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# ARTIFICIAL INTELLIGENCE AND ITS UTILIZATION IN HR AND BUSINESS ANALYTICS

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***Abstract*—Analytics have been employed by companies for several decades, but now many firms are interested in building their capabilities for artificial intelligence (AI) as well. Many AI systems, however, are based on statistics and other forms of analytics. Companies can get a "running start" on AI by building upon their analytical competencies. In the last few years, all companies have been interested in the analysis of data related to Human Resources and have focused on human capital, which is considered the major factor influencing the company's development and all its activities at all levels of human resource policies. Data analysis (HR analytics) will significantly improve business profitability over the next years. We started with an extensive survey of different human resources problems and risks reported by HR specialists, then a comprehensive review of recent research efforts on computer science techniques proposed to solve these problems, and finally focused on suggested artificial intelligence methods. This review article will be an archive and a reference for computer scientists working on HR by summarizing the IT solutions already made in human resources for the period between 2008 and 2018. It aims to present the issues that HR researchers face and for which computer scientists seek solutions. It summarizes at the same time the recent and different methods, IT approaches, and tools already used by highlighting those using artificial intelligence. AI also provides the HR department with an opportunity to improve the candidate and employee experience by automating repetitive, low-value tasks and freeing up the time to focus on more strategic, creative work.**

***Keywords*—Artificial intelligence, HR analytics, HR issues, HR risks, Human resources problems, and Business analytics.**

## I. INTRODUCTION

Human Resources Management has undergone profound transformations as a result of the diversification of issues related to the HR function and a strengthening of its influence in the strategic decision-making processes of companies. Today, the HR function is moving more and more towards personalizing HR practices that take into account the specificities of each target. The goal is to help managers achieve better intergenerational collaboration. Human Resources Analysis enables companies to make good use of their "employee" databases to make the best decisions and improve their operational performance. At a time when business leaders are preparing for a digital world that is gaining momentum, artificial intelligence based on the "machine learning" technology promises to revolutionize human resources departments at different levels: recruitment, training, management of career, mobility, compensation, and benefits to attract talent and high potential, treat and evaluate nominations as quickly as possible, check the suitability of the profile and position and predict the candidate's added value for the company, these are the major challenges of any Human Resources Department. One of the most difficult situations for any company that wants to be modern and competitive is to lose one or more of its successful employees to one of its competitors. The results are possible to map the existing profiles according to each employee's productivity and effectiveness. Inspired by the functioning of the human brain, this technology is the subject of a technological boom and it is increasingly bringing about convincing results in the giants of technology (Apple, Facebook, Google, Microsoft ...). The treatment of the data is intelligence that must be interpreted and mastered to make the best of it. And it is based on this reflection and on its intuition that the HR function will be able to capitalize and place its function at a higher strategic and decisional level. Some may think that data and algorithms could be a substitute for the intelligence of their decision when in fact; they allow a better expression of this intelligence. It is fundamental to understand that if data becomes unavoidable, it

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is not independent. All its value lies in the reading and interpretation of this information by human intelligence. Data does not replace the intelligence and courage of HR; it is at their service. HR, supported by the data, has the means to build its future. Challenging ready-made representations and preconceived ideas to induce propositions based on these observations is the challenge that accompanies the taming of data by HR. .

## II. REVIEW

### 1. Three eras of analytics

Large enterprises and small start-ups alike are (or should be) on a continual path of evaluating and elevating how they use data and analytics to drive value and competitiveness**.** In Davenport (2013), I defined three eras of analytical activity over the lifespan of the concept:

● Analytics 1.0

The era of artisanal descriptive analytics (business intelligence), data management, and the advent of analysis and reporting tools. In this phase that dominated business analytics for decades, the value was largely driven by goals of internal decision support rather than advanced predictive capabilities or granular statistical insights. Most analytical tasks were performed in an "artisanal" fashion, with high labor intensiveness and low speed of completion.

● Analytics 2.0

The era of big data analytics, when powerful new data management platforms (such as Hadoop) and tremendous innovation around information-based offerings (Google, Facebook, LinkedIn) led to the emergence of data scientists (Davenport & Patil, 2012). The primary goal in this period shifted from internal decision support to "data products" built around data and analytics for use by customers. Search and recommendation engines, "people you may know" features, and many others helped online firms build their businesses. Leading firms like Google in this period began to use rudimentary forms of machine learning in search and ad targeting applications.

● Analytics 3.0

The era of data economy analytics, in which companies in traditional industries also embrace big data and analytics. The hallmark of Analytics 3.0 is the need for longstanding companies to transform their business models and cultures with extensive use of analytics. In this era, large-scale companies create data and analytics-based products, and analytical activities are increasingly "industrialized," often with thousands of machine-learning models.

### 2. Analytics 4.0: The era of artificial intelligence

Analytics 4.0 is the next step in analytical sophistication for organizations, and it is the era of artificial intelligence or cognitive technologies. It became widely adopted – with adoption rates, depending upon geography, of 20 to 30% across large enterprises in 2016 and 2017 (Deloitte, 2017; McKinsey Global Institute, 2017). It features not only the use of AI methods but also greater use of autonomy in the execution of the methods, particularly automated machine learning (Davenport, 2018). Three aspects of AI suggest that enterprise adoption of AI as the next era of analytics:

● As with prior analytics phases, unlocking the full potential of different flavors of AI requires vast data, immense data processing, and (for the most part) cutting-edge statistical methods. For this reason, AI fits well into the analytics family and should not be treated as distinct from it.

● At the same time, the mix of investments, skills, internal partnerships, and top-level strategy required for enterprise AI has important differences from those required for Analytics 2.0 and Analytics 3.0. For example, the computer science knowledge required to understand and embed learning algorithms – particularly those beyond basic machine learning–into automated processes often goes beyond the traditional analytics skill set.

● Unlike the situation with traditional business analytics, business leaders will face profound choices related to AI-driven automation of "knowledge work" – activities whose main value derives from knowledge, creative thinking, and non-repetitive problem-solving. Nearly every knowledge worker's job is ripe for some level of automation, although "augmentation" is perhaps a more likely outcome (Davenport & Kirby, 2016).

### 3. Analytical and non-analytical AI

Machine learning is at the core of many approaches to artificial intelligence, and is analytical (i.e., statistical) at its core. It has been employed for several decades and may be more familiar as "predictive analytics" (Siegel, 2016). Basic machine learning is predictive analytics. It uses "supervised learning" – the creation of a statistical model based on data for which the values of the outcome variable are known. For example, a machine learning model attempting to predict fraud in a bank would need to be trained on a system in which fraud has been established in some cases. Machine learning can involve as simple a modeling approach as linear regression. The resulting model is tested with a validation dataset, for which the predicted outcome is compared to the known outcome. Then once a model is found that explains the variance in the training data and predicts well, it is deployed to predict or classify new data for which the outcome variable isn't known – sometimes called a scoring process. The first FICO score, which uses a form of basic machine learning to create its credit scores, was introduced in 1989. In other words, this is a well-established idea, and it is very analytical. Beyond regression-based machine learning models, there are many more types of possible algorithms in machine learning, many of them somewhat esoteric. They range from "gradient boosted tree" models (an approach that builds models that addresses errors of previous models, thus boosting the

predictive or classification ability) to "random forests" (models that are collections of decision tree models). Machine learning also encompasses even more complex model types like neural networks and deep learning, which are also statistical.

**3.1. Deep learning**
Deep learning models, a complex form of neural networks, "train" networks that are then used to recognize and characterize situations based on input data. The data employed often include not only depth (millions/billions of data elements) but also breadth (each element can have thousands of features). Deep learning tends to be used to perform tasks such as voice or image recognition. The models are often powerful in these applications, but given their complexity and the abstract nature of their features or variables, they are not very interpretable by human analysts.

**3.2. Statistical natural language processing (NLP)**
These systems extract information or meaning (entities, locations, topics, sentiment) from statistical patterns in speech or text. They provide a rough assessment of what a piece of text means, or a more refined view of trends in a larger corpus. This form of NLP is based on a statistical analysis of words or phrases (as in Google Translate and some deep learning applications for speech recognition). Statistical NLP is based on machine learning and appears to be improving its capabilities faster than semantic NLP. It requires a large "corpus" or body of language from which to learn.

**3.3. Semantic NLP**
This form of NLP is based on semantic analysis and ontologies (decomposition and relationships among words and phrases). It was the only real option pursued by NLP until the past decade or so, and it can be moderately effective if words, syntax, and concept relationships are trained into the system effectively. The training and "knowledge engineering" of language – often referred to as creating a "knowledge graph" within a particular domain – can be labor-intensive and time-consuming, however. It requires the development of ontologies or models of the relationships between words and phrases. Although it is difficult to create semantic NLP models, several "intelligent agent" systems make use of that approach today.

**3.4. Natural language generation (NLG)**
NLG systems typically rely on workflow, rules, and sentence templates to generate language based on data. More complex forms of NLG, such as that used by Narrative Science's Quill, rely on idea generation and idea generation (Paley, 2017).

**3.5. Robotic process automation (RPA)**
This technology automates the performance of digital tasks. RPA employs a combination of rule engines, workflow and orchestration tools, and "presentation layer" interfaces to existing systems – but no statistical analysis. It is most commonly used to automate structured back-office tasks, and often provides quick implementation and relatively high levels of ROI.

**4. Human resources risks**
HR risk management focuses on the specific risks employees pose to the business. This could involve risks around improper employee management, employee behavior, or the way you hire and lose employees. Proper risk management doesn't just focus on entry-level employees but also implements a common risk management framework supported by appropriate standards throughout the organization.

**4.1. The Social Dialogue**
A failure in the management of social dialogue following a lack of communication or precision of managerial objectives can generate strong tensions within the company: prolonged strike (absenteeism, demotivation, lack of trust between managers and employees).

**4.2. Skills Management**
A lack of follow-up of the skills and talents of the company systematically leads to an accentuated departure of key employees of the company: increased demotivation of staff, lack of training, and stagnation of teams.

**4.3. Well-Being and Motivation at Work**
Some managerial practices such as the setting of unattainable goals and the lack of communication between managers and employees can be considered as a trigger for stress, burnout, or even suicide of employees.

**4.4. Employee Safety**
A lack of formalization of safety procedures and the absence of internal control in this area may lead the company to possible civil and/or criminal penalties following injuries or even deaths in the workplace.

**4.5. "Malicious" HR Practices**
A calamitous social climate may be the result of an unsensitised management system based on excessive pressure on the part of management ( pressure on objectives) and lack of control of managerial practices internally (harassment of staff, unequal treatment of situations). Predict: Indicators to assess the social climate.

**4.6. HR Costs**
A lack of control of HR costs may lead to additional costs and a structural increase in management costs, especially in the absence of management and HR management control: poor management of payroll, cost health insurance / provident insurance.

**5. IT SOLUTIONS AND ARTIFICIAL INTELLIGENCE FOR HUMAN RESOURCES PROBLEMS –**

**5.1. The Different HR Issues Studied**

According to our research, several HR issues have been asked to computer scientists to find the best possible solutions; most of the issues raised are concerning: Jobs, talents and skills management, candidature/ staff selection and recruitment, attrition, turnover, future human capital needs, HR performance, and effectiveness, etc. The following graph shows the important HR issues raised and for which computer scientists have proposed different IT solutions.

**5.2. IT Solutions for Human Resources Issues**

Our detailed research shows that the solutions using artificial intelligence algorithms (Machine Learning, Neural networks, Data Mining) are the most used to solve HR problems. They oversee the others by a use percentage of 41%, followed by 29% of other analysis methods or simple statistics, 14% of BI, Big Data, and Data Warehouse solutions, and 16% of simple analysis using software, ERP, frameworks, or websites.

**5.3. Artificial Intelligence Solutions for Human Resources Issues**

Abridged with the acronym AI, it is the science treating the production of human knowledge, and offering machines the ability to imitate human reasoning and intelligence. It simulates the execution of tasks similar to those handled by the human being: recognition, prediction, classification, understanding, dialogue, adaptation, and learning. The keyword Artificial Intelligence is quite the buzz in the virtual world in all domains today and since its appearance, it has undergone a renaissance in the form of Machine Learning and subsequently the emergence of Deep Learning, which has boomed over the last few years; thereby giving a new type with deeper examples and algorithms to Machine Learning. Furthermore, we cannot talk about these terms without mentioning the neural networks which represent the core of our research because of their importance in all substantial items already mentioned. According to our quantitative research, several IT solutions have been proposed to solve the various problems related to human resources. Many Artificial Intelligence solutions have been applied, using different methods and algorithms.

## III. CONCLUSION

AI is on the rise and will usher in the era of Analytics 4.0. Given the potential of AI for transforming business, the impact of Analytics 4.0 will likely be significantly larger and more disruptive than previous technology transitions. Furthermore, companies that transition to Analytics 4.0 may accelerate away from those that don't. These companies will likely have developed other competencies such as agile, cloud, and open source technologies that provide additional benefits. Given the learning and technical competencies required for large-scale AI work, it may be difficult to be a "fast follower". The process toward realizing AI success starts with the basic understanding of what AI is, how AI will impact the enterprise, what current capabilities are, and what a viable action strategy should be. Companies that leverage their existing analytical capabilities are likely to have a much faster and more effective start with AI.

Hence from our research on the two axes: Human Resources and Artificial Intelligence, we were able, first of all, to highlight the different issues raised by the experts and the managers of the domain and to target the most posed problems, afterward. We have tried to find all the solutions proposed by scientists and computer scientists for each problem and especially those using Artificial Intelligence techniques for the period between 2008 and 2018. We concluded from the number of articles found that several HR Analytics were proposed and most of them used artificial intelligence algorithms and methods, which shows the rapid and observed development and the increased interest and competition in applying this technology in the HR field.

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