

A Bibliometric Analysis Data Visualization in Human Resource Management

Bandar Abdullah AlMobark

College of Computer and Information Sciences,
Imam Mohammad Ibn Saud Islamic University (IMSIU)

Riyadh, Saudi Arabia

bamobark@imamu.edu.sa

Summary

As the old saying goes "a picture is worth a thousand words" data visualization is essential in almost every industry. Companies make Data-driven decisions and gain insights from visual data. However, there is a need to investigate the role of data visualization in human resource management. This review aims to highlight the power of data visualization in the field of human resources. In addition, visualize the latest trends in the research area of human resource and data visualization by conducting a bibliometric analysis. The study adopted a literature review on recent publications from 2017 to 2022 to address research questions.

Keywords:

Data visualization; bibliometric analysis; human resource management; network visualization; decision-making; density visualization

1. Introduction

Humans are very visual creators, as the saying goes: a picture is worth a thousand words. The human brain processes visuals 60.000 times faster than text, as stated by a study conducted by 3M corporation in 1997. Data visualization is the graphical representation of information that translates pieces of information into a visual context. Data is displayed visually using optical elements such as graphs, charts, dashboards, and maps. [1, 2] discussed the result for covid19 data and provided the results applying SEIR prediction model. Data visualization is not about making data more aesthetic; the main goal is to provide insight

into complex datasets by communicating their main aspects clearly and effectively through graphical means [3]. Data visualization is a field that intersects in between information science, communication, and design. Visual analytics tools such as Power BI, Tableau, Excel, Python [4], and R helps to turn enormous datasets into business insights. Allows decision-makers and business users to discover new patterns, recognize relations and connections between data, and make data-driven decisions. Data visualization can be a powerful tool in the field of human resource management in any organization. Good human resource analytics and visualization help companies achieve business goals efficiently and effectively, reduce human risk, gain a competitive advantage, and maximize return on investment. Nevertheless, there is a need to investigate the role of data visualization in HR professions; how they comprehend data visualization based on HR data and eventually arrive at decisions [1, 2]. To the best of my knowledge, no review paper highlighted the role of visualization. This review aims to highlight the power of data visualization in the field of HR analytics. In this review paper, I will attempt to answer these specific research questions:

Q.1: what are the benefits of applying data visualization in HR analytics?

Q.2: what are the latest research trends in the area of human resources and data visualization?

This review proceeds as follows. Firstly, the method used for this review is presented. Secondly, the results and discussion of the answers to the research questions are explained. Finally, the conclusion and suggestions for future research are provided.

2. Methodology

A literature review was carried out to investigate the research questions. Recourses such as; Scopus, web of science, ACM, and IEEE Databases were used to gather the literature on September 20, 2021. Resources were collected from articles, preceding papers, and book chapters. During the search process, the keywords :("data visualization" OR "visualization" AND "Human Resource" OR "employee") were identified. The publication years were limited from 2017 to 2022 and restricted to publication in the English language. Bibliometric analysis was conducted using the web of science database to investigate research question two [5]. The publications year were restricted between 2017 and 2022 in the field of computer science. Web of science is one of the most comprehensive databases in academic articles. Data were analyzed using the web of science analyzer and Vosviewer.

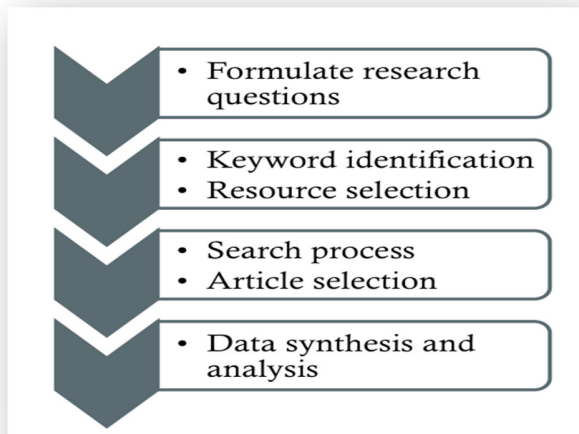


Fig. 1. Search methodology

3. Result and Discussion

Applying visualization in human resource management enables the HR team to deliver service more effectively and efficiently. Researches approved that visualization can improve recruitment and hiring decisions, Improve employee retention,

develop more effective training, and improve overall decision-making [6], [7], [8], [9], [10], [11], [12].

3.1. Improve Recruitment and Hiring Decisions

Finding the right talented candidate in the current market at the right time can be a challenging issue for a recruiter that deals with a massive amount of data every day. According to a statistic released by Manpower Group in 2020, almost 73% of employers struggle to find talented candidates, and 45% of employers are concerned about finding employees with the necessary talents. The issue is not about the lack of skilled candidates but the failure to reach the best ones. The human resource team can leverage data visualization in recruitment analytics to improve the hiring process. For example, [6] developed an interactive visualization system based on improved parallel coordinates in d3.js [13]. The system ResumeVis was built for both human resources and job seekers. In the same way [14] proposed a classification approach and preprocessing to the raw HR data, which can be applied to defined work-specific skills set requirements and the progress of international skillset requirements. Similarly, [3] proposed an interactive visualization approach to compare candidate resumes to obtain a final brief list of the best candidates. They suggested an interactive environment that provides a visual representation of the data in the CVs to compare more than two CVs. The approach allowed exploring, assessing, comparing resumes, and recommending the best candidates for job applications by the CVs scoring system. Visualization techniques such as; funnel chart, heat map, and kanban can be used in recruitment analytics. Funnel charts are graphical representations used to visualize a process of progressive data reduction as it moves from one block to another. Each block of the funnel represents a stage of a process. The recruitment funnel is a framework that can be used in the recruitment process to determine and hire the best candidate. For instance, a study conducted by [15] suggested a funnel approach to optimize recruitment analytics in an ITES company and make better hiring decisions in the future. Talent Mapping is another visualization technique that uses a color-coded system. Heat maps or geographical maps can reveal what attracts candidates, and it used in the employment websites such as LinkedIn.

3.2. Improve Employee Retention

Employee retention is the ability of a company to keep talented employees and reduce employee attrition. As stated by the bureau of labor statistics in 2021, the number of U.S employee turnover has increased gradually in the last year. Employee turnover affects an organization's sustainability negatively, decreases productivity, and lowers morale. An interactive Sankey diagram is one way that helps in understanding employee flow in an organization. The human resource team can contemplate employee turnover and movements as a network that reflects changes in human capital over time. Lupton et al. in 2017 suggested a hybrid Sankey diagram from a different data source. Another way is to predict employee turnover is by using machine learning (ML) and visualization techniques. For example, [16] studied the ability to defined employee churn using the Power BI visualization tool. The study predicted and visualized employees who tend to leave the organization using random forest and logistic regression models. In the same way, [17] examined employee attritions [18] using predictive analysis and visualization tool R. Similarly, [19] predicted employee turnover using supervised machined learning, classifier rule visualization, and extraction methods.

3.3. Develop More Effective Training, Enhance Productivity and Overall Decision Making

Improving organizational performance is directly related to employee qualifications, training, and performance. The human resource team can assess employees' performance in the company over time. [20] Investigated the performance of twenty employees over six months using Elasticserach and Kibana visualization. They were able to track employees' improvement or declined performance-using visualization. In the same manner, an HR training program can utilize data visualization [21]. To illustrate, [22] confirmed that visualizing the HR framework in Japanese firms could play a vital role in training HR employees with little experience. Murthy [23] argued that HR data visualization and storytelling enhanced HR analytics, functioning, and decision-making. Augmented and virtual reality is an emerging technology of visualization that can be optimally adapted in human resource

management. [24] Suggested embracing virtual and augmented reality to support employee recruitment and training programs to develop highly skilled and qualified workers. “ Table.1” summarizes the area of research that is covered in HR analytics and visualization.

TABLE 1. Research area in HR and data visualization

Reference	Area covered	Visualization technique
(wang et al.,2021) Ozcan et al., 2020) (Filipov et al.,2019) (Mohapatra & Sahu ,2017)	Hiring process and candidate acquisition	ResumeVis CV3 Funnel chart Kanban HeatMap
(Ameer et al., 2020) (Setiawan et al., 2020) (Zhao et al., 2018) (Mohhamed & Ouddus, 2019)	Predict employee attrition	R Power PI Python
(Sato et al., 2019) (Lalic et al., 2020)	Training	Virtual reality (VR) Augmented reality (AR) Storytelling
(Raguvir & Babu , 2020) (Murthy et al., 2017)	Employee performance	Kibana

Research trends in the area of human resource and data visualization

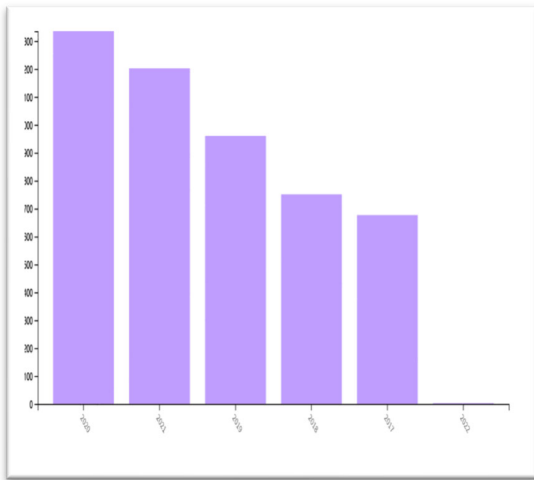


Fig. 2. Publication Trend

Based on the web of science analytics “Fig. 2”, shows the publications trend in human resource visualization in the field of computer science per year. It shows that the interest in human resources and data visualization increasing gradually from 2017 to 2022. The publications reached the highest growth in 2021 with nearly 27 %. The growing number demonstrates the increasing interest from academia in the significance of the research domain. The trend additionally indicates that publications will extend to increase in the coming future.

TABLE 2. Top 10 productive journals

Table.2 lists the top ten affiliations that published the most articles on data visualization in human resources, the number of papers contributed, and the geographic location. Chinese Academy of sciences in China published the majority with 323 records, followed by the University of California system in the United States. The top-ranked authors are from the Chinese academy of sciences, which reflects the positive relationship between affiliations and authors. For further investigation, the co-citation analysis method was used to investigate the relationship between authors. [25] Discussed the trends for IIOT keywords data visualization applying for higher education. Similar study is conducted for education data mining with student’s data to

visualize and predict their performance. A study for recruitment

Affiliations	Record	
	Count	Location
CHINESE ACADEMY OF SCIENCES	323	China
UNIVERSITY OF CALIFORNIA SYSTEM	202	U.S.A
ZHEJIANG UNIVERSITY	165	China
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE CNRS	163	France
UNIVERSITY OF CHINESE ACADEMY OF SCIENCES CAS	143	China
UNITED STATES DEPARTMENT OF ENERGY DOE	133	U.S.A
TSINGHUA UNIVERSITY	102	China
UTAH SYSTEM OF HIGHER EDUCATION	95	U.S.A
HARVARD UNIVERSITY	93	U.S.A
UNIVERSITY OF TEXAS SYSTEM	92	U.S.A

process applying chatbots is investigated in [27] where authors found chatbots or virtual assistants influence across the employment practice and in [28], a bibliometric study was conducted for different results via open source library software. A data visualization and analysis is conducted in [29, 30] for educational data collected from IoT and big data application in education. Further, Data Visualization for HR’s Impact and Influence is conducted in a white paper [31]

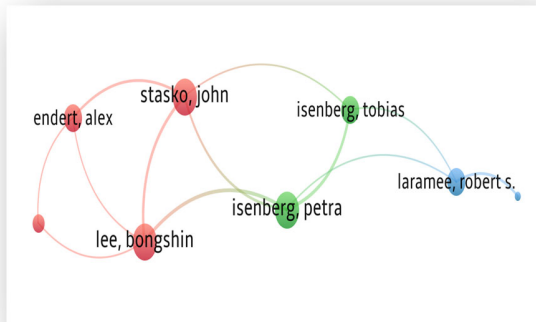


Fig. 3. Author's network

“Fig.3” visualize the co-citation network using VOSviewer. The selection process of authors was an author with a minimum of five documents. The finding suggested that only 16 out of 2923 authors met the threshold and were selected for co-citation network analysis.

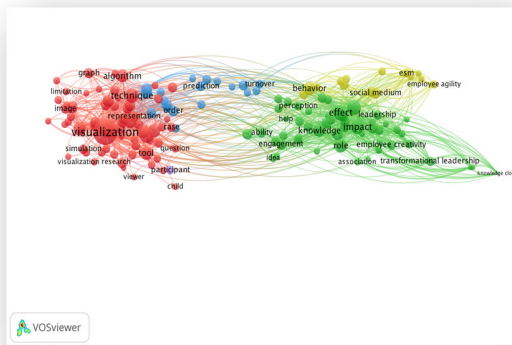


Fig. 4. Topics network visualization

“Fig. 4” maps the co-occurrence of terms in the research area of human resources and data visualization using VOSviewer. The counting method was set to full counting, which means that all occurrence of a term document are counted. The minimum of relationship with terms was set to 10. 154 terms out of 256 terms that met the threshold were selected based on a relevance score.

Terms such as researcher, study, and hypothesis were manually excluded. There were four clusters: red, blue, green, and yellow that showed the relationship between topics. From “Fig.5” it can be seen that Keywords that frequently showed were: visualization, knowledge, prediction, impact, effect.

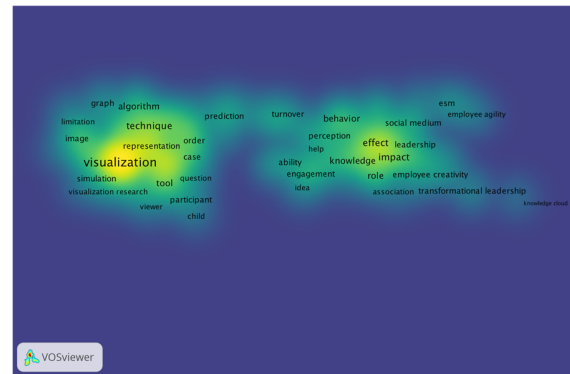


Fig. 5. Topics density visualization

4. Conclusion

This paper conducted a literature review in addition to bibliometric analysis to investigate the role of data visualization in human resource. The review was supported by the latest publications in the field of data visualization and human resource. Results showed the positive impact of data visualization in human resource management in; improving recruitment decisions, employee retention, training, productivity, and decision-making. The articles for the bibliometric analysis were extracted from the web of science database from year 2017 to 2022. The influential institutions and trending articles were identified. In addition, the result indicates an increasing interest in the last years of research publications in the field of human resources and data visualization.

References

[1] Caughlin, D.E. and Bauer, T.N. (2019), "Data Visualizations and Human Resource Management: The State of Science and Practice", Buckley, M.R., Wheeler, A.R., Baur, J.E. and Halbesleben, J.R.B. (Ed.) *Research in Personnel and Human Resources Management (Research in Personnel and Human Resources Management, Vol. 37)*, Emerald Publishing Limited, Bingley, pp. 89-132.

- [2] Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact?. *Scientometrics*, 105(3), 1809-1831.
- [3] Friendly, M. (2008). A brief history of data visualization. In *Handbook of data visualization* (pp. 15-56). Springer, Berlin, Heidelberg.
- [4] Khan, S. (2021). Visual Data Analysis and Simulation Prediction for COVID-19 in Saudi Arabia Using SEIR Prediction Model. *International Journal of Online & Biomedical Engineering*, 17(8).
- [5] Y. Zhang and Y. Luo, "Data mining technology based on the visualization of enterprise human resources information data research," *2020 5th International Conference on Mechanical, Control and Computer Engineering (ICMCCE)*, 2020, pp. 2489-2493, doi: 10.1109/ICMCCE51767.2020.00538.
- [6] Gong, T., Jiang, Y., Saldivia, L. E., & Agard, C. (2021). Using Sankey diagrams to visualize drag and drop action sequences in technology-enhanced items. *Behavior Research Methods*, 1-16.
- [7] Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact?. *Scientometrics*, 105(3), 1809-1831.
- [8] Wang, X., Zhang, J., Yao, K., & Qin, J. (2021). ResumeVis Interactive Visualization of Resumes Based on Multi-Source Data. *International Journal of Web Services Research (IJWSR)*, 18(2), 40-53. <http://doi.org.sdl.idm.oclc.org/10.4018/IJWSR.202104010>
- [9] Filipov, V., Arleo, A., Federico, P., & Miksch, S. (2019, June). CV3: Visual exploration, assessment, and comparison of CVs. In *Computer Graphics Forum* (Vol. 38, No. 3, pp. 107-118).
- [10] Alfaifi, Asma Abdulsalam; Khan, Shakir Gayour (2022) "Utilizing Data from Twitter to Explore the UX of "Madrasati" as a Saudi e-Learning Platform Compelled by the Pandemic", *Arab Gulf Journal of Scientific Research*, Vol. 39 Issue 3, p200-208. <https://doi.org/10.51758/AGJSR-03-2021-0025>
- [11] Setiawan, I., Suprihanto, S., Nugraha, A. C., & Hutahaean, J. (2020, April). HR analytics: Employee attrition analysis using logistic regression. In *IOP Conference Series: Materials Science and Engineering* (Vol. 830, No. 3, p. 032001). IOP Publishing.
- [12] Lalić, D., Bošković, D., Milić, B., Havzi, S., & Spajić, J. (2020, August). Virtual and Augmented Reality as a Digital Support to HR Systems in Production Management. In *IFIP International Conference on Advances in Production Management Systems* (pp. 469-478). Springer, Cham.
- [13] P. Chertchom, "Employee assessment using data mining techniques: modeling individual capability to improve the competency of companies," *2018 International Conference on Information Technology (InCIT)*, 2018, pp. 1-5, doi: 10.23919/INCIT.2018.8584861
- [14] M. Ameer, S. P. Rahul and S. Manne, "Human Resource Analytics using Power Bi Visualization Tool," *2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS)*, 2020, pp. 1184-1189, doi: 10.1109/ICICCS48265.2020.9120897.
- [15] M. AlAjmi, S. Khan (2015) PART OF AJAX AND OPENAJAX IN CUTTING EDGE RICH APPLICATION ADVANCEMENT FOR E-LEARNING, *INTED2015 Proceedings*, pp. 4058-4063.
- [16] Ozcan, S., Sakar, C. O., & Suloglu, M. (2020). Human resources mining for examination of R&D progress and requirements. *IEEE Transactions on Engineering Management*.
- [17] Mohapatra, M., & Sahu, P. (2017). Optimizing the recruitment funnel in an ITES company: An analytics approach. *Procedia computer science*, 122, 706-714.
- [18] Mohammed, D., & Quddus, A. (2019). HR analytics: a modern tool in HR for predictive decision making. *Journal of Management*, 6(3).
- [19] Setiawan, I., Suprihanto, S., Nugraha, A. C., & Hutahaean, J. (2020, April). HR analytics: Employee attrition analysis using logistic regression. In *IOP Conference Series: Materials Science and Engineering* (Vol. 830, No. 3, p. 032001). IOP Publishing.
- [20] Nikolaidis, P.; Ismail, M.; Shuib, L.; Khan, S.; Dhiman, G. Predicting Student Attrition in Higher Education through the Determinants of Learning Progress: A Structural Equation Modelling Approach. *Sustainability* 2022, 14, 13584. <https://doi.org/10.3390/su142013584>
- [21] Zhao, Y., Hryniewicki, M. K., Cheng, F., Fu, B., & Zhu, X. (2018, September). Employee turnover prediction with machine learning: A reliable approach. In *Proceedings of SAI intelligent systems conference* (pp. 737-758). Springer, Cham.
- [22] Raguvir, S., & Babu, S. (2020). Enhance employee productivity using Talent analytics and Visualization. *2020 International Conference on Data Analytics for Business and Industry: Way Towards a Sustainable Economy (ICDABI)*, Data Analytics for Business and Industry: Way Towards a Sustainable Economy (ICDABI), 2020 International Conference On, 1-5. <https://doi.org.sdl.idm.oclc.org/10.1109/ICDABI51230.2020.9325682>
- [23] S. Khan, "Data Visualization to Explore the Countries Dataset for Pattern Creation", *Int. J. Onl. Eng.*, vol. 17, no. 13, pp. pp. 4-19, Dec. 2021.
- [24] Sato, Y., Kobayashi, N., & Shirasaka, S. (2019, July). A Proposal of HR System's Visualization Based on Harvard Model, Life Cycle, and Organization Strategy and Management Type. In *2019 8th International Congress on Advanced Applied Informatics (IIAI-AAI)* (pp. 740-745). IEEE
- [25] Murthy, M. V. S., Kinange, U., & Shaikh, A. (2017). Influence of HR Analytics Representation on Awareness, Technology and Decision Making: A Study of Medium and Large Organizations. *Reviews of literature*
- [26] Lalić, D., Bošković, D., Milić, B., Havzi, S., & Spajić, J. (2020, August). Virtual and Augmented Reality as a Digital Support to HR Systems in Production Management. In *IFIP*

International Conference on Advances in Production Management Systems(pp. 469-478). Springer, Cham.

- [27] Khan, Shakir. "Artificial Intelligence Virtual Assistants (Chatbots) are Innovative Investigators." *International Journal of Computer Science and Network Security* 20.2 (2020): 93-98.
- [28] S. Khan (2017) AN INTER-OPERABILITY AND OPEN SOURCE PROBLEM FOR INTEGRATED LIBRARY SYSTEM (KOHA) AND DIGITAL LIBRARY (DSpace) AS SINGLE SYSTEM, EDULEARN17 Proceedings, pp. 7041-7047. <https://dx.doi.org/10.21125/edulearn.2017.2650>
- [29] Shakir Khan (2018) "Modern Internet of Things as a Challenge for Higher Education", *IJCSNS International Journal of Computer Science and Network Security*, Vol. 18 No. 12, pp. 34-41.
- [30] S. Khan and S. Alqahtani, "Big Data Application and its Impact on Education", *Int. J. Emerg. Technol. Learn.*, vol. 15, no. 17, pp. 36-46, Sep. 2020. <http://dx.doi.org/10.3991/ijet.v15i17.14459>
- [31] Sinar, E. F. (2018). Data Visualization: Get Visual to Drive HR's Impact and Influence. Society for Human Resource Management (SHRM)-Society for Industrial- Organizational Psychology (SIOP) Science of HR White Paper Series



Dr. Bandar Almobark received his Bachelor, Master and PhD in 1997, 2002 and 2007 respectively. He is member of many scientific committees in Saudi Arabia. He is currently working as Assistant Professor at College of Computer and Information Sciences in Imam Mohammad Ibn Saud Islamic University, Riyadh (Saudi Arabia). His research interest are

Information Retrieval, Digitization, Electronic Record Management, Software and Application Development, Content Analysis and Data Analysis, Emerging Technology, Open Source Software, Library Automation and Mobile / Web Application. He published many research papers in international journals and conferences in his research domain. He has around 15+ years of experience in managerial, teaching and research. Dr. Mobark is teaching bachelor degree courses in the college of computer at Imam University.