A Review of Digital Technologies in HRM

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ABSTRACT

Advancement in technology has led to the present age being described as the "digital age". Human Resource (HR) is a department which is typically managed in person rather than an automated process. Digital HR can be deified as the administrative support of the HR functions in an organization by using internet technology (Voermans & M.van, 2007). Broderick & Boudreau,(1992) defined Human resource information system as the amalgamation data-centric computer software and hardware that compile, document, store, manage and deliver the data that can be used for the betterment of human resources.

The domain of analytics uses various quantitative methods in-order to organize, examine and abridge a huge amount of data (Mortensonet al., 2015). Understanding a huge amount of data owned by organizations is of deep interest as it empower the organization for informed decision making (George & Kamalanabhan, 2016). The various technologies currently being used in HR domain focuses to identify data, capture data, modelling and predicting of data, in order to upsurge productivity of the organization.

The present review intends to study the recent trends in technologies used by organizations in the area HRM. The review is based on peer-reviewed articles from databases including EBSCO, Emerald and Sage publications. References from organizational reports have also been included, since academic articles are sparse in the topic of study which includes technologies in HRM and cloud in HRM.

Using digital technologies in HR will lead to improvement in organizational performance through talent-related decisions, forecast workforce requirement, optimizing talent through development and planning. It will also enable HR to help an organization to achieve corporate goals through informed decision making. Additionally, it enables managing employees through recruitment, training, employee satisfaction, productivity, assigning of tasks as per the qualification. It also helps in identifying the reason for attrition and identifying high-value employees for leaving.

Keywords

Digital HRM, Technologies in HR, HR Analytics, Artificial Intelligence, Data Mining, Machine Learning, Cloud Technologies in HRM, e-HRM, HRM

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Introduction

The world of Human Resource (HR) is evolving, and the ongoing diffusion of technology in business opens an area of unpredictable changes and advancements. While HR professional will always require an adroit for managing people, they must also achieve business goals by impending digital technology. Even now baring a few organizations, most of them stay rooted in traditional modes of engagement. For HR to be converted as a strategic partner in business, artificial intelligence in automation of HR functions is essential.

Paradigm shift in the business process globally is having significant impact on the organizations. Earlier Information systems (IS) were used to store and investigate data (Parry et al., 2007) but now with the development of machine learning in the field of natural language processing, allows human and machine interaction through which we can automate an array of tasks. The purpose of HR digitization is to make entire human resource management (HRM) functions more streamlined (Martin et al.,2008; Ruel et al.,2004). Organizations use digitization in day to day activities like recruiting and virtual training (West & Berman, 2001), personal management and payroll, employee assessment and reporting. The extent digitization also varies from various companies and the industry type.

With the world advancing in the area of information technology, digital dominance has covered each and every feature of cultural, societal and economical changes around the globe. Changes in these area have technically led the present age being described as the "digital age". Human Resource (HR) is a department which is typically managed in person rather than automated process. However, with the advancement in technology this is rapidly changing, with the emergence of applications like Software as a Service (SaaS) for human capital management (HCM). Conventionally, HR department used technology in an organization for managing the payroll of employees and maintaining record for them, but advancement in technology enhanced the every functions of HRM, including function such as recruitment and retirement, promotion and training, compensation and leaves (Pemmaraju, 2007). By adding digital HR outlook, the Human Resource department on an organization focuses on transforming the workforce and thus leading the organization growth and development. Data already exist in the HR department. In spite of the huge amount of data residing in this domain, it was surprising that use of Analytics in HR was delayed. Hence, this domain is considered as the late entrant in using analytics(King, 2016) and is not actively involved in using the analytics in the processes of HRM (Rasmussen & Ulrich, 2015;. There is much more to Digital HR than simple descriptive data collection and reporting.

Analytics is a domain which is developed with computer science engineering, with the help of quantitative methods to establish, analyze and make sense of huge data that are generated by the current generations (Mortensonet al.,

2015). In today's current scenario analytics is regarded as a mandatory tool for creating value from people and pathway to broaden the strategic influence of the HR functions (Angrave et al., 2016). Organizations have commenced to appreciate the power of data possessed by them and are now interested in synthesizing these data for informed decision making (George & Kamalanabhan, 2016).Therefore the current piece of study intends to understand the recent trends in the HR Analytics domain. The study will also highlight the various techniques that are currently used in business units to analyze their HR data for informed decision making. As the HR functions are digitalized, they are now more technology oriented and are lacking human touch, thus putting a limitation on HR personal role. The functions are now becoming more IT centric rather than people centric. It is been observed that due to this ongoing trend of digitization HR managers lay more emphasis on acquiring IT skills rather than gaining soft man management skills (Sinha & Mishra, 2014). Therefore, the present piece of research work intends to study the recent technologies used in the HR digitization.

Literature Review:

HR Analytics

Studies form major database indicates that Human Resource Analytics (HRA) is a comparatively novel term; which appeared in literature during 2003-04. Lawler et.al.(2004) suggested that HR analytics represents various statistical techniques and investigational approaches that describes the various HR activities in an organization.

The studies have defined HR analytics as process of analysis or a process of informed decision making. Study by Falletta, (2014) describes the specific components of HR analytics. Bassi, 2011defines HR analytics as a systematic reporting of HR processes based on "what- if situations and predictive models. It was also suggested by the researcher that HR analytics is evidence-based method for informed decision making in an organization. She suggested that the analytics not only consists of various tools and technologies but enhance reporting of HR functions to predictive modelling. Mondore et al., (2011) concludes that HR analytics has a straight influence of people in organizational performance. According to the researchers Rasmussen & Ulrich, (2015) & Angrave et al., (2016), HR analytics is a fad. As per Abrahamson & Eisenman, (2008) a fad is insignificant and non-rational things that has no lasting effect on the organization or the management techniques. The study by Momin & Mishra, (2015) suggested that with the help of HR analytics the employees in the organization can reduce the attrition rate, and help to significantly increase the training practice in the organizations.

These definitions summarize HR analytics to a) HR analytics is all about analysis of HR-related data b) it not only focuses on HR functional data but also integrate data of various HR functions c) HR analytics uses technologies to gather information, process it and report the findings d) It supports people related decisions and lastly e) HR analytics connects between the HR decisions outcomes to the organizational performance.

The various technologies that have been used in the HR analytics domain are discussed in length in the sections below.

E-HRM: Electronic Human Resource Management (e-HRM) is not a new research stream now, as the studies began in early 1995 (Strohmeier, 2007). The major goals of e-HRM in an organization includes reduction of cost through restructuring various HRM processes (Marler, 2009). The enhance effectiveness through e-HRM provided better HRM services and help the managers to take informed decisions.(Johannes et al., 2004). A study by Marler & Fisher, (2013) focused to apply evidence-based framework (Rousseau et.al., 2008) to understand various empirical researches that are carried on e-HRM to ascertain the relationship between e-HRM and organizational efficiency. Voermans & M.van, (2007)observed the attitude towards e-HRM. The authors tried to develop model based on Davis Technology model and Ulrich models on HR roles. Based on the case-study research on the 5 organizations Johannes et al., (2004) suggested, e-HRM is widely used in organizations for cost reduction, improved client service management and incorporation of various HR functions. Additionally, Bondarouk et al., (2009) did a qualitative study on public sectors organizations to examine the association between the usage of e-HRM requests and perceived effectiveness of the various HR functions. Ruël & Kaap, (2012) tried to study the approximation of e-HRM and its frequency of usage with respects to the value created for HRM. Additionally, they also tried to establish a relationship between facilitating conditions between HRM and its value created for HRM. Strohmeier & Kabst,(2009) observed various factors that affect cross- national adoption of e-HRM in the organizations.

Data Mining: Due to advancements in the area of information technology, improved decision support system and expert system have enhanced the results of human resource management. Studies by Chien & Chen, (2008)have defined data mining as a method of extraction of beneficial patterns from big database through programmed or unprogrammed analysis of data. With the help of this technique the need of storing data in computer and the users can now actively extract data from multiple key-points for making analysis and prediction. Although the data mining techniques is widely used in many fields and have resulted in benefitting results. The benefits of data mining applications were immensely profitable in semiconductor and engineering data analysis industry, (Kusiak, 2001), (Braha, D., & Shmilovici, 2002). However, very few studied have been done to measure the benefits of data mining in the Human resource management. As data mining methodologies are developed for analysis and exploration by programmed or un-programmed means, to discover useful information from the large data to draw meaningful pattern and resulting in informed decision support. Therefore, to conclude that data mining is discovery driven and not assumption driven (Huang et al., 2012). With various techniques such as neural network, genetic algorithms, statistics, decision trees and visualization techniques are used over the years

The process of data mining can be normally characterized as association, clustering, classification, and prediction (Han & Kamber,2001). Research by (Kirimi & Moturi, 2016)

proposed a forecasting model that forecast employee performance which allows human resource experts to focus on enhance the performance appraisal process in human resource management. For the predictive analysis the researchers have used The Cross Industry Standard Process for Data Mining (CRISP-DM). it was found in the research that the performance of an employees was highly affected by the age, qualification, professional training, experience in sector, material status, gender and earlier appraisal score.

The research by (Zhao, 2008)tried to find out various data mining method that can be applied to enhance the performance management in human resource management. Talent management can also be looked at by various techniques of data mining (Hamidah et al., 2011) In the study the research tries to implement talent management task to recognize the possible talent by foreseeing performance of the employee by past experience knowledge. Also, the paper proposed the probable Data Mining methods for talent forecasting. (Strohmeier & Piazza, 2010), tried compare the data mining approach with the conventional data querying approach in human resource management and suggested that data mining compliments the complements the conventional querying approach. A review of literature by (Strohmeier & Piazza, 2010) that currently research is method driven that domain -driven.

Artificial Intelligence and Machine Learning:

Artificial intelligence (A.I.) is the process of making computers do things that people do but in a better way (rich,1985). these include a variety of function s like natural language processing, problem solving, perception understanding etc. It tries to solve that occur in real world environment. Artificial intelligence had not only simplified human learning but also have enhanced the employee engagement. The usage if AI has enhanced the processing of the various HR functionalities such as recruitment, training and development, compensation and reward management, selection and performance management (Dickson & Nusair, 2007). It streamlines the HR processes at a very low cost. Earlier the AI programs were used to respond to simple instructions like playing chess (Buchanan, 2005). A study by Mehrabad & Brojeny,(2007) suggested that all the HR processes would be carried by AI programs with higher effectiveness and lower cost. Singh & Finn, (2003) explained how AI is a great resource for zeroing down the desired candidate for a particular job opening. They also described the process of resume scanning in their study. They also suggested that the system was capable of organizing the summary report of the scanned resume and make available to the managers to take an informed decision. If the desired candidate is not resulted in the search the systems automatically create a database of resume for further usage. Malinowski et al., (2008) suggested that AI is used to create teams in an organization by paring members in such a way that resulted in higher efficiency of the employees. Additionally, AI helped HRM for employee retention. A study by Dickson & Nusair, (2007)also suggested the practical understanding of how the resume is handled by the recruiters and how the AI technology is influencing hiring managers to take an informed decision. AI has changed the way the how the data was stored, processed and accessed in the recruitment function of HRM. A research by (Abubakar et al., 2019) have suggested theoretical and empirical evidences for understanding of the employee's reaction to the bases of an employee's feeling of social worth.

Machine learning is a technique through which the computers function and recognize patters as humans do. This is done by the analysing and understanding various patterns which are done already. The usage of the data and understanding of the statistics behind its play's an important role in machine learning. It is a process where computer algorithms find patterns in data and suggests or predicts the future outcome. By using machine learning the two important processes talent acquisition and employee engagement can by improved significantly (Faliagka et al., 2012). The study by Faliagka et al., 2012) also suggest an approach which is suitable for assessing job aspirants for online employment system. It focuses on how the algorithms of machine learning sort the candidate by positioning the various profile as desired by the employer. A study by Taleb Zadeh Kasgari et al., (2019), tried to model the limitation of human mind which results in human perception delay. The authors developed a learning method termed as probability distribution identification to find the probable model which is best suited for delay in observation of human brain. Research by Yingbo et al., (2007) suggest that the staff assignment is important in a workflow management system.

Cloud Technologies in HR: Cloud technology is a new infrastructural development in the Information technology domain (Buyya et al., 2009). The primary objective of the cloud-based architecture is to provide consumers, the computing resources which is presented by numerous service providers. According to Rimal et al., 2011, the key purpose of cloud computing is to deliver services with increased scalability, data reliability and accessibility of data in highly dispersed environment. With the help of virtualization, the cloud computing technology is installed or deployed for the services to be provided. Studies have also suggested that cloud architecture is based upon the 4-layers of architecture which are mainly: a) fabric, b) unified resource, c) platform, and d) application layers. The research also suggests that the cloud technology can be reconfigured dynamically to satisfy consumer requirement based on virtual resources.

The first layer i.e., fabric layer consists of hardware level resource, such as storage, network and computing resources. The unified layer typically consists of the resources that are encapsulated so that it can be used by the consumers as integrated resources Motahari-Nezhad et al., (2009). Specialized tools, middleware and services added to the unified resource in order to develop web hosting platform environment. At last, the application layer hosts the applications that run on cloud. Infrastructure as a Service (IaaS), Software as a Service (SaaS) and Platform as a Service (PaaS) are the various virtual cloud computing applications.

Cloud computing is widely used in the human resource domain. The department of hr is usually located in diverse location, which leads a lack of communication among the employees resulting in disorganized and timely access of information among the employees. These results in ineffective data processing and uninformed decision making

which in turn effects the organizational performance. These gap in the information flow can be managed by the help of cloud technologies. The data which is available centrally helps HR professional in recruitment track applications, monitor performance training people create mobile workforce, enhance flexibility, encourage two-way interaction among employees generate reports, and enhance effectiveness of the organization and the employees. In addition to the above properties the cloud technology is not very expensive to install the infrastructure and maintenance. The cloud service providers assist organizations with software and various computing resources in terms of network support, software support and hardware support. Additionally, cloud computing technology supports the human resource management by alignment of employees and organization goals, encouraging team work, and career management. Association of HR and cloud computing model helps in the enhancing the innovativeness, performance, and intellectual principal of an organization.

Table1: Studies of HR Digitization.

Author	**Purpose of the study**	**Findings of the Study**
Abubakar et al., 2019	This study focuses on hypothetical influences and empirical evidence for sympathetic employee reactions to distributive, procedural, and interactional (in)justice — three crucial bases of employees' feelings of social self-worth	This paper reveals that distributive, procedural, and interactional (in)justice contributes to higher levels of knowledge hiding behaviour among employees and that this impact is non-linear (asymmetric).
Dickson & Nusair, 2007	The paper talks about the applied knowledge of the dynamic changes in what ways the recruiters handle the resumes and the technologies associated with it.	The result of the study suggests that the technology helps the organizations to find ways to ensure the better management of the applications received.
Rich, 2018	The study talks about how Artificial intelligence (A.I.) helps the organization to do assignments better than the human touch. It also includes how natural language processing is helping in various AI functions.	The results suggests that the only way to better the usage of AI is to focus on the problem statement so that the better management can be done.
George & Kamalanabhan, 2016	The paper suggests that Artificial intelligence is a developing area in Human resource management which increases the efficiency in the HR processes.	The results of the paper suggest the effective usage of the technology for adaptation of effective HR into sustainable HR.
Motahari-Nezhad et al., 2009	This study briefly describes benefits of using cloud computing, and also indicates the discuss the assistances of using cloud services in an organization.	The paper describes the two approach 1) a structured architecture for the virtual organization, and 2) a theoretical architecture for a virtually operating organization.
Chen & Huang, 2008	The purpose of the study is to revel the various fuzzy set techniques to the taxonomic concept in order to increase the level of association between the two.	The study developed the algorithm named CROSS-FMSM in order to develop the cross level consecutive patterns.
Huang et al., 2012	This study develops a theoretical model based on TAM3, and then inspects its perceived usefulness, perceived ease of use, and its ability to explain users'	The results show inferences with DMT adoption.

	intentions to use DMTs.	
Kirimi & Moturi, 2016	The study identifies Data Mining methods for the extraction of important information for forecasting employee performance by means of earlier evaluation records in a public management development institute in Kenya.	The study suggested that employee performance was highly influenced by experience, age, academic qualification, professional training, gender, marital status and previous performance appraisal scores.
Chien & Chen, 2008	This study tried to lessen the gap by using a data mining based on decision trees rules for personnel selection.	The research results provided decision rules linking personnel information with work performance and retention.
Strohmeier & Piazza, 2010	The study reviews on research done on HR data mining to methodically to illustrate recent development and advise areas for further work.	The result of the review indicates that HRM establishes a notable domain of data mining research which is influenced by method- and technology.
Huang et al., 2013	The study integrates task-technology fit (TTF) model, expectation–confirmation mode (ECM), and habit, to examine the determinants of continued use of DMTs.	The results of the study indicate that task-technology fit impacts directly in 2 factors of technology usage a) user satisfaction b) perceived usefulness. It was also concluded in the study that there is an indirect effect on user intention. Habit came out to be the main predictor of continuous usage intention.
Hamidah et al., 2011	This study is based on the application of data mining approach for the development of the employee which is directly related to their future performance.	The results of the study indicated the, potential classification techniques and prediction model for forecasting employee's performance.
Strohmeier & Piazza, 2010	The current study reviews explore on HR data mining to reveal methodically recent progressions as well as outstanding tasks for upcoming work.	The review reveals that researchers that are being done are rather method-oriented than domain-oriented.
Adli et al., 2014	The study main aim was to track the effectiveness of E-HRM on Aker Oil Company's performance in Malaysia, it also tried to see whether there is a significant relationship between productivity of HRM and cost reduction.	The results of this study are useful for the management of the organizations who want to pay attention to the factors which motivate the employees and enhances employee satisfaction.
Marler & Fisher, 2013	The goal of this paper is to provide the evidence -based supervision to the employee and the organization to	The results of the study suggest that strategic HRM predicts e-HRM results and relationship between the

	understand nicely the relationship between e-HRM and strategic HRM. W	two is context dependent.
Voermans & M.van, 2007	The purpose of this paper is to analyse on attitude of users towards E-HRM. A research model was formulated, based: Davis' technology acceptance model and Ulrich's model on HR roles.	The study finds differences in perceived usability of IT systems, and HR roles. It was also seen in the study that the employee showed a positive attitude towards E-HRM systems.
Bondarouk et al., 2009	The study examines the effect of E_HRM which was directed at a public sector organization.	Results of the study indicates that effectiveness of E-HRM depends upon line managers and employees.
Falanaka et al., 2012	The study aims at evaluating online recruitment systems, leveraging the benefits of machine learning algorithms.	The result indicated that the employees who were hired by online recruitment system showed consistency in their performance, so it was concluded that the automated process can be trusted and the human intervention can be minimized.
Eminagaoglu & Eren, 2010	There are 3 basic aim for this research:1) to understand how effective is the E_HRM in a logistics company. 2) cam machine learning help in the model prediction based on the earlier gathered information. 3) testing of algorithms that can determine the performance of error rates, ROC curves, Kappa statistics and F-measures	The results of the study indicated that the algorithms reduce the error that are cause due to human intervention.
Yingbo et al., 2007	The aim of the study to see how the machine learning algorithms lessen the work burden of the employees in an organization.	The study revealed that an average prediction accuracy of 85.8% and 80.1% on two car manufacturing enterprises respectively due to the digitized HR functions.
Momin & Mishra, 2015	The aim of the study is to understand how strategic workforce planning provides a multi – dimensional approach towards building a human capital management.	The results indicates that with the correct usage of HR analytics a strategic workforce reduces the attrition rate of the employees and enhance the training culture in the organization.

.Methodology:

To identify the relevant research contributions of scholarly articles, internet search engine – google, google scholar and several online databases such as emerald, jstor, science direct and Scopus were employed. As it is known that digitization of human resource management intersects with various methods and domain of HR, so search terms like

"HR Analytics", "Data Mining"," AI and Machine Learning in HR", "Cloud Technologies in HR", "e-HRM" and "Digitization of HRM" were employed. Synonyms like "HR", "HRM", "AI" were deployed, also terms of HR sub-domain were employed" recruitment", "commensuration", "training and development" etc. were used as search term. The resulting combinational possibilities resulted over 300 pairs of search terms. We further restricted out search to articles that were published in English language. We considered the time frame of 2000-2020. Some of the important article which occurred in the search were published before the timeline, but as the papers were important, they are included in the "Artificial Intelligence and Machine Learning" section of the current study.

Result And Discussion:

A. **General aspect**: the research in the digitization of HRM is growing research fields. Although the research articles on e-HRM were published in the early 90's, the various other technologies were published in articles since 2000.

B. **Domain aspect**: Majority of research in digitization have been conducted in recruitment, training area. these domains of HR were able to use digitized process because these domains consisted huge amount of data, and it was easy to apply the data driven prognosis. It is clear from the literature that the HR functions used technologies which helped the managers with the informed decision-making capacity and also helped in the reduction of time and money. It is clearly evident from the literature that the technologies like data mining, artificial intelligence and machine learning helped the organizations in the recruitment and selection processes. Whereas cloud technology helped organizations with the staffing and training and development of the employees. From the earlier researches we can conclude that technologies were used in each of the domain and there was no such specification that a particular technology will be used for one particular HR function. The organizations deployed technologies which resulted in high productivity and were easy to use for the employees.

If we focus on current work environment and think about the near future, we must realize how radically we need to change our working style to incorporate with the upcoming work requirements. "Digitization", is a part of the response, as it consists of skills, abilities, attitude and the knowledge that is mandatory to work in this age. In the current digital age, every individual need to encompass both the general knowledge and job or task role related digital proficiencies. In the current digital age, the emergence of digital jobs like "data scientist", "domain specific analyst" etc. have emerged. However, the career opportunities will be truly based on the digital proficiency of the individual. The use of digital technologies in an organization is based on the HR relevance rather based on HR aspects. In order to use technology in HRM, practical relevance and problem statement has to be clearly articulated.

This research paper tries to highlight the various technology that are being currently used in the organization for the digitization of various functions. The paper also highlights the domain specific technology usage and its benefits to the organization. Although, the research aimed to include all the relevant literatures, but some of the aspects were not covered due to the unavailability of the articles. We look forward to the various research opportunities in this domain. Thus, as a research outlook and to add to the novelty of the topic, we deliver to add steps towards the research agenda.

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