

A Comprehensive Bibliometric Analysis of Human Resource Analytics: Trends, Themes and Future direction

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Abstract- The study intends to comprehend the conceptual, intellectual, and social growth of HR analytics by identifying and analysing the most pertinent scientific work in the field using the software packages Bibliometrix and Biblioshiny, a bibliometric study was performed on academic publications from the “Scopus and Web of Science (WoS) databases”, covering the years 2006 to 2024. 377 papers were chosen once the exclusion criteria were applied. The study gives a quantitative overview with tables, graphs, and maps, highlighting important subjects in HR analytics. Key performance indicators including publication and citation metrics are also identified. The findings demonstrate that HR analytics is a cutting-edge, adaptable field that can leverage technology to enhance employee experiences, corporate performance, and HR initiatives. The study opens the door for additional research and development in the subject of HR analytics by offering an awareness of the key themes, noteworthy publications, and collaborative networks in this area.

Key words: bibliometric analysis, Human Resource analytics, HR analytics, Workforce analytics, Talent analytics, People analytics, Human Capital analytics

1.1 Introduction-

In the rapidly evolving subject of human resource analytics, research has exploded, producing a wealth of knowledge and ongoing scholarly discourse. Using a variety of bibliometric techniques, this report scrutinizes HRA studies spanning the years 2006 to 2024 in academic publications. Themes that are emphasized include "HR analytics," "Talent analytics," "People analytics," "Human Resource analytics," and "Human Capital analytics." We seek to summarize the key findings of HRA scholarship by parsing 15817 references and article information. We seek to map the collective intellectual trajectory of HRA scholars by the analysis of keywords, author patterns, and collaborative networks using bibliometric analysis. With its increasing effect and acceptance besides academia, Bibliometric analysis has become a powerful tool for evaluating scientific publications (**Ellegaard & Wallin , 2015**).

In order to identify novel trends in the efficacy of research components, bibliometric study is implemented., collaboration patterns, and journals and articles (**Linnenluecke et al., 2020; Moral-Muñoz et al., 2020; Donthu et al., 2021a, 2021b**). Additionally, it is implemented to analyse existing literature to ascertain the conceptual underpinnings of a specific subject (**Ismail et al., 2024**).

The term "human capital" describes an individual's knowledge, information, concepts, abilities, and state of health. We are living in the "age of human capital" because, in modern economies, human capital is by far the most important sort of capital. The extent and efficacy with which individuals

invest in themselves determines their economic performance as well as that of entire economies (Becker, 2002).

Kale et al. (2022) research highlights importance of “HR analytics” in modern business, highlighting its potential to improve employee performance and productivity. By utilizing these tools, organizations can track personnel's performance online, leading to better talent management, recruiting quality, and reduced employee turnover.

1.2 Literature review

Literature reviews are conducted through the utilisation of bibliometric analysis. Academic articles on HR analytics published between April 2024 and 2006 were examined identified through searches of the "Web of Science" and "Scopus" databases.

Many sources, such as social media platforms, websites, mobile devices, e-commerce, Internet of Things (IoT) devices, business applications, machine data, government records, financial transactions, log records, and machine logs, are the source of big data. To extract critical trends and insights for creative thinking and decision-making, these sources generate vast quantities of data that necessitate processing and analysis (Sharma et al., 2023; Wu et al., 2013).

The "3Vs" (Akter et al., 2016) are employed to characterise it, as they represent "volume, velocity and variety". The term "People Analytics" originated with Google, according to the authors of (Marler & Boudreau, 2017), who use it to characterize their data-driven approach to HRM. Given that the world's top businesses use it to strengthen their competitive edge, as noted by [5], Google's success has made the idea more widely recognized as a best practice in human resource management for day-to-day “decision making” (Zeidan & Itani , 2020). Aral et al. (2012) underscore the importance of “performance pay, information technology, and human resource analytics” in order to create a more efficient incentive system that enhances production (Kaur et al., 2023). This concept is further supported by Shrivastava et al. (2018), who elaborate on the successful integration of analytics into Google's HR practices to facilitate data-driven decision-making (Mizrak F., 2023; Mohammed, 2019).

According to Bassi et al. (2016), who offer insights on how analytics may be utilized to improve leadership development programs, human resource analytics is successful in leadership development. The expanding significance of data-driven approaches in human resources management is shown by Mohammed's (2019) exploration of the implications of “HR analytics for predictive decision-making” in businesses. There is doubt about HR practitioners' ability to use data analytics successfully, despite the potential benefits of HR analytics (King, 2017; Lochab et al., 2020; Qamar et al., 2021) research on HR analytics highlights its role in enhancing organizational performance, while their bibliometric study identifies current trends and sets future research agendas, emphasizing the importance of staying informed. Hendry & Pettigrew, (1986) emphasise the importance of "HR analytics" in improving organisational performance, decision-making processes, and strategies, thereby reinforcing the quantitative aspect of HR.

1.2.1 Objectives of the study:

1. To analyse the evolution of human resource analytics.
2. To determine the authors and sources that are most pertinent to human resource analytics
3. To identify the key terms associated to Human resource Analytics

1.3 Data collection and methodology

Systematic reviews offer the opportunity to combine academic knowledge with practitioner judgment and expertise in evidence-based practice (Denyer & Tranfield, 2009). Ball & Tunger (2006)

suggests that bibliometrics can be used to identify patterns in thematic analysis, revealing changes in fundamental structures.

The data was obtained from the "Scopus" and "Web of Science" databases. From 2006 to 2024, a "Scientific Mapping Workflow for "bibliometric analysis" was implemented to accomplish this. The terms "workforce analytics," "talent analytics," "people analytics," "human resource analytics," "human capital analytics," and "HR analytics" refer to the data collected between 2006 and 2024 (April). The keywords, abstracts, and titles of the publications must all contain these terms. The records of each database were exported in CSV file format from the "Scopus database" and plain text file format from the "Web of Science" database after the database results were collected to ensure data source consistency (Solanki et al., 2023). Ultimately, both files were to be combined into a single xlsx file for processing. Ball & Tunger, (2006) manual outlines the process of standardizing a database using R-Studio data frames, removing duplicates (Manual, 2019) , and combining records from various databases. After eliminating 81 duplicates, 377 research publications were examined using R statistical software.

The Bibliometrix software was utilized to conduct a bibliometric study of science mapping using the scient metric methodology (Ball & Tunger, 2006 ; Palos-Sánchez et al., 2022). The Biblioshiny online interface, created by ball & Tunger (2006), is accessible through "Comprehensive R Archive Network (CRAN)", providing a thorough method for bibliometric analysis. Based on a recent study (Moral-Muñoz, 2020) which claims that "Bibliometrix" provides the most suitable and thorough method for bibliometric analysis. (Lizano-Mora et al., 2021). To conduct bibliometrix analysis, "Bibliometrix R software package" should be installed after that execute the "library(bibliometrix)" command in "R-Studio" (Team R.C, 2013). To load the Biblioshiny web interface, the "biblioshiny()" command was executed. It gives statistics and facts a visual representation. The HR analytics that are the subject of this study are predetermined. Ellegaard & Wallin (2015) study highlights the growing importance of bibliometric analysis in non-ILS communities, highlighting its utility in assessing scientific production trends and scholarly research impact.

1.4 Results

The analysis and standardization portion of the Scientific Mapping Workflow technique was completed. Over 18-year span, removing duplicates resulted in the identification of 377 documents.

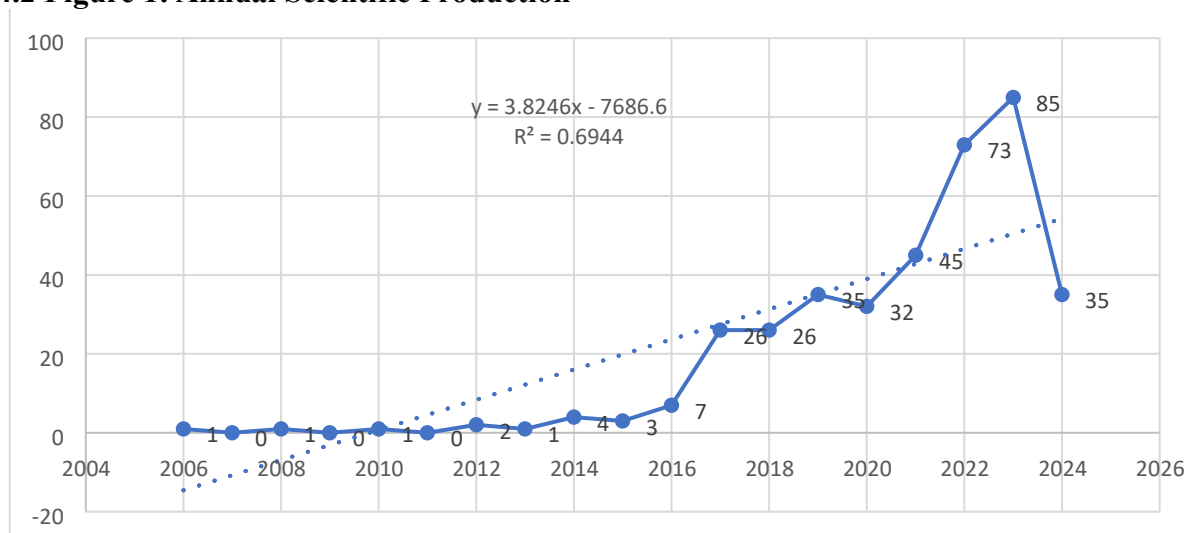
1.4.1 Table 1: Summary of the research data

Description	Results
"Time period"	2006:2024
"Sources (Journals, Books, etc.)"	244
"Documents"	377
"Annual growth rate"	21.87
"Document average age"	3.22
"Average citation per document"	13.92
"References"	15817

Document type	
“Articles”	214
“Article; early access”	13
“Book review”	5
“Book review; early access”	1
“Conference paper”	107
“Editorial material”	7
“Editorial material; early access”	1
“Review”	29
Content of the Documents “Keywords plus (ID)”	1200
“Author’s keywords (DE)”	1055
Authors “Authors”	
“Single authors”	820
“Multiple authors”	59
	761
Collaboration	
“Single author”	70
“Co-authors per article”	272
“International co-authorships %”	1141

These articles were sourced from 244 distinct sources, with an average of 13.92 citations per article. Similarly, there were references to 70 distinct single authors, 1055 keywords, and 377 documents. The specific component focuses on how HR analytics research is still in its infancy and how it continues to forge new connections with other academic fields.

1.4.2 Figure 1: Annual Scientific Production



In figure 1, **Marle & Boudreau's 2017** review paper on HR analytics demonstrates a surge in research since its inception in 2006. **Peeters et al.'s 2020** paper explores the key ingredients for people analytics teams to contribute to organizational performance. **Qamar & Samad's 2021** review paper captures the state of the art and identifies current research trends. **Chatterjee & Hadi's 2015** analysis shows a positive link between the number of scientific publications and the validity and accuracy of the research topic, indicating a positive correlation between the two.

1.4.3 Table 2: Relevant sources

Sources	Articles
“Personnel Review”	13
“Human Resource Management Journal”	12
“Journal Of Organizational Effectiveness”	12
“Human Resource Management”	9
“Human Resource Management International Digest”	7
“Lecture Notes in Networks and Systems”	7
“Human Resource Development Review”	6
“Management Decision”	6
“Human Resource Management Review”	5
“International Journal of Human Resource Management”	5

Table 2, depicts top relevant sources, “**Personnel Review**” with 13 documents, making it the leading journal in publishing research related to Human resource Analytics. This suggests that firm performance, human resource information systems (Simms,2020) , HR analytics and management systems are given top priority. “**Human Resource Management Journal**” and “**Journal of Organizational Effectiveness**” follow closely with 12 articles, focusing on HR management and analytics, organisational performance, highlighting a significant interest in work management. With 9 articles, the “**Human Resource Management**” prioritizes performance work systems, mixed-methods, HR, HR analytics and perception. The journal of “**Human Resource Management International Digest**” and “**Lecture Notes in Networks and Systems**” , with 7 articles, seek to emphasize the value of analytics and its benefits in human resource management.

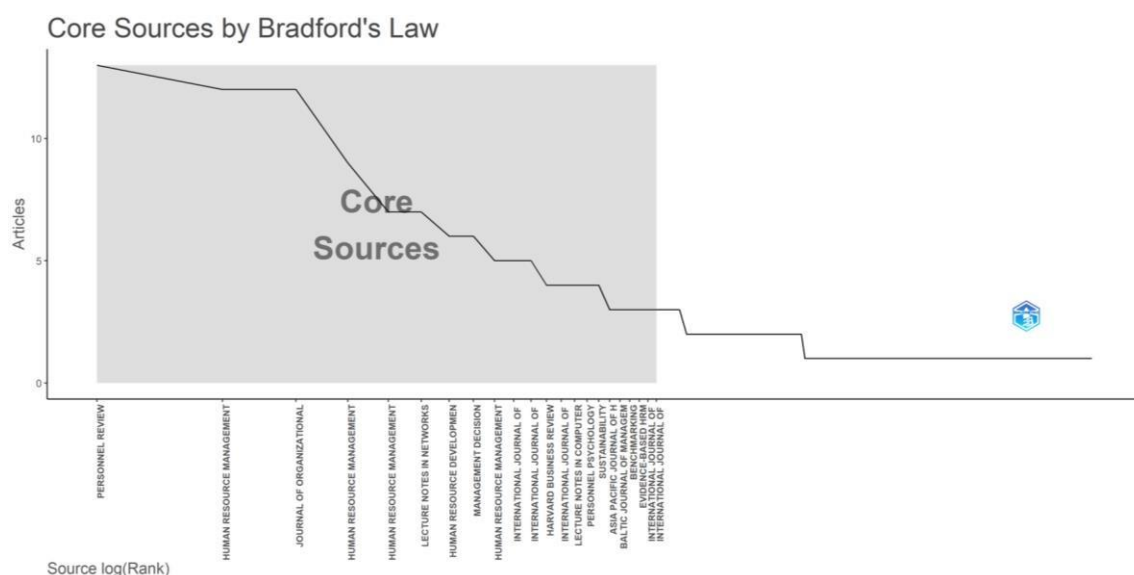
1.4.4 TABLE 3: MOST CITED SOURCES

Paper	DOI	Total Citations	TC per Year	Normalized TC
“ANGRAVE D, 2016, HUM RESOUR MANAG J”	10.1111/1748-8583.12090	210	23.33	4.40
“SIVATHANU B, 2018, HUM RESOUR MANAGE INT DIG”	10.1108/HRMID-04-2018-0059	203	29.00	6.24
“MARLER JH, 2017, INT J HUM RESOUR MAN”	10.1080/09585192.2016.1244699	191	23.88	6.16
“ULRICH D, 2015, HUM RESOUR MANAGE R”	10.1016/j.hrmmr.2015.01.004	165	16.50	1.64
“DAVENPORT TH, 2010, HARVARD BUS REV”	NA	150	10.00	1.00

“ARAL S, 2012, MANAGE SCI”	10.1287/mnsc.1110.1460	141	10.85	1.92
“NEWMAN DT, 2020, ORGAN BEHAV HUM DEC”	10.1016/j.obhdp.2020.03.008	133	26.60	6.74
“CHANG EH, 2019, P NATL ACAD SCI USA”	10.1073/pnas.1816076116	122	20.33	7.54
“RASMUSSEN T, 2015, ORGAN DY”	10.1016/j.orgdyn.2015.05.008	118	11.80	1.17
“VAN DEN HEUVEL S, 2017, J ORGAN EFF PEOPLE PERFORM”	10.1108/JOEPP-03-2017-0022	105	13.13	3.39

Table offers a thorough examination of the citation count (TC) of a variety of papers, including those by **Angrave et al. (2016)**, and **Marler & Boudreau (2017)** **Sivathanu & Pillai (2018)**, The total count of citations a document has received is denoted by the TC, with higher counts indicating significant influence. Notable papers include **Sivathanu & Pillai's (2018)** 203 citations, Angrave et al.'s 210 and 191 citations, and Marler & Boudreau's 191 citations. These metrics provide insight into the citation impact of research projects in bibliometric analysis.

1.4.5 Figure 2: Core Sources by Bradford's Law



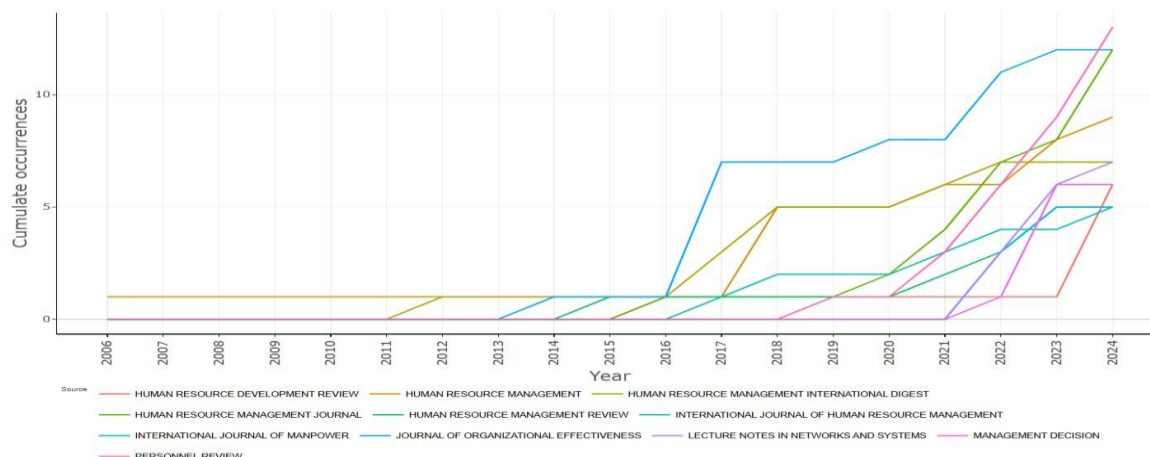
Ionescu-Tirgoviste et al. (2015), **Meihami, & Esfandiari, (2024)**, used Bradford's law to analyze the distribution of publications in relevant journals in the HRA sector. The graph illustrates the total number of articles and the logarithmic rank of journals. **Su et al., 2020**, employed this law to determine historical trends and prospective research orientations. The "Core Sources Zone" represents primary sources that significantly contribute to the literature, with a steep initial slope and a gradual decline in articles outside this core region.

1.4.6 TABLE 4: JOURNAL IMPACT

Element	h_index	g_index	m_index	TC	PY_start
“HUMAN RESOURCE MANAGEMENT JOURNAL”	9	12	1	356	2016
“JOURNAL OF ORGANIZATIONAL EFFECTIVENESS”	9	12	0.818	464	2014
“PERSONNEL REVIEW”	7	13	1.167	185	2019
“HUMAN RESOURCE MANAGEMENT”	5	9	0.263	260	2006
“HARVARD BUSINESS REVIEW”	4	4	0.267	269	2010
“INTERNATIONAL JOURNAL OF HUMAN RESOURCE MANAGEMENT”	4	5	0.5	262	2017
“SUSTAINABILITY”	4	4	0.667	27	2019
“HUMAN RESOURCE MANAGEMENT INTERNATIONAL DIGEST”	3	7	0.231	240	2012
“HUMAN RESOURCE MANAGEMENT REVIEW”	3	5	0.3	272	2015
“INTERNATIONAL JOURNAL OF ADVANCED TRENDS IN COMPUTER SCIENCE AND ENGINEERING”	3	3	0.5	34	2019

Bansal et al. (2022), Guffey (2016), and Jain et. al. (2024) conducted a study on academic journals in various fields, including “Workforce analytics”, “Talent analytics”, “People analytics”, “Human Resource analytics”, “Human Capital analytics”, “HR analytics”. The h-index measures a journal's global citation (**Rehman et al., 2023**), while the g-index measures the number of highly cited articles (**Azad & Parvin,2022**). The m-index normalizes the h-index by the number of years since the journal's inception, indicating the average annual increase in influence (**Guffey, 2022**). The total citations reflect the journal's overall impact within the academic community. Notable journals like the Human Resource Management Journal, Journal of Organizational Effectiveness, and Personnel Review and Human Resource Management are highlighted, highlighting their contributions to published research in Human Resource Analytics.

1.4.7 Figure 3: Source Growth



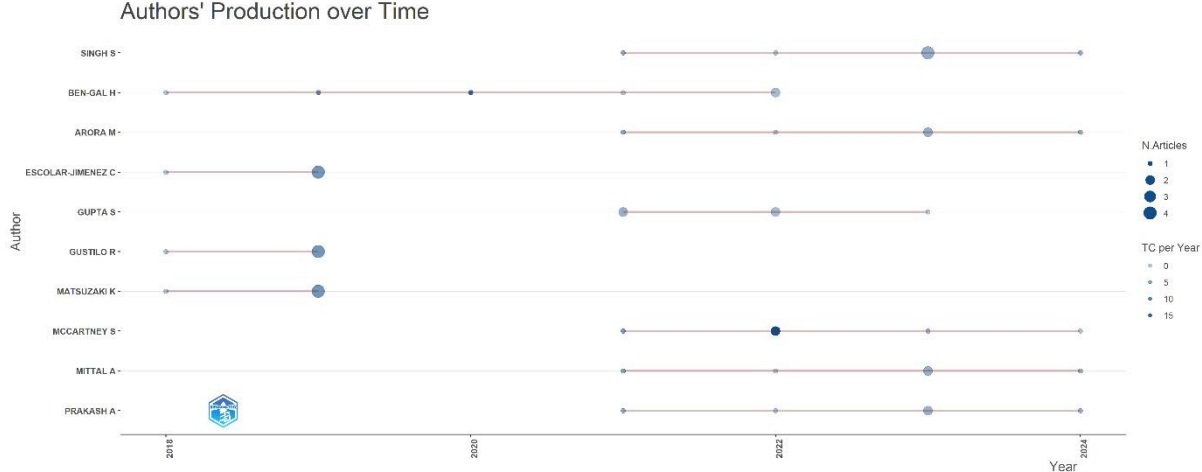
A line graph in figure 3 illustrating the growth of academic journals from 2006 to 2024 is used to analyse trends. The slopes of each line indicate growth rates, with steeper slopes indicating rapid increases and flatter slopes indicating slower growth. Certain journals display spikes, indicating increased attention, while others show steady growth or smaller slopes, indicating more recent or specialized positions. This graph aids in discussions on scholarly dynamics, journal impact, and field development, enabling comparative analysis among journals and understanding the competitive environment.

1.4.8 Table 5 Relevant sources

Authors	Articles	Articles fractionalized
“SINGH S”	7	2.20
“BEN-GAL H”	6	2.45
“ARORA M”	5	1.20
“ESCOLAR-JIMENEZ C”	5	1.50
“GUPTA S”	5	1.92
“GUSTILO R	5	1.50
“MATSUZAKI K””	5	1.50
“MCCARTNEY S”	5	2.17
“MITTAL A”	5	1.20
“PRAKASH A”	5	1.20

Author with highest publication is Swati Singh from “Bharatiya Vidya Bhavan's Usha and Lakshmi Mittal Institute of Management” , New Delhi, India, followed by Hila Chalutz-Ben Gal from “Bar-Ilan University”, Israel.

1.4.9 Figure 2:Top Author’s Production over Time



The graph illustrates the publication patterns and impact of various authors from 2018 to 2024, showing both the number of articles published and their citation rates per year. Each horizontal line represents an author, with points indicating publication years while the color intensity signifies citation rates per year. Notably, authors like Escolar-Jimenez C. and Gustilo R. have fewer publications but higher citation impacts 7.5 and, suggesting significant contributions to their fields. Author like Singh S., Arora M., McCartney S., Mittal A. and Prakash A. has consistently concentrated on topic, as seen in Figure 2

1.4.10 TABLE 6: DISTRIBUTION OF SCIENTIFIC PRODUCTION ACCORDING TO LOTKA’S LAW

Documents written	No. of Authors	Proportion of Authors
1	693	0.845
2	85	0.104
3	25	0.030
4	9	0.011
5	6	0.007
6	1	0.001
7	1	0.001

The application of “Lotka's Law” (Ghorbani, 2024) provides a basis for studying author productivity, understanding publication patterns, and exploring the underlying dynamics of scholarly communication in various fields (Potter, 1981). Table 6 reveals that 84.5% of authors wrote a single document on HR Analytics, while 10.4% wrote two documents on this topic.

1.4.11 TABLE 7: IMPACT FACTOR OF AUTHORS

Element	h_index	g_index	m_index	TC	NP	PY_start
“ESCOLAR-JIMENEZ C”	5	5	0.714	50	5	2018

"GUSTILO R"	5	5	0.714	50	5	2018
"MATSUZAKI K"	5	5	0.714	50	5	2018
"MCCARTNEY S"	4	5	1	85	5	2021
"ARORA M"	3	5	0.75	30	5	2021
"AVRAHAMI D"	3	4	0.6	89	4	2020
"BAGGA T"	3	3	0.75	20	3	2021
"BEN-GAL H"	3	6	0.429	136	6	2018
"BOUDREAU J"	3	3	0.273	273	3	2014
"FU N"	3	4	1	60	4	2022

Table 7 presents a comprehensive bibliometric assessment of researchers, highlighting critical metrics like h_index, g_index, m_index, total citations, number of publications, and year of publication. The authors of the paper "**A Neural-Fuzzy Network Approach to Employee Performance Evaluation**", **Escolar-Jimenez C**, **Gustilo R**, and **Matsuzaki K** are the top HR analytics writers with an h-index of four. **McCartney S.** has a rapid accumulation of impactful research, while **Boudreau J.** stands out with 273 citations from just three publications. This dataset is essential for analysing and comparing research impact over time.

1.4.12 TABLE 8: AFFILIATION OF AUTHORS

"Affiliation	Articles
"TILBURG UNIVERSITY"	9
"AMITY UNIVERSITY"	8
"TATA RESEARCH DEVELOPMENT AND DESIGN CENTRE"	7
"IMT SCHOOL FOR ADVANCED STUDIES LUCCA"	6
"INDIAN INSTITUTE OF MANAGEMENT ROHTAK"	5
"K.R. MANGALAM UNIVERSITY"	5
"RMIT UNIVERSITY"	5
"ROYAL MELBOURNE INSTITUTE OF TECHNOLOGY (RMIT)"	5
"UNIVERSITY OF GRANADA"	5
"UNIVERSITY OF MODENA AND REGGIO EMILIA"	5

Table 8 displays the universities that the writers are affiliated with **Tilburg University** in the Netherlands stands out among them with nine publications, closely followed by Amity University in India with eight. Additionally, the **IMT School of Advanced Studies** in Lucca and the Tata Research Development and Design Centre have six and seven publications, respectively, while the other universities listed have five publications for each.

1.4.13 Table 9: Corresponding Author's countries

Country	Articles	SCP	MCP	Freq	MCP_Ratio
	104	104	0	0.276	0
INDIA	56	53	3	0.149	0.054
USA	53	49	4	0.141	0.075
GERMANY	19	15	4	0.05	0.211

UNITED KINGDOM	14	11	3	0.037	0.214
NETHERLANDS	13	10	3	0.034	0.231
AUSTRALIA	11	9	2	0.029	0.182
SPAIN	11	8	3	0.029	0.273
CHINA	9	3	6	0.024	0.667
ITALY	9	7	2	0.024	0.222

The data required for doing a bibliometric analysis that assesses nations' contributions to a particular scientific topic is provided in the table under "Scientific Production by Country." Metrics like total articles, frequency (Freq), MCP ratio, single country publishing (SCP), and multiple country publications (MCP) are among them (**Bonilla-Chaves & Palos-Sánchez, 2023**).

1.4.14 TABLE 10: AVERAGE NUMBER OF ARTICLES CITATION PER COUNTRY

Country	TC	Average Article Citations
USA	1751	33.00
INDIA	590	10.50
UNITED KINGDOM	400	28.60
NETHERLANDS	371	28.50
AUSTRALIA	209	19.00
DENMARK	200	50.00
ISRAEL	175	25.00
ITALY	140	15.60
BELGIUM	111	18.50
CHINA	105	11.70

As Table 10 shows, by country, the USA has the most article citations (1751), accounting for an average of 33.00% of citations. India is ranked second with 590 citations, ahead of the UK (400) and the Netherlands (371).

1.4.15 TABLE 11: MOST CITED ARTICLES

Paper	DOI	Total Citations	TC per Year	Normaliz
“ANGRAVE D, 2016, HUM RESOUR MANAG J”	10.1111/1748-8583.12090	210	23.33	4.40
“SIVATHANU B, 2018, HUM RESOUR MANAGE INT DIG”	10.1108/HRMID-04-2018-0059	203	29.00	6.24

“MARLER JH, 2017, INT J HUM RESOUR MAN”	10.1080/09585192.2016.1244699	191	23.88	6.16
“ULRICH D, 2015, HUM RESOUR MANAGE R”	10.1016/j.hrmr.2015.01.004	165	16.50	1.64
“DAVENPORT TH, 2010, HARVARD BUS REV”	NA	150	10.00	1.00
“ARAL S, 2012, MANAGE SCI”	10.1287/mnsc.1110.1460	141	10.85	1.92
“NEWMAN DT, 2020, ORGAN BEHAV HUM DEC”	10.1016/j.obhdp.2020.03.008	133	26.60	6.74
“CHANG EH, 2019, P NATL ACAD SCI USA”	10.1073/pnas.1816076116	122	20.33	7.54
“RASMUSSEN T, 2015, ORGAN DYN”	10.1016/j.orgdyn.2015.05.008	118	11.80	1.17
“VAN DEN HEUVEL S, 2017, J ORGAN EFF PEOPLE PERFORM”	10.1108/JOEPP-03-2017-0022	105	13.13	3.39

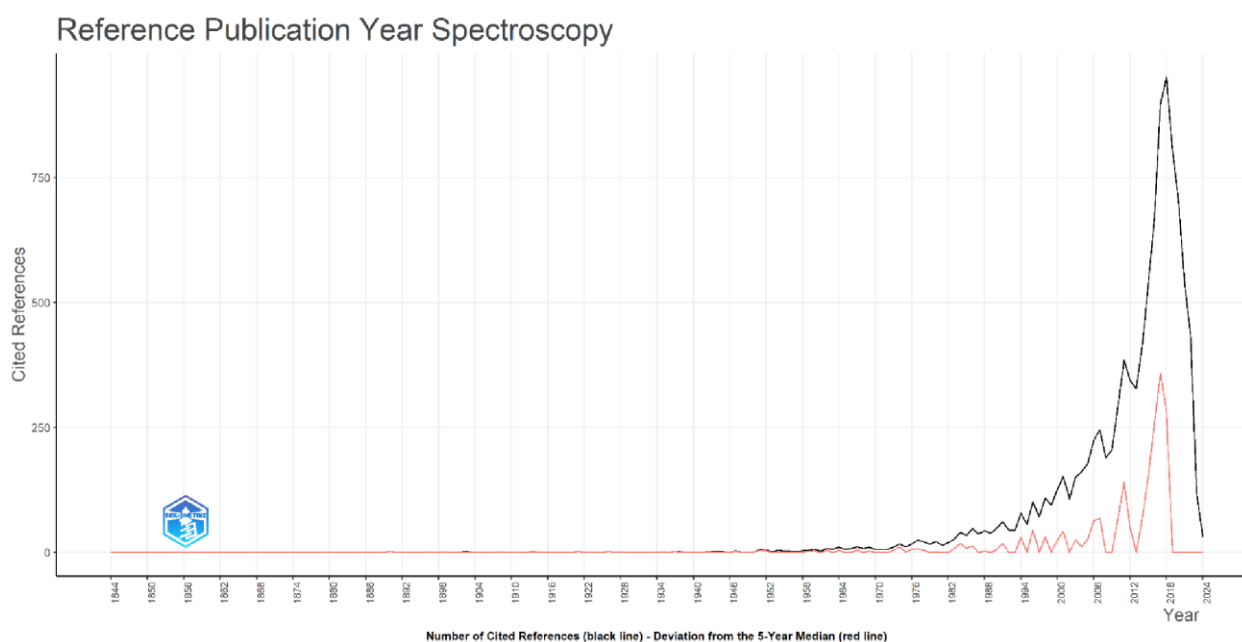
Boudreau, Angrave, Pillai, Marler, Ulrich & Dulebohn, and other researchers have conducted studies on human resource analytics as shown in table 11. **Angrave et al. (2016)** highlighted the potential of big data in HR analytics, while **Sivathanu & Pillai (2018)** examined the technology's impact on talent management. **Marler & Boudreau (2017)** conducted an “Evidence-based review”, while **Ulrich & Dulebohn (2015)** highlighted the significant transformation in HR practices. TC Per Year and Normalized TC metrics provide further insights into the impact of HR on organizations.

1.4.16 TABLE 12: MOST CITED REFERENCES

Cited References	Citations
Marler J.H., Boudreau J.W., An Evidence-Based Review Of Hr Analytics, The International Journal Of Human Resource Management, 28, 1, Pp. 3-26, (2017)	57
Angrave D., Charlwood A., Kirkpatrick I., Lawrence M., Stuart M., Hr And Analytics: Why Hr Is Set To Fail The Big Data Challenge, Human Resource Management Journal, 26, 1, Pp. 1-11, (2016)	50

Rasmussen T., Ulrich D., Learning From Practice: How Hr Analytics Avoids Being A Management Fad, <i>Organizational Dynamics</i> , 44, 3, Pp. 236-242, (2015)	41
Minbaeva, D. B. (2018). Building credible human capital analytics for organizational competitive advantage. <i>Human Resource Management</i> , 57(3), 701-713.	38
Boudreau, J., & Cascio, W. (2017). Human Capital Analytics: Why Are We Not There?. <i>Journal Of Organizational Effectiveness: People And Performance</i> , 4(2), 119-126	26
Huselid, M. A. (2018). The Science and Practice Of Workforce Analytics: Introduction To The HRM Special Issue. <i>Human Resource Management</i> , 57(3), 679-684.	26
Tursunbayeva, A., Di Lauro, S., & Pagliari, C. (2018). People Analytics—A Scoping Review Of Conceptual Boundaries And Value Propositions. <i>International Journal Of Information Management</i> , 43, 224247.	26

Table 12 shows Angrave et al. (2016), Rasmussen et al. (2015), and Bonilla-Chaves & PalosSánchez (2023) conducted a bibliometric analysis on the “Evidence-based review” of HR analytics, identifying significant works with extensive citations. The study, which includes 57 citations, is followed by Marler et al.'s (2017) work, with 50, 41, and 38 citations respectively. “Reference Publication Year Spectroscopy” (RPYS) identifies seminal works and historical foundations by visualizing the frequency of cited references (Jiang W., 2018). This technique reveals research and publication culture across disciplines by analyzing citation patterns in published works (Mars et al., 2014; Lian et al., 2019; Wray et al., 2024). A notable growth in the cited references or publications in the discipline of spectroscopy is indicated by the graph's strong upward trend in the black line. As a result, the graph indicates that the peak or increase in spectroscopy-related publications and research most likely started about 1980.

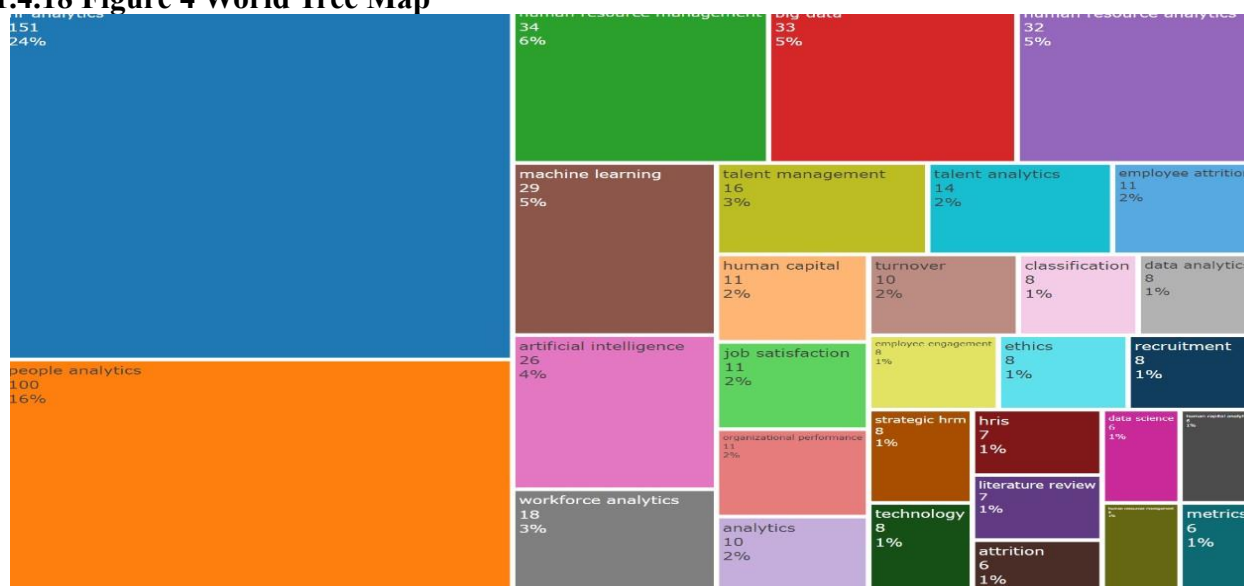


1.4.17 Table 14: Keywords

“Words”	Occurrences
“hr analytics”	151
“People analytics”	100
“human resource management”	34
“big data”	33
“human resource analytics”	32
“machine learning”	29
“artificial intelligence”	26
“workforce analytics”	18
“talent management”	16
“talent analytics”	14

Some concepts, phrases, and subjects that are commonly used in documents can be identified as keywords. The data gathering method uses these keywords (Hossain et al., 2020) as a baseline since they encompass the concept of systems thinking and its related concepts. As shown in Table 11 “HR analytics” is the most dominated words used in the document followed by “People analytics” and “Human resource management”. Next in the row is “Big data” that is used by 33 times, which shows the growing interest of authors.

1.4.18 Figure 4 World Tree Map



Using the primary phrases on a keyword map in the style of a tree map, Figure 7 illustrates the distribution of topics relevant to HR analytics. Based on the inclusion criteria applied in the databases, these are the most pertinent terms. These comprise "HR analytics," "People analytics," and "Human Resource management," accounting for 24%, 16%, 6%, and 5% of the overall incidence, respectively. Furthermore, three notable terms—"big data," "human force analytics," and "machine learning"—have 5% each.

1.4.19 Figure 1 Word Growth

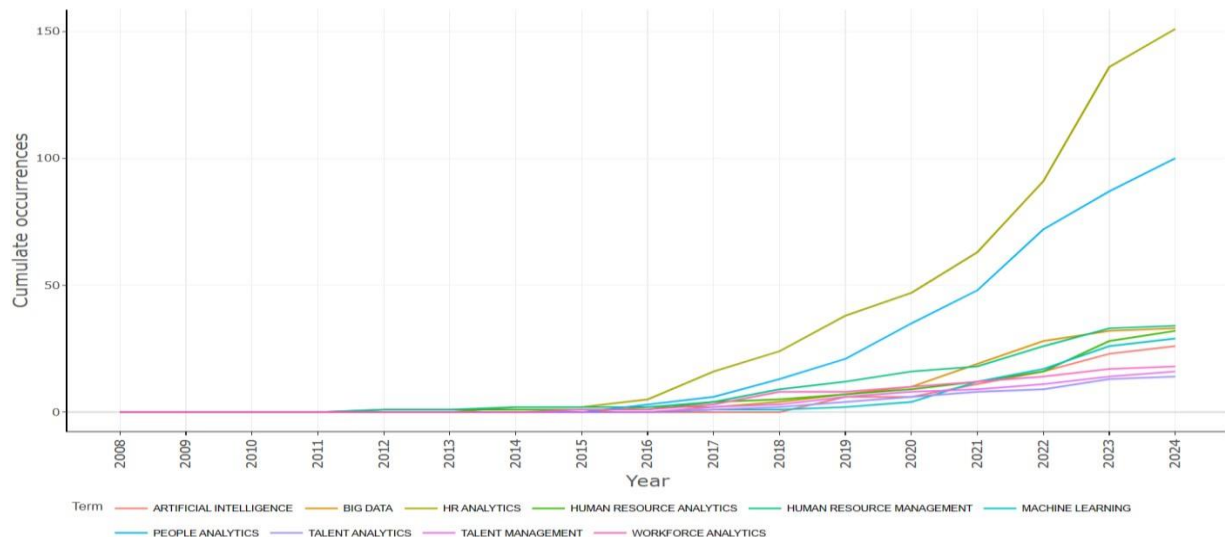
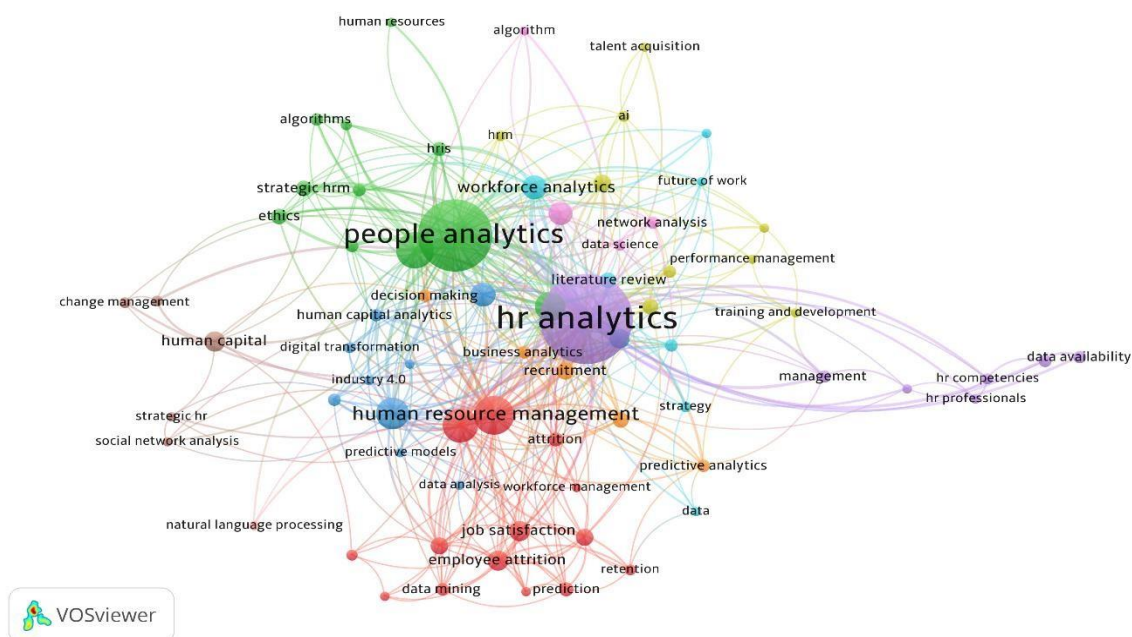


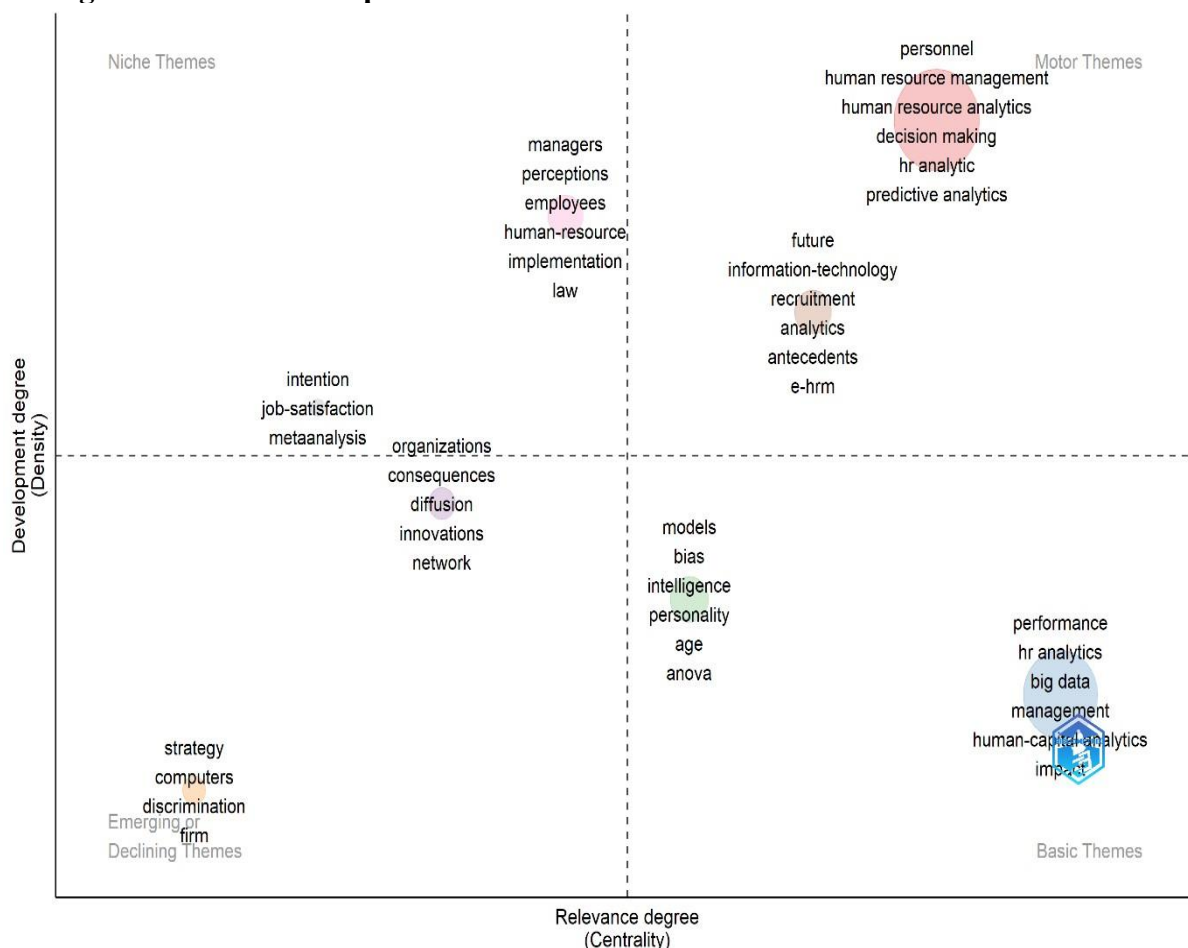
Figure 6 illustrates the behavior of keywords over time, which indicates a word growth tendency that has to be examined. The term "HR Analytics" is prioritised over the term "People analytics" in the timelines for each keyword, even though the latter term's trajectory indicates logistic growth during the study period. Additionally, there has been a noticeable rise in the terms "Big data" and "Human Resource Management" throughout time.

1.4.20 Figure 6: co-occurrence Author's keywords



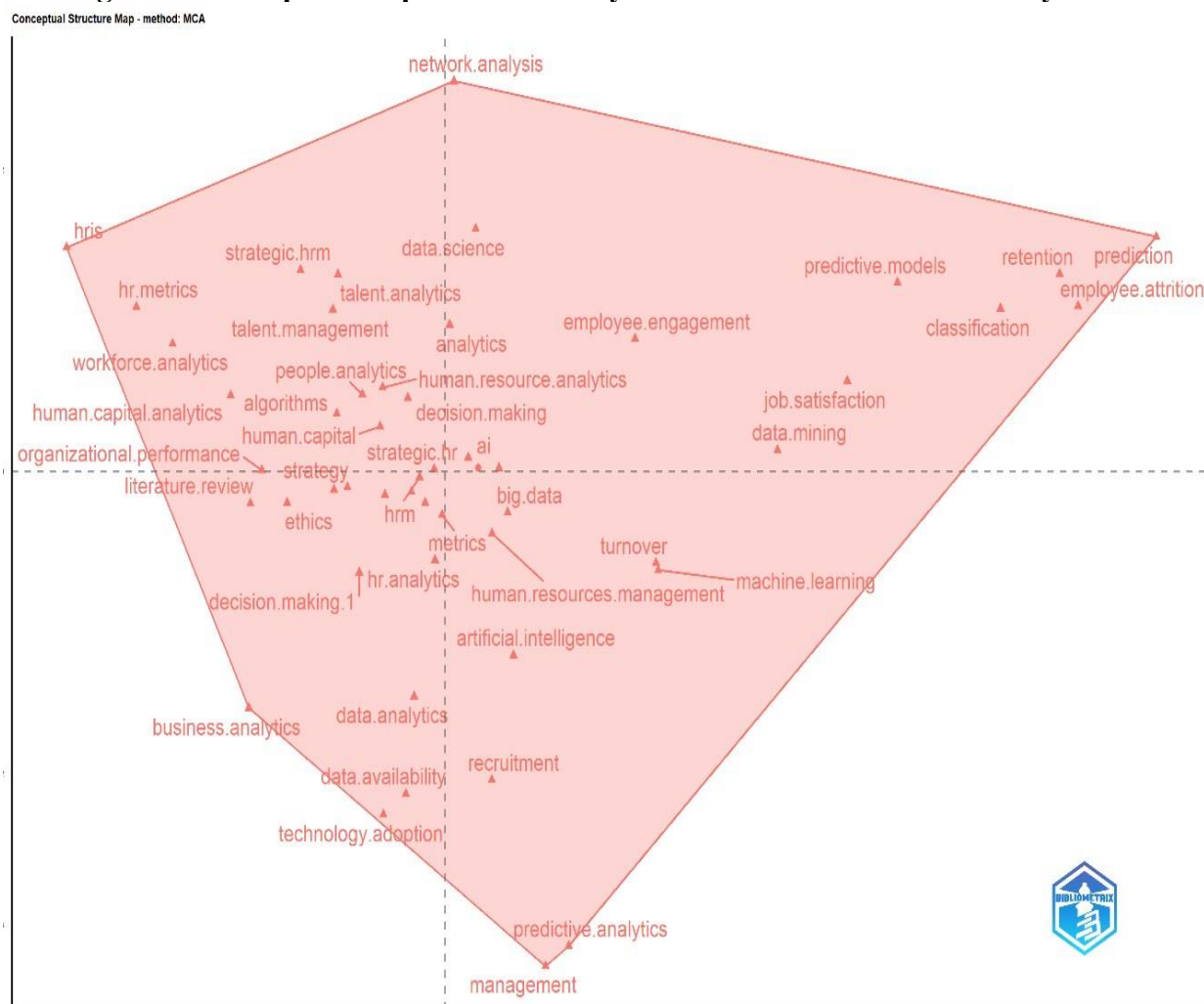
For the purpose of locating clusters or communities inside a network, the widely known and effective Louvain algorithm (**Mutiara, 2023**) is employed. To gauge how strongly a network is divided into communities, it seeks to optimize the modularity of the network. Co-occurrence Network structure is a series of themes related to the main node of “**HR Analytics**” and “**People analytics**” which is represented in form of cluster algorithm given by Louvain clustering algorithm.

1.4.21 Figure 7: Thematic map



Thematic analysis (Hassan Shah et al., 2022) as shown in figure 7 offers an organized method for locating significant ideas and interpretations while enabling academics to investigate the richness and complexity of qualitative data. It is a versatile and popular approach for qualitative research in many different fields. It categorizes themes within a field based on their centrality and density. Centrality indicates how frequently a theme is mentioned alongside others, while density reflects its internal connectivity. Themes are grouped into quadrants: “Motor theme” contains well-established, highly developed themes they are “HR Analytics”, “Predictive analytics”, “Human resource Management” and “Future technology”, “Niche Themes” holds specialized, well-developed themes they are “Meta analysis”, “Job satisfaction” and “Manager perception” and “Intelligence”; “Basic Themes” features important but less develop themes they are “Big data”, “Models” and “Intelligence”; “Emerging or declining themes” includes developing or fading themes they are “Strategy”, “Discrimination” and “Innovation”.

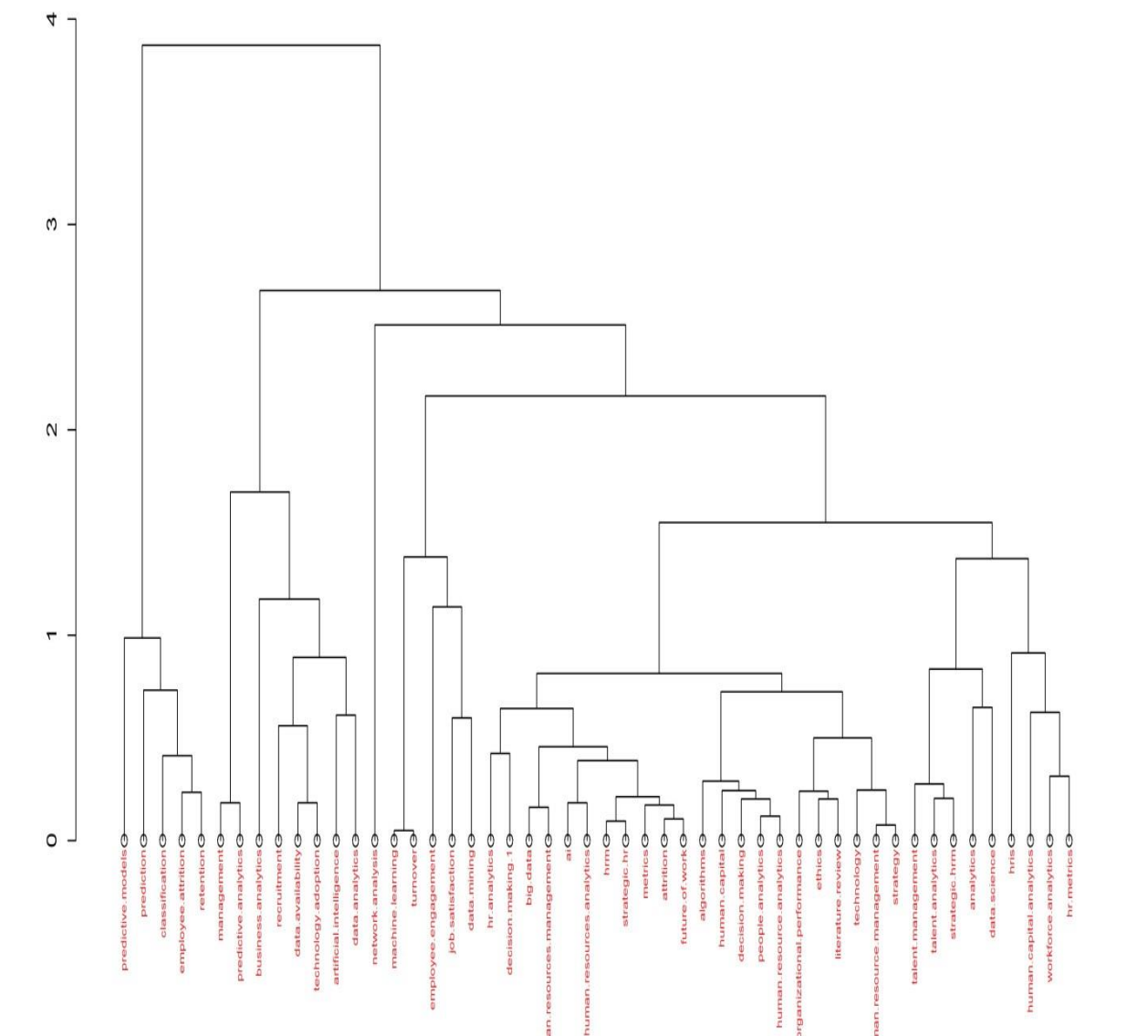
1.4.22 Figure 8: Conceptual map of authors' keywords in Human resource Analytics



Dim 1 (24.03%)

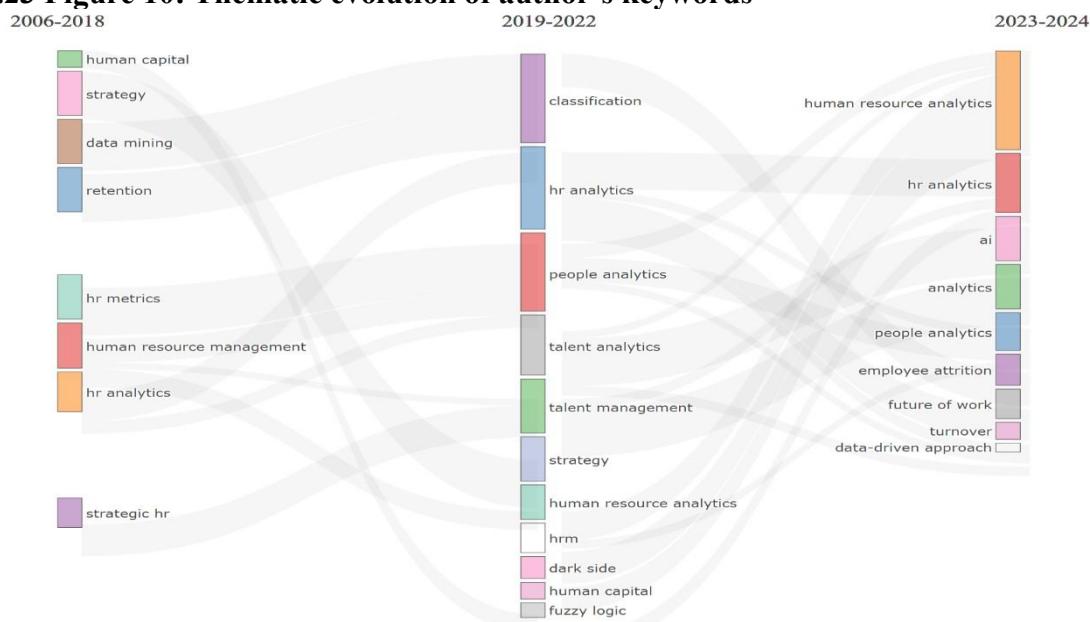
The degree of analysis of the research investigations at the HR Analytics level appears to be indicated by the first dimension (24.03%). The terms "analytics" and "human resource" are highlighted on the left side of Figure 11 such as : "hrm", "hr analytics", "decision making", "ethics", "strategic hr", or "organizational performance". On the righthand side of this dimension are more "employee-oriented" terms and "data related" terms such as "turnover, "recruitment", "human resource management", "job satisfaction", "machine learning", "data mining" or "ai". However, the amount of specific application and specialization of the published materials pertaining to the author's keyword is represented by the second dimension (14.09%). Words like "predictive analysis," "technology adoption," "management," and "data availability" are found toward the bottom. Top-level terms such as "data science," "network analysis," "hris," "retention," or "employee attrition" indicate the degree of specialized work involved in this study.

1.4.22 Figure 9: Thematic Dendrogram



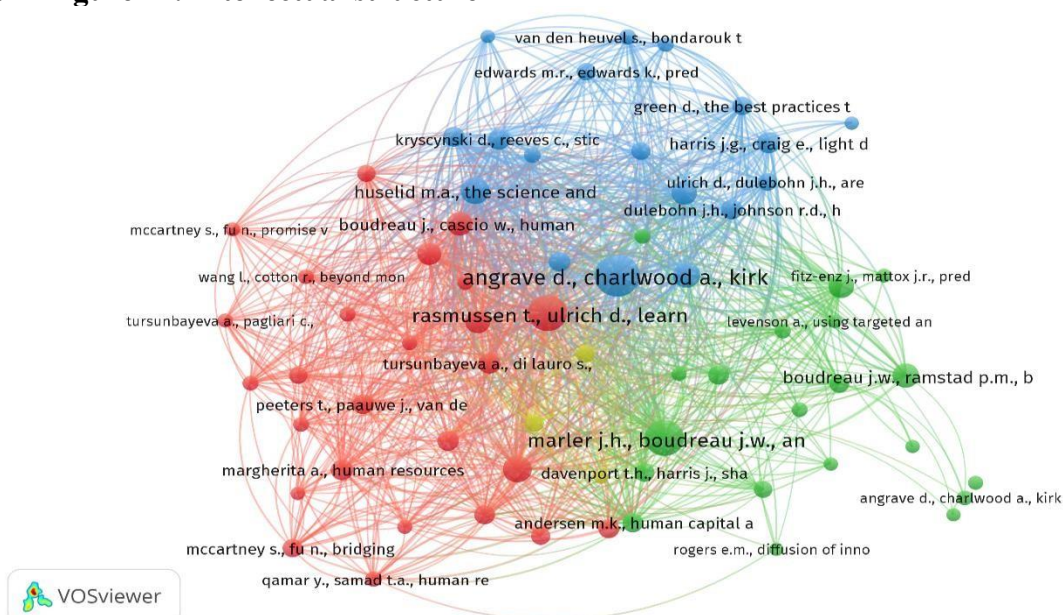
In figure 9, Petchey & Gaston (2007) and Podani & Schmera, (2006) have identified dimensions in a dendrogram, a tree-like figure that demonstrates hierarchical clustering methods. The dendrogram's branches, arranged according to commonalities, are a key aspect of the study. The first branch, which pertains to Human Resource Analytics, is situated at its topmost point. The dendrogram is further divided into two sub branches, further it has been bifurcated into two sub branches first with inertia of 0.99 with 45 keywords like “predictive models”, “prediction”. “classification”, “retention”, and “management”. While the second sub branch has inertia of 3.18 with 45 words such as “predictive analytics”, “recruitment”, “machine learning” and “big data”.

1.4.23 Figure 10: Thematic evolution of author's keywords



Cobo et al. (2011), study on thematic evolution highlights the progression of study field themes over time, tracking their emergence, decline, or transformation. Analysing this using bibliometric tools and visualization techniques helps researchers understand trends, connections, and importance of key concepts. After 2019, the term "HR analytics" was consolidated with "people analytics", "talent analytics", "dark sider", and "hrm".

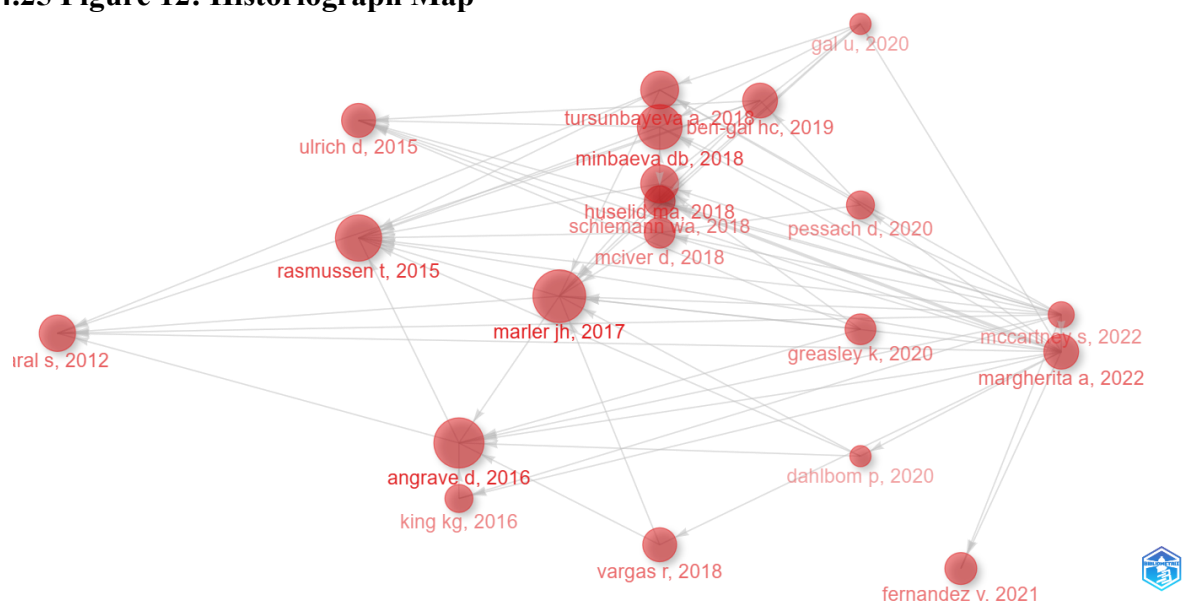
1.4.24 Figure 11: Intellectual structure



Co_citation analysis examines the connections between documents that have been referenced in order to comprehend how the fundamental themes in a field of study have developed (**Fahimnia et al., 2015; Donthu et al., 2021**). This is depicted in figure 11 as a series of citation occurrences that demonstrate a centre of gravity, as demonstrated in the primary publication of the study. “**Angrave D., Charlwood A., Kirkpatrick I., Lawrence M., Stuart M.**” and **Rasmussen T., Ulrich D.**, these are the most influential and co-cited authors in the time period analysed. The process is as follows in

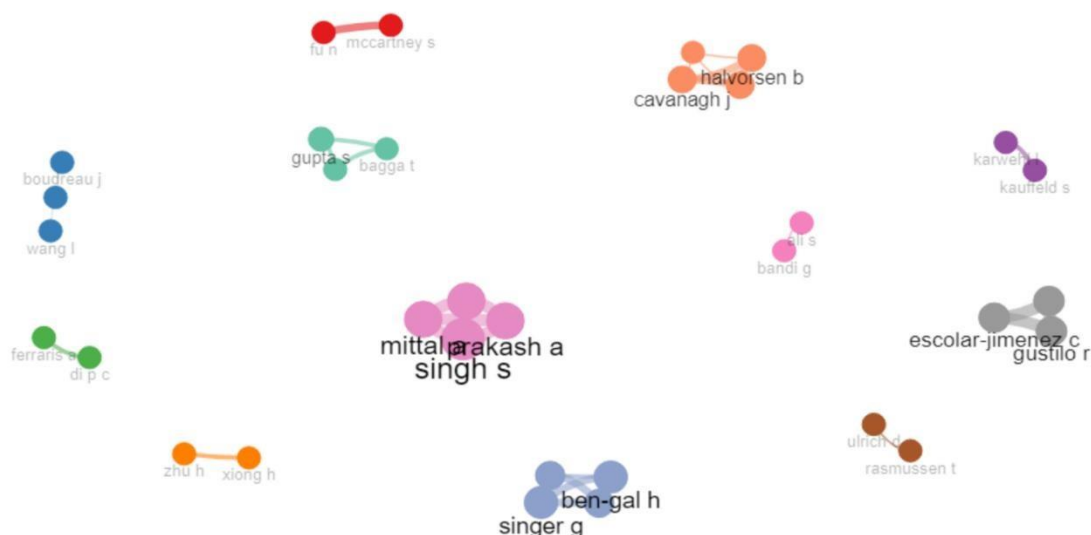
Biblioshiny: Co_citation> cited references>minimum number of citations of cited network is 10
>52 meet the threshold.

1.4.25 Figure 12: Historiograph Map



Rasmussen et al. (2015) work on Learning from Practice in HR analytics is a significant contribution to the field. **Thor at al. (2016)** and **Garfield et al. (2010)** research on Detailed comprehension of the evolution of ideas, influences, and impact over time is provided by historiographic analysis. When it comes to HR analytics, this culminates in a path that includes the primary authors **Marler's 2017 activities**, “An Evidence based Review of Hr Analytics” being followed by **Angrave D, 2016** work, “Hr and Analytics Why Hr Is Set To Fail The Big Data Challenge” and Rasmussen et al., 2015 work, “Learning From Practice How Hr Analytics Avoids Being A Management Fad”.

1.4.26 Figure 13 Collaboration Network



Peters & Van Raan, 1991 and **Donthu et al., 2021** co-authorship technique examines the relationships between authors and their affiliations, focusing on their impact on the advancement of the field of study. The cooperation network in HR analytics, represented by the graph in Figure 13, helps understand scientific collaboration dynamics, identify significant writers or organizations, and find potential partners. The first association of authors ARORA M;PRAKASH A;MITTAL A;SINGH S followed by AVRAHAMI D;PESSACH D;SINGER G;BEN-GAL H. is beneficial for both experienced researchers and novices seeking collaboration opportunities.

1.5 Conclusion

Stefan Strohmeier, Steven McCartney, Felix Wirges, Sheshadr Chatterjee, and Hila Chalutz Ben-Gal are leading the way in HR management by “leveraging cutting-edge technology” like “artificial intelligence” and “machine learning”. They have explored how these technologies can enhance traditional HR practices, improving employee performance appraisals and decision-making. The growing importance of “HR analytics” in organizational management calls for further research to address knowledge gaps and explore other theoretical perspectives. **Felix Wirges and Steven McCartney** have also highlighted the value of people analytics and HR technology in their recent works.

Shobhanam Krishna, Koechling Alina, and Said Achchab have highlighted the growing integration of “artificial intelligence and cutting-edge” technologies in the field of human resource management. The relationship between “HR analytics” and “AI” has evolved significantly, indicating a shift towards more data-driven and technologically sophisticated HR practices. The integration of AI and ML with HR analytics, as explored by these experts, demonstrates how cutting-edge technology can transform HR analytics and enhance organizational decision-making, highlighting the importance of data-driven insights in influencing organizational strategies.

Organizational management is increasingly leveraging HR analytics to enhance decisionmaking processes and corporate performance. The study highlights the need for further research to fill gaps and explore theoretical viewpoints. Human resources professionals are essential in the utilisation of precise data and HR analytics to inform strategy and decisionmaking, underscoring the continuous development of this discipline.

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