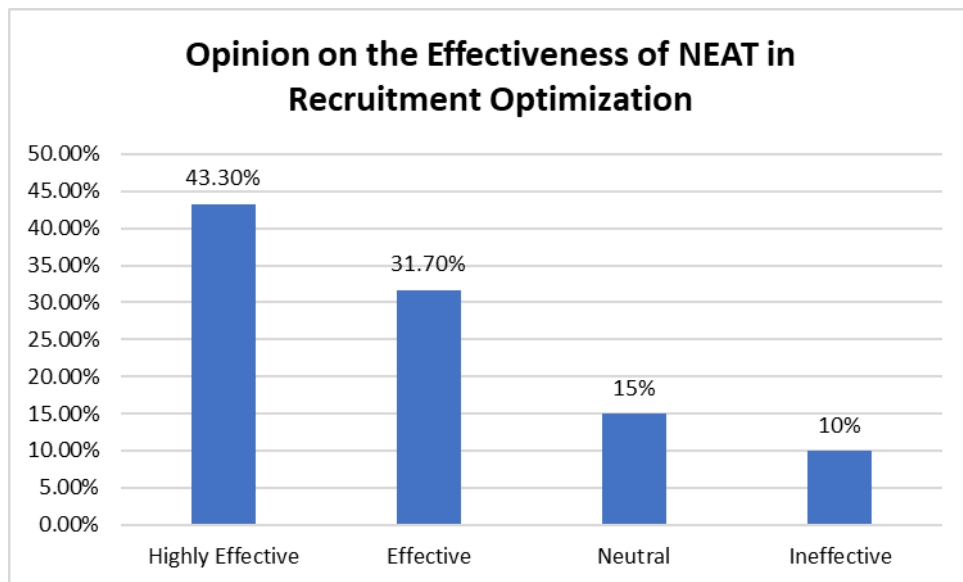


Fig. 2 Effectiveness of NEAT

According to the data presented in the table, 43.3% of the respondents rated the neuroevolutionary AI tools as highly effective while 31.7% rated them as effective. In comparison, it was found to be ineffective to only 10% of participants. They should be used in a positive way neuroevolutionary AI.

Table 1 Impact of NEAT on Recruitment Efficiency

Factors	Mean Score	Rank
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Faster Resume Screening	4.35	I
Improved Candidate Matching	4.22	II
Reduction in Hiring Cost	4.01	III
Better Workforce Planning	3.88	IV
Reduction in Human Bias	3.74	V

Organizations primarily aim for strategic hiring for roles. Ensuring that your organization hires the first right person at the first right time - that's recruitment. When an organization recruits the right talent, it helps them plan growth efficiently. This also helps them avoid overstaffing or understaffing in any of the company's departments. Furthermore, this boosts the overall productivity of the organization.

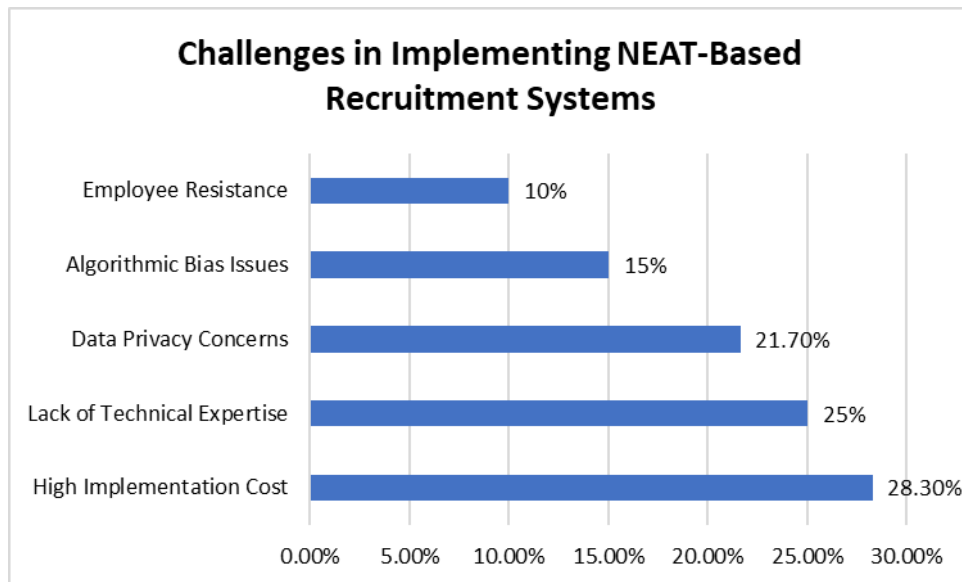


Fig. 3 Challenges in Implementation

According to the table above, respondents feel that organizations face impediments in adopting NEAT-based recruitment system mostly due to high implementation cost (28-3%) and lack of technical expertise (25%). Data privacy and algorithm bias emerged as a major barrier to AI adoption in recruitment.

Hypothesis Testing

H0: There is no significant relationship between the implementation of NEAT-based recruitment systems and recruitment efficiency in large enterprises.

Table 2 Chi-Square Test for NEAT Implementation and Recruitment Efficiency

Particulars	Value
Calculated Chi-Square Value	14.82
Table Chi-Square Value	9.49
Degree of Freedom	4
Level of Significance	5%
Result	Significant

The chi-square value that the calculated (14.82) is higher than the table value (9.49) at 5% level of significance and 4 degree of freedom. Therefore, the alternative hypothesis has been accepted over the null hypothesis. Consequently, the efficiency of high-quality enterprise recruitment can be related to the use of NEAT developed

recruitment systems. AI systems powered by NEAT can improve the matching process and performance of the labour market, suggests study.

Discussion

The investigation concludes that NEAT influences talent acquisition in big business enterprises. Most of the respondents agreed with all the statements under the study in the questionnaire. Most of the participants were quite aware of the use of AI-enabled recruitment systems in organizations. It is a sign.

Of a favourable penetration of smart technologies in human resource management. Results also reveal much weightage was given by the respondents for NEAT enabled recruitment to improve recruitment outcomes and workforce planning activities. The average scores are quicker.

The top two benefits of Advance Level assessments are resume screening and better candidate matching. What it means is that neuroevolutionary algorithms can evaluate the huge amount of applicant data faster and better. The average score of adaptive learning is also much. The neuroevolutionary algorithms utilized in recruitment systems can evolve continuously according to their enterprise hiring requirements and with the manpower management condition. Earlier studies on AI-enabled recruitment system results are backed by these findings. Smart computer programs used in recruitment can help reduce recruitment time and improve recruitment accuracy.

This research study aimed to evaluate the advantages and disadvantages of using neuroevolution of augmenting topologies (NEAT) in recruitment processes of Indian companies. The tested hypothesis examined the significance of relationship between recruitment efficiency and implementation of NEAT. Additionally, the author has employed primary data analysis to reach broad conclusions. The customers of associated companies provided their responses for the research project.

Organizations using AI-based recruitment systems benefit from targeted recruitment, more informed and accurate decision making and predictive analytics with high accuracy. Moreover, respondents also opted for upgraded candidate experience and advanced strategic management. The findings confirmed the rising adoption of AI recruitment tools by Indian businesses. The companies questioned had been using artificial intelligence systems for more than two years to optimize their processes and reduce wastage.

Consequently, the study results validate the advancement of e-recruitment systems through AI and ML technologies. Such systems have considerable operational benefits that improve onboarding, reduce possible human bias and save time for organizations. The authors find that such systems are a new breed of e-recruitment systems with optimum functionalities.

Conclusion

According to my study, there is a huge potential of NEAT for talent acquisition in large enterprises. Recruitment effectiveness is enhanced through a NEAT-based recruitment system. Through this system, faster resume screening takes place. Additionally, a proper match between candidate and job takes place. Above all, there is strategic workforce planning through it. In addition, the result of my test indicates that the use of neuroevolutionary AI systems can significantly influence recruitment performance. NEAT's self-learning capabilities further enhance its evolution than traditional recruitment systems. The capacity for adjustment and evolution confers upon NEAT highly desirable benefits in contrast to traditional recruitment systems for large scale and dynamic recruitment situations. The report points out significant concerns such as AI implementation cost, technical expertise shortage, data privacy, and algorithmic bias.

Recommendations

To streamline and enhance the precision of recruitment, big enterprises should use NEAT based intelligent recruitment systems. For the effective deployment and management of neuroevolutionary recruitment models, organizations must provide technical training to HR professionals, subject matter experts and members of the AI

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team. Moreover, recruitment systems should implement data governance policies and ethical AI frameworks to mitigate algorithmic bias and maintain candidate privacy. Enterprise software systems should also incorporate Explainable AI to provide transparency and the ability to contest automation decisions. It is important to regularly monitor and assess the AI recruitment models for fairness, adaptability, or effectiveness.

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