

Exploring the dynamica virtus of Machine Learning (ML) in Human Resource Management - A Critical Analysis of IT industry

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Abstract— “A breakthrough in machine learning would be worth ten Microsofts” - Bill Gates, Chairman, Microsoft
The fact that humans have been progressing to reach a point where machine does most, if not all the mechanical labor is not new. What is new is the use of machines that is intelligent enough to replace humans in analyzing situations, portraying situations and scenarios, and then taking the (presumably) right decisions. This paper focuses on the use of machine learning that has replaced certain functions related to Human Resources Management, specifically in the IT industry. The paper is sectioned into five parts. In the first section the topic on hand is introduced, evolution of Machine Learning, introducing congruence of Machine Learning with HR functions such as Recruitment, Performance Management, Training & Development, Managing Attrition, Compensation Management etc. Section two, does a literature review that outlines the work previous written in this area i.e review of literature is done on this aspect. Section three takes a case study approach to highlight select IT companies that are using AI/ML for their HR functions. The fourth section attempts to design a simple Model from the literature review done. The fifth section presents the authors’ conclusion of the findings, and draws a futuristic picture.

Keywords— Machine Learning (ML), Replacing HR with ML, AI and HRM

I. INTRODUCTION

Unerringly in the current scenario, in any business ecosystem it is a competitive necessity to have data information play a big role in strategy, planning and operations & implementation, rather than a competitive differentiator. Every industry now talks about analytics and its crucial role in decision making, be it marketing, finance, customer relationship or management of human resources (HRM).

Companies that were not generally using data to address critical decision making scenarios such as – Improving Manager effectiveness; Impact of Employee engagement; Team performance issues; etc. have started using Data and its analysis in a big way . Human resources as stream and its managers and leaders are now learning to recognize that data-driven insights can have a major impact, reducing risk and driving success in decision-making around talent management and organizational performance - human talent prediction.

Managing the organizational talent is one among the many other challenges for HR professionals. Specifically to ensure the right person for the right job at the right time. Predicting human talent is an alternative to deal this concern. Use of classification and prediction in data mining which is used in

many other organizational functions can also be implemented to human talent.

II. MACHINE LEARNING IN HR- LITERATURE REVIEW

AI start-up companies invested a whopping \$300 million in 2014. This was an unbelievable 300% rise from the preceding year. A Gartner report [1] Oct 2016, made Top Three predictions. One of the predictions was the relationship of machined to humans. Further it said that (i) It is predicted that by the year 2018 at least 20% of the business content would be authored by machine; (ii) It is also predicted that by the same year, millions workers of the global workforce will over-seen by a robot; and last prediction seemed to be adverse for the Human Resources management (iii) By 2018, there will fewer employees that smart machines in nearly 45% of the rapidly developing companies!

Thanks to the new computing technologies, present day’s Machine Learning is unlike the earlier machine learning historically. Today’s machine learning has evolved from pattern recognition and the concept that computers can perform specific tasks without actually being automated to do so; The followers of Artificial Intelligence [2] sought to seek whether computers could learn from data and

information. There is a substantial focus on the repetitive aspect of machine learning that expose models to new data, which are able to adapt independently. Machines learn from previous computations to generate dependable, repeatable decision-makings and outcomes. In this section, the related work on the topic has been identified and presented in a nutshell.

Meghan M. Biro [3], mentions that AI programs can predict outcomes based on past experiences fed into the program. Because AI can recognize patterns and analyses data at light speed, it can help HR directors make decisions with greater confidence. He also suggests a few ways AI can work with the best HR professionals to better manage data-heavy tasks, spot top talent in unlikely places, and even improve employee satisfaction to reduce turnover rates.

- Algorithms can help find the right job candidates from a nearly endless pool of possibilities
- AI can assess candidates to find the best job position for them
- Evaluate more candidates faster with machine learning
- Improve employee satisfaction through regular, unbiased performance reviews aided by AI

In an earlier study *Meghan M. Biro* [4], says Algorithms, Talent Analytics, and Predictive Behaviour Technology definitely having a substantial effect on HR, and making it much more of a science. According to the study in a recruitment scenario, typically Recruiters devote on an average 6.25 seconds reviewing a resume. Given that there are lakhs of jobs created, it is presumed that computer algorithms do a better in evaluating skills, personality, and overall job fit than humans. In a related study, by a non-profit organization in the USA, - *National Bureau of Economic Research*, Machine-assessed candidates even stayed in their positions longer than those selected by recruiters.

Adam C. Uzialko, [5] in his study *How Machine Learning Is Changing the Hiring Process* narrates that Machines have the inordinate ability of rapidly scanning and organizing enormous volume of information . With the emergence of machine learning, they are becoming reasonably agile at providing scenarios & recommendations and decision-making support to humans as well. This aspect of machine learning can be best put to use in the hiring process, where both recruiter and recruit depend on a good fit.

Daniel Faggella [6], in his article '*Machine Learning in HR*' describes that Human Resources has been slow on the uptake of machine learning and artificial intelligence when compared to the marketing, communications, or even health care industry. Advances in algorithms have helped companies predict employee attrition. Thus the worth of

machine learning in human resources can now be assessed. Taking this one step further would be the deep-learning neural networks that are moving toward more apparent reasoning in depicting criteria for having taken a specific result or conclusion.

Mark Tomassen [7] (2015), in his study on *Machine Learning in HR* concludes that Machine Learning as an integrated part of various HRM technologies, has the potential to take over the administrative and repetitive tasks of HR professionals. This leaves HR professionals more time to create value for the organization. Machine Learning can make sure that HRM is taken seriously in the organization. HR decisions are backed up with data and the added value of HR cannot be denied by other departments or professionals.

Jeanne Meister [8] (2017), in her Forbes article *The Future of Work: The Intersection of Artificial Intelligence and Human Resources* notes that HR leaders have started to test chat-bots to bring a innovative change in the employee experience. Investment in AI has surpassed from \$282 million in 2011 to \$2.4 billion in 2015, which is a massive 746% increase in 5 years. The year 2016 continued to see the upsurge in the investment with another \$1.5 billion, in more than 200 AI-motivated companies.

Jo Faragher [9], in his study on *Artificial Intelligence* found that 15% of HR leaders were affected right now by AI and automation, while a further 40% think it will have an impact in the next two to five years. The role of technology overall in HR has increased in importance; 60% of the survey respondents felt that technology-enabled HR had become more central to their role in the past year. According to a global online research survey 86% of HR leaders felt that HR definitely has a vital role to play in helping and supporting organizational innovation.

Jim Barnett [10], in his research work on the role of AI in people management explains how predictive analytics meets perspective analytics in HR- by gathering data including employee engagement levels, performance information, feedback on culture, and insights on why people leave, AI can surface company-and team-specific predictions instantly. These predictions may comprise the types of employees who will be the most efficacious, the populations that are at high risk for turnover or performance-related concerns, or the kinds of teams that will develop the most innovative solutions. Making connections and identifying an order or methods using AI systems can be done in almost real-time, that would be other-wise difficult and time-consuming for individuals to discover. This makes the HR teams to become involved in many strategic initiatives of their companies such as planning of their programs. This predictive intelligence makes the HR teams more proactive.

Rob Light [11] in his paper *How AI will revolutionize HR* discusses how AI is useful in employee training- Customized sessions of training for individual employees can be conducted by analysing data from Artificial intelligence, based on the information gathered from employee interactions. Each individual assimilates learning in varied ways and they have different skill sets, thus letting the employees to learn to the best of their abilities will only accelerate their on-boarding and improve levels of their productivity. Ultimately, the objective of using Machine learning is to log and understand how an employee responded to a training based on their performance and, from there-on, decide upon the most effective technique for future trainings [12].

Dolly Arora (2016), in her paper *AI and the field of HR* describes how cluster technique is used in searching the right candidates- AI goes beyond search key words by translating uncommon search terms and finding hidden patterns. Most candidate search solutions can only find candidates that use the same words as used in your job description. If you say Software Engineer, you'll get only those people who use exactly that term in their title. But there are high chances of you missing the perfect candidate who happens to possess the right skills but uses a different job title. Artificial intelligence uses data clustering techniques by using statistical reasoning to determine whether two entities are the same. The matching algorithm would evaluate if a "coder" and "software developer" are likely to be similarly skilled person. This process is different significantly from the current industry standard that is to create a set of guidelines and rules to process and filter data. Thus the refined searching and matching process is rendered successful with higher precision, better results and an extremely lesser turnaround time.

In 2013, Oxford University researchers in a published paper [13] titled: "The Future of Employment: How Susceptible are Jobs to Computerization" talk about a model to calculate probability of worker substitution in a given industry sector. According to the researchers - C.B. Frey and M.A. Osborne - at Oxford University, conclude that machines may supplant almost 47% of active workers in the future. 48% of the 1,896 prominent scientists, analysts, and engineers queried in a recent Pew survey on the future of jobs, said the AI revolution will be annihilating the human job market on a large scale. In another scary warning, the Bank of England says that as many as 80 million jobs in the U.S. in the coming decade might be replaced by robots.

Typically the HR functions that an organization would be doing are –

- Recruitment Selection
- Track Employee Engagement

- Support Employee Development
- Match Employees to Skills
- Skills Verification
- Organizational Job Fit
- Talent Discovery
- Background verification
- Employee Retention and Attrition
- Employee referral Network
- Performance & Compensation Management

Out of these, most of them can use AI for better outcomes and meeting the objectives.

Jerry Thurber, Co-Founder, CEO and Chief Idea Officer at *Innotrieve*, a data retrieval company talks about how pattern recognition of AI helps in connecting the dots for the above mentioned functions of HR.

III. OBJECTIVES OF THE STUDY:

- To understand the use of AI and ML in HR functions
- To study the use of AI and ML in the IT industry.
- To attempt a model based on the findings

IV. SAMPLE CASES OF IT COMPANIES

Companies which invest in Machine Learning or Artificial Intelligence are realizing great returns and a distinct competitive advantage in the HR functions including hiring process. A few companies' cases have been selected in this paper to show how they transformed their HR processes through the use of Machine Learning. The following sample cases highlight how the companies succeeded in implementing Machine Learning in HR.

Case # 1 Google- ML for saving recruitment cost and time

In his Business Line [14] article, KV Kurmanath finds Google, which trails behind Amazon's AWS and Microsoft in the cloud business, has made a strong pitch to businesses and enterprises, saying that its expertise in Artificial Intelligence (AI) and Machine Learning (ML) makes it a better bet in the segment. Machines can now identify and analyse objects in a video and can help firms make sense of vast piles of video data. A technology launched by Google can not only identify, say, a dog, but can also tell its breed. Demonstrating[15] features of Video Intelligence APIs, Fei-Fei Li, Google's Chief Scientist (Cloud Artificial Intelligence and Machine Learning), terms videos as the dark matter of the digital universe and said the firm now throws light on this, solving an important problem.

Though many of the People Analytics [16] (SAS-Machine Learning) and AI projects the company are highly

confidential, a handful of case studies and articles have been published which highlight the company's findings.

In his Harvard Business Review article [16], David Garvin describes, what is perhaps, People Analytics' most famous endeavor, Project Oxygen, which "sold Google's engineers on management." The project sought to understand and improve management practices at Google by collecting data—starting with exit interviews and ending with employee survey data—to understand what makes managers effective. Initially, some within the company speculated that the engineer-driven organization actually didn't need managers. However, after analyzing data points from hundreds of employees, the People Analytics team was able to not only identify what makes managers successful at Google, but also to highlight the importance of managers, even in a very flat organization [11].

Google's approach to talent acquisition has been equally successful. The company used analytics to calibrate the 'ideal' number of job interviews for a candidate from ten down to five, saving hours of time and millions of dollars on recruiting costs (Davenport et al). Laszlo Bock, head of Google's People Operations function since 2006, goes into great detail on the evolution of Google's hiring processes in his book *Work Rules!* He describes how the company started out slowly—they recruited and hired only the best, and still live by the mantra that you should only hire someone who is better than yourself in some meaningful way. However, as the number of applications to get a job at the company skyrocketed, so did the amount of data the company had for predictive analytics.

Now, as Bock describes, the company has realized that there are four discrete attributes that predict if an individual will be successful in the company, these attributes are general cognitive ability, emergent leadership, "Googleyness" (a combination of intellectual humility, conscientiousness, comfort with ambiguity, and proof of taking bold or remarkable paths in their life), and profile-related knowledge. In Bock's time at Google, the company has stopped hiring for Ivy League degrees and started hiring for ambition. He shares that the company now has more faith in a top student from a large state school than an average Ivy League graduate.

Further on, hiring for the right people, Google has, "produced an algorithm to review rejected applications...that has helped the company hire some talented engineers its screening process would have otherwise missed" (Derose). This example demonstrates that the company like Google can go that extra mile to ensure their fundamentals of their predictive algorithms are on the basis of hard science, and nothing else. This in yet another way talks about the Google perfection in everything they do. The high standards that the

Google employees hold themselves to is the very reason that the employees and executives absolutely trust the decisions made with the help of big data analytics. (Retrieved from: https://medium.com/@deadlocked_d/to-all-recruiters-use-machine-learning-to-hire-better-candidates-c5aad22f3319#.n8frzormf)

Google's DeepMind AI program:

One of major ability of humans is the ability to remember their experience and skills, to them apply to new tasks, this comes naturally to humans. A person who has the skill of ball-room dancing can easily learn Salsa, since the first skill helps the second. But recreating this ability in computers has proved a huge challenge for AI researchers. AI programs are generally excel in one set of tasks only. But AI researchers have overcome this key stumbling block in artificial intelligence with a software that has the ability to learn one task after another employing the skills it obtains on the way.

DeepMind, the program developed by Google's AI company, has taken on an array of diverse tasks and executed them as good as a human could do. Significantly, and exceptionally, the AI has the ability to remember how it resolved problems in the past, and uses the knowledge to address newer ones.

As is common knowledge, AI is not capable of the common-sense intelligence that humans derive from when they are faced with new challenges; its use of past learnings are very much limited. But if ever AI researchers were to construct so-called artificial general intelligence (AGI) machines that match human intelligence this work shows a way around a problem that has been partially solved.

James Kirkpatrick at DeepMind. Says that if ever there are going to be computer programs that are more intelligent and more useful, then they will have to have the ability to learn sequentially.

Most AIs are based on neural network programs. This leads to problem because of the way AIs tend to work. They learn how to perform tasks, such as playing chess or poker, by endless rounds of trial and error. But once a neural network is trained to play chess, it can learn another game later by overwriting its chess-playing skills. The AI program is afflicted with what AI researchers call "catastrophic forgetting".

AI Programs do not have the capability of upskilling on an existing skill unlike the humans. Neither are they flexible to gain expertise in a new situation that is tricky to handle, as a human would do. "Humans and animals learn things one after the other and it's a crucial factor which allows them to learn continually and to build upon their previous knowledge," said Kirkpatrick.

AI scientists studied a lot on the neuroscience of animal and human behavior to build the new AI, It is known that animal and humans learn continuously by keeping the brain synapses connected, that makes the past skills to be retained to build the new on it as a foundation.. The survival of the fittest paradigm in the animal kingdom, the stealth required for hunting are a few examples of how animals (and humans under different environment) build on skills by retaining the older ones.

DeepMind AI mimics the learning of the brain in a simple way. Before it shifts from one task to another, it logically analyses the connections in its neural network that are most central for the tasks it has learned so far. It then makes these difficult to alter as it acquires the next skill. "If the network can reuse what it has learned then it will do," said Kirkpatrick

To test this new approach, the researchers let *DeepMind* play some classic games online and computer-based, in unsystematic order. It was found that several days later, on each game, *DeepMind* was if not better, as good as a human player in most of the games. This was due to the new memory consolidation approach, that the AI researchers used as part of their building the AI program - *DeepMind*.

It was interesting to note that *DeepMind* treated each task differently in the games that it played depending on the simulated scenario and environment at play,

The AI researchers published their findings and work in the journal, Proceedings of the National Academy of Sciences, where they explained how the new AI solved problems with skills it had learned in the past. But there was no clarity as to whether learning from the past skills made the AI perform better. While the program learned to play different games, it did not master each one as well as a dedicated AI would have.

One of the reason that was thought of as to why the AI did not ace each game was that it sometimes unsuccessful in understanding the importance of certain connections that were required for its playing strategy. "We know that sequential learning is important, but we haven't got to the next stage yet, which is to demonstrate the kind of learning that humans and animals can do. That is still a way off. But we know that one thing that was considered to be a big block is not insurmountable," Kirkpatrick said [15].

(Retrieved from <https://www.theguardian.com/global/2017/mar/14/googles-deepmind-makes-ai-program-that-can-learn-like-a-human>)

Case #2 ATS Software- use of algorithms to model hiring pattern

ATS software went through a lot of techniques to structure the large volume of applications it received , but it yet it required human eyes to sieve through them for bringing on board the candidates for interview. An increase in cost of labour by ways of having people to screen candidate applications, recruiters and hiring managers to leading ultimately to find a suitably worthy candidate. This is where artificial intelligence (AI) is satisfying the lacuna. AI uses "algorithms to help companies sift through the noise and find a signal," Goodman said. "For HR and recruiting, this means modeling historical patterns of hiring. We can say whether a company likes to hire people with a certain career arc, who went to a certain school, or who are from a certain geography. There are lots of signals we can look for that can help you find people you should interview." According to Goodman, it is not expected that AI will at any time be able to tell who to hire and who not to hire, but it is effective at bringing down a voluminous numbers applicants to the suitably appropriate fits. An recruiting web platform - *Restless Bandit* is acutely focused on exploiting organizations' existing internal applications databases to find prized candidates for presently open positions. One of the key feature of *Restless Bandit* is not only to identify previously applied candidates who might be a fit, but also automatically updates old resumes from the publicly available data on that individual, to ensure they are still a good fit for the company. Then the best part - it also contacts suitable candidates. As of now, this service of *Restless Bandit* can be availed by large corporations, generally multinationals only, since it needs an extensive internal resume database from which its draws information [5]. (Retrieved from: <http://www.businessnewsdaily.com/9638-ai-hiring-big-data.html#sthash.2gF7OzLX.dpuf>)

Case #3 JetBlue- Application of data techniques in hiring

While not all companies can aspire to have the innovative AI tool that Google has with its data-savvy environment. Nor do the other companies have software engineers to develop such algorithms for the people management team during their unrestricted time. A few companies have used data analytics to manage and master their HR processes. JetBlue Airlines, for instance has seen remarkable outcomes employing data analytics in their recruitment processes. In 2015 summer at a conference in Wharton Business School, 2 of JetBlue's talent experts shared some of these with the audience that lead to their company's success.

It is understood that companies cater their analytics to their business needs. JetBlue is no different. They hire flight attendants with service-oriented mind-set and helpfulness, instead of hiring engineers for intellectual ability. An article from the conference shares quote (sic), "Last year, though, the company learned an interesting lesson... 'For our flight attendants, we had always looked to find the nicest people we could possibly find to be in the sky with [customers],'

then some customer data analysis, performed in conjunction with the Wharton School, yielded unexpected results: 'Being helpful trumps being nice. Being helpful even balances out the effect of somebody who is not so nice,'... 'People will tell you they know the right kind of person for a given job. But what we think isn't always what is best.' unquote (Wharton)

JetBlue and Google have both used data analytics to revitalize their hiring processes in a way that works to eliminate biases, make processes more efficient, and ultimately save the company time and money. Both have also successfully leveraged their unique company cultures and missions to design an analytics program that answers the right questions. Although Google emerged quickly as a hub for talent analytics, JetBlue proves that any company can find a way to apply data techniques to improve their hiring processes. Like Google and JetBlue in their pre-analytics days, your company has a tremendous amount of untapped information at its fingertips, and it is time you use it to your advantage.

(Retrieved from: <http://www.businessnewsdaily.com/9638-ai-hiring-big-data.html#sthash.2gF7OzLX.dpuf>)

V. USAGE OF AI AND ML IN HR- A SIMPLE MODEL:

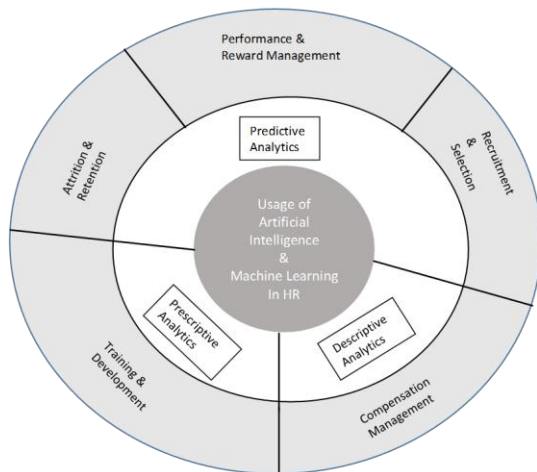


Figure 1 Usage of AI and ML in HR- A suggested model

This model narrates the application side of different analytics in core functions of the Human Resource Management. In order to bring this model, three major analytics are considered and also the extent of application of these analytics on core HR functions are linked as described below.

Uses of Predictive Analytics: it is inferred from the above model that predictive analytics is largely used in the core functions such as Recruitment & Selection, Performance & Reward Management and Attrition & Retention Management. For instance, based on the previous years,

recruitment figures, the current year's recruitment numbers can be decided. Likewise, rate at which the employees left in the previous years will give an indication of attrition rate of the current year.

Uses of Prescriptive Analytics: one of the major objectives of Prescriptive Analytics is to find the best course of action for a given situation. In training and Development, the application of Prescriptive Analytics is comparatively higher than the other functions. As soon as the evaluation part is completed in the training program, it is possible to suggest mid-course corrections to employees on skill enhancement in needed areas. Also, target group shall be identified for the further advanced level of training program.

Uses of Descriptive Analytics: the main motto of Descriptive Analytics is to create a concise historical data to result in useful information and mainly prepare the data for future analysis. In HR Compensation Management needs a lot historical information primarily to fix the salary band and subsequently to provide increments and allowances.

VI. CONCLUSION

There can be many innovative ways of applying Machine Learning and Artificial intelligence in HR functions. From voice recognition to robot automation and algorithms using Analytics, ML and AI seem to ideal for compiling data in HR Systems that would be useful in verifying information, resolving task-specific problems and research areas in HR functions.

The business environment today demands swiftness in all organization functional implementation and the motive for this is not difficult to fathom – business opportunities are generated with quick decision-making at the right time; Information availability on the finger tips; Learning from mistakes; Expediting business processes and pattern recognition to identify trends;

The model presented (Figure 1) is a very infant one, that helps the segregation of the routine functions in HR that have, in the contemporary times, become voluminous to handle and sift through. Thus this model helps in understanding broadly the Machine Learning required for assisting in the Analytics as needed by the organization. It is to be considered that any Organization has to acquire the right kind of analytics tools and the right kind of skilled employees who would help the organization achieve the goals as envisaged in the HR functions. Lest not to be forgotten, these goals are in sync with the larger strategic goals of the organization.

While many HR functionaries fear that ML & AI will replace many HR functions thereby reduction in people hiring,

research has indicated that there is no basis for this apprehension. People in HR functions need to re-orient and take their skills to the next level. Rather than limiting to mundane HR functions ranging from managing and training employees, conflict resolution, talent management, role-fit, career mapping, they need to move to collate, find patterns, and interpret the employee data from a 360 degree perspective to provide insights and find innovative ways to manage the HR functions. And this is where intelligent AI systems and ML can be of great help.

Use of technology is fraught with some risks of sidelining some repetitive jobs, but people overall are adaptive and change is only constant. Survival of the Fittest derives from Adapt-or-Perish mantra everywhere in organizations and more so it should be for HR functionaries. Once the people get used to digital skills, they can take their job to the next level by performing relatively repetitive tasks, fast and flawlessly. Most people would not want go back to mediocre ways of accomplishing their goals. ML and AI are here to stay in Human Resources Management.

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