

Conference Name: International Conference on Business, Economics, Law, Language & Psychology, 20-21 February 2024, Dubai

Conference Dates: 20-Feb- 2024 to 21-Feb- 2024

Conference Venue: Flora Creek, Deira, Dubai, UAE

Appears in: PEOPLE: International Journal of Social Sciences (ISSN 2454-5899)

Publication year: 2024

Misbah Faiz, 2024

Volume 2024, pp. 344-361

DOI- <https://doi.org/10.20319/icssh.2024.344361>

This paper can be cited as: Faiz, M. (2024). Drivers & Outcomes of Human Capital Analytics.

SSHRA 2024 – Social Science & Humanities Research Association International Conference, 20-21

February, 2024, Dubai. Proceedings of Social Science and Humanities Research Association

(SSHRA), 2024, 344-361.

DRIVERS & OUTCOMES OF HUMAN CAPITAL ANALYTICS

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Abstract

The current article analyzes human capital analytics and develops a model for the drivers and outcomes of human capital analytics. A total of 81 articles have been analyzed using content analysis and a model has been developed for drivers and outcomes of human capital analytics. The model identifies four drivers and seven outcomes of human capital analytics. The drivers include organizational culture, employee hard & soft skills, employee competencies and skilled workforce. The outcomes include stronger inter-departmental relationships, improved employee experience and behavior, knowledge-based decisions, improved company performance, provision of competitive edge, risk reduction and enhancement of strategic organizational capability. We see that human capital analytics is an emerging phenomenon and yet much literature does not exist on the phenomenon. Considering minimal exploration of HR

data analytics and its hidden role in the company's performance, the area has been less approached. Our review addresses the mentioned shortcomings and provides a roadmap for future research.

Keywords:

Human Capital Analytics, People Analytics, Systematic Literature Review

1. Introduction

Human capital analytics (HCA) is a factual approach to ensure effective people-oriented decisions within the organization. It provides logical analysis instead of a subjective approach. It provides the organization and the managers with different insightful information that is crucial for companies or business transformation [1]. HR analytics makes use of a logical and systematic approach to visualize different data in the business for better decisions. It enables employees to form a knowledge management system within the organization [2].

HR big data analytics is now a main tool for companies to solve different business problems. It tends to provide a data-driven approach for companies to use HR data and improve capability [3]. HR data analysis helps companies in forecasting and decision-making process. The use of HR data analytics has increased in the modern days, it ensures productivity and technology support for businesses to automate HR operations [4]. Human capital analysis is a structural approach, which provides a structure network analysis approach (SNA) for companies. It ensures a set of different links and nodes of fresh insights and other organizational roles. HCA also helps managers to identify different factors raised from social aspects in the company. This structural approach helps companies tackle economic challenges and create social values [5].

Minimal research has been done in this area. Considering minimal exploration of HR data analytics and its hidden role in the company's performance, the area has been less approached. Also, HR analytics are comprised of different datasets and analytical tools, it requires strong research, and statistical and analytical skills from the researcher to find and analyze its impact on the HR management in any organization. In this regard, it is relatively challenging for most of the researchers. Moreover, identifying HR outcomes and key drivers is another challenge for the companies and the independent researchers, it requires intensive evaluation and analysis of different variables.

The study's systematic approach focuses on the analysis of human capital analysis using secondary data i.e., published articles. It develops a model to identify the key drivers and outcomes of HCA for future work. The study makes use of systematic literature review approach which is explained in detail in the methodology section. Following the key drivers and outcomes, the study has also focused on three key emerging trends for future work, it provides a way forward for future workers to further penetrate the human capital analytics role in the business transformation.

2. Methodology

A systematic literature review was carried out and bibliometric approach was used in order to analyze the findings of the study. Conducting bibliometric analysis allowed the researcher for more objectivity and to sift through the large amounts of data. The research was carried out in various steps. Full-length articles were analyzed in the process as they are considered as validated knowledge [1]. The review undertaken in this study did not consider any books, conference papers or doctoral thesis. We searched the title, keywords, abstract and text for “human capital analytics”. Our research was not limited to any specific period and therefore, the oldest article dates back to 1998. The most recent articles have been published in 2023. To ensure quality of the data, all articles were taken from “Scopus”. Scopus was used in order to screen the related articles. In this manner, we had quality articles for analyzation. The journals from which the articles were included, include but not limited to *Personnel review*, *Journal of business research*, *Human resource management*, *European journal of innovation management*. Our search yielded a total of 81 articles. These papers were read, analyzed, and coded. The information collected for the articles included names of the authors, number of authors in each article, the year of publication of the articles, journal in which the article is published, abstract, methodology used, research technique, country, author’s affiliation, reference list and number of citations of the articles.

3. Findings

According to our findings, much research was not being carried out prior to 2015. More research articles have been published after 2015. 45 articles were published from 2020-2023 where 25 articles were published from 2015-2019. 11 articles were published before 2015. This trend is evident, as authors have just recently started to focus on human capital analytics within the organizations. In order to analyze the impact of the articles, the number of citations has also been taken into account. Table 1 gives us information on the highest number

of citations. Table 1 reflects that the most cited articles are that of Erevelles et al [7] which have been cited 727 times.

Overall, the articles that have been reviewed in the study have been written by 207 different authors. Whereas, on average, each article has 2.6 authors. Table 2 reflects that 15 articles have been published by Elsevier, 23 have been published by Emerald, 6 articles have been published by John Wiley and Sons, whereas 2 have been published by Springer and the rest have different publishers.

Table 1. Number of citations

Article	Total citations
Erevelles S., Fukawa N., Swayne L. (2016)	727
Aral S., Brynjolfsson E., Wu L (2012)	166
Rasmussen T., Ulrich D (2015)	129

Table 2. Publishers

Publisher	No. of Articles
Elsevier	15
Emerald	23
John Wiley & Sons	6
Springer	2
Others	35

4. Content Analysis

We develop a model that summarizes the extant literature in the domain of human capital analytics. We conducted analysis and coding for a systematic content analysis. The research objectives and findings were analyzed in order to develop the model. We developed the model summarizing the extant literature into the driver of human capital analytics and outcomes of human capital analytics.

Summarization of the extant literature on human capital analysis has helped us to identify four key drivers of human capital analytics (Fig.1) including organizational culture, employee hard & soft skills, employee competencies and skilled workforce. Following the drivers, the literature helped us to identify seven key outcomes of HCA (Fig.1) that determine its role in business transformation. This outcome includes stronger inter-departmental

relationships, improved employee experience & behaviour, knowledge-based decision-making, improved company performance, provides competitive advantage, reduction in risks and enhancement of strategic organizational capability. The literature also helped us to analyze the importance of these outcomes in business performance. It forms a structural connection between different elements within the business. Later on, the analysis of these drivers and outcomes from the literature helped us to identify key emerging trends in the domain of human capital analytics to assist future researchers. These emerging trends increase the HCA's significance for companies.

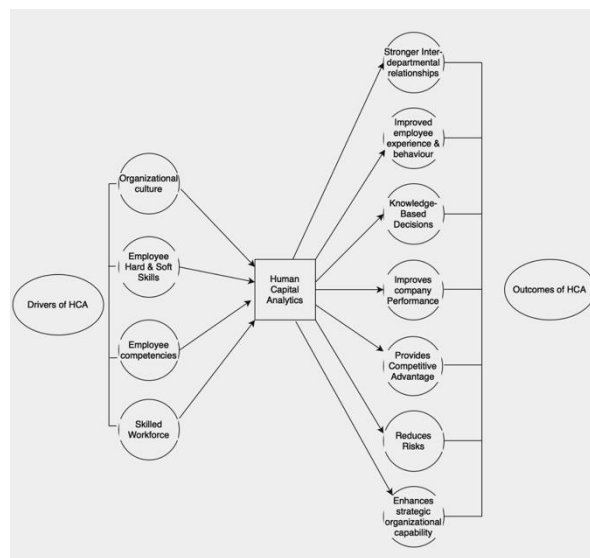


Figure.1. HCA Model

4.1. Drivers of Human Capital Analytics

Human capital analytics are mostly triggered by different drivers. These drivers increase the role of HCA in any organization. The key drivers of human capital are explained below. These drivers include organizational culture, employee soft & hard skills, employee competencies and skilled workforce.

Organizational culture is one key driver of human capital. Organizations usually experience diversity in management and human resources. Diversity in the organization is mainly the outcome of cultural differences among employees [6]. In this regard, organizational culture drives the importance of diversity management. Human resource is mainly attributed to diversity management. For any organization, diversity recruitment initiatives are crucial, they need to be implemented to determine the effectiveness of diversity management [8]. becomes a way forward for diversity management in any organization. Using HCA,

organization management can generate information about diversity within the organization to make effective decisions. The approach becomes inclusive because organizational culture allows and uses HCA to take diversity recruitment initiatives. Further, organizational culture enables HCA to align with big data and machine learning. HCA can use machine learning techniques for effective workforce management. The main principle behind the use of big data is machine learning techniques [9]. Organizational culture can induce the use of machine learning techniques for human capital analytics for effective workforce management. Organizational culture forces HR analytics to enhance employee engagement and retention process, it builds self-service model for business transformation [10]. In modern days, employee retention and engagement has been a priority for the organizations. Organizational culture uses HR analytics as a tool to optimize and create a trend of talent retention [11]. The culture of employee retention and engagement in any business increases the role of HR analytics in managing decisions related to retention and engagement. HR data analytics changes the way an organization, derives social and cultural values from the data [12].

Employee hard and soft skills are another key driver of human capital analytics in any organization. The use of employee soft & hard skills allows the organizational management to use HR analytics and transform business and form HR business strategies [13]. Employee soft & hard skills allow the business to use HR analytics to overcome its associated issues. Supposedly, Andersen [14] argued that human capital analytics are still in stage of infancy, several issues such as maturity that leads to lack of implementing good software, improper data, limited resources and organization purchasing decisions which tend to be key challenges. Moreover, lack of strategic training i.e., the mindset, is another key issue, it is significant for designing and training process [15]. Loss of strategic HR analytics strategic potential in re-organization of all initiatives followed by lack of HR analytics competencies are major issues [14]. The organization or business with skilled (both soft & hard) employees can use HR analytics more effectively to change the business dynamic and generate accurate data for effective decisions. Human capital analytics (HCA) are mainly associated with gathering, and processing data to predict and make decisions for effective management of HR-related problems [2]. HR analytics are comprised of statistical applications and different modelling processes to tackle business problems. However, HR analytics requires employee skills to overcome challenges such as data cleansing, data quality management, overcrowded, privacy and compliance and identification and tracking of data [16]. This indicates that HR analytics cannot be used without employee soft & hard skills, the presence of statistical and modelling

skills in employees can trigger the process of HR analytics in any organization. The skills directly focus on the logical connection between analytics and organizational performance. Employee competencies are another key driver of human capital analytics. Employee competencies mainly focus on the skills that are required in any business or organization to effectively manage HCA. Andersen [14] identified six employee competencies that are crucial for human capital analytics in any business. The skills include the presence of statistics or numerical skills, the skill of data management for rearranging or reorganizing HR analytics data, storyteller skills to understand the decisions and their outcomes, the ability to visualize HR analytics results, physiological and business understanding skills to avoid overconfidence while making business decisions. With the presence of these employee competencies, any business can use HR analytics effectively to tackle future challenges and transform the business. Further, employee competencies drive the role of HR analytics in any organization. For instance, in the digitalization of the HR era, digital transformation requires the presence of quality professionals or employees with Knowledge, skills, abilities and other characteristics (KSAO) competencies to effectively manage and predict the analytics data and increase the chances of development of HR operations [17]. This indicates that HR analytics effectiveness can be triggered through employee competencies such as KSAO skills for HR digital transformation. Also, HR analytics in the modern world is quite sparse, there is always room for contributions to increase its effectiveness in the business. It is indeed a game changer which requires comprehensive investigation and review of analytics in HR functions [1], this, strong employee competencies i.e., numerical, statistical and analytical skills can find a way for its effective contribution in HR operations. Data analytics are driven by the workforce and talent in the organization, it allows the company or organization to make effective decisions [18]. The skilled workforce works as a driver for HR analytics. Human resource analytics mostly work at the dashboard level. They require different analytical tools and trained professionals to manage resources in the organization. The use of a skilled workforce becomes an essential driving factor to ensure the effectiveness of human capital analytics [19]. Further, skilled workforce and human capital are directly and indirectly connected. The strong reliance of firms on big data analytics requires organizations to have a skilled workforce to manage the firm's operations. In the presence of big data, most firms rely on data analytics techniques [20]. The use of these analytical techniques and the presence of a skilled workforce in the organization is crucial. A skilled workforce allows the firms to opt for data analytics techniques such as human capital analytics. Also, in the absence of a skilled workforce, companies mostly focus on the IoT to monitor and evaluate employee performance. The pervasive nature of using IoT

with analytics brings unfairness and creates doubts, it awash the organization with flooded data that can be problematic for managers to make decisions [21]. A skilled workforce allows human capital analytics to use data that effectively supports the employee evaluation process.

4.2. Outcomes of Human Capital Analytics

In most of the studies, human capital analytics has significant outcomes in any organization. These outcomes have key contributions to the business transformation. The following key outcomes based on the analyzed studies have been discussed below.

Forming a stronger inter-departmental relationship within the organization is one key outcome of human capital analytics. HR analytics can form a stronger inter-departmental connection in businesses to generate profit. Petković, Knežević and Pavlović [22] examined the connection between intellectual capital and financial performance improvement. A significant connection has been formed between intellectual capital and financial improvement in the French wine industry. The presence of intellectual analytics data allows firms and businesses to use intellectual capital efficiently. In the era of big data usage, most companies' HRM practices are directly involved in human capital analytics with the objective of improved efficiency and effectiveness in the process of talent acquisition and talent retention. HR analytics plays a crucial in the scientific approach towards these HR practices [20]. For this objective, companies focus on inter-departmental relationships through effective communication to ensure the timely acquisition and retention of talent. HR data analytics statistical support to HR management to share information with higher management during the process. HR big data analytics allows the firms to significantly improve their deployment process, it improves the workforce relationship by integrating HR and other key departments of the organizations [9]. HR analytics are not a fad, when they mature, they create immediate cooperation with all other departments such as finance, production and other operations [23].

Improved employee experience and behaviour is a significant outcome of HR analytics. Using HR analytics employee can transform their overall behaviour in a challenging environment. HR analytics allows employees to learn and experience the demand for workforce data and workforce decisions. It helps employees and HR professionals to ensure evidence-based decisions aligned with the organization's insights [24]. Employees or HR professionals can change their behaviour because they know the failure of an evidence-based approach can lead to damage to HR performance. HR analytics allows employee to change their behaviour by identifying the differences in their HR role and HR practices to increase productivity.

Workforce analytics are crucial for differentiating between HR practices and the strategic supportive role of employees, it improves the human capital strategy [25]. In this regard, the employee can learn to differentiate between their supportive role and key HR practices. Talent is the primary and key driving factor of scientific advancement. Human talent is important for scientific development, they can use algorithms [26]. For this human talent can use data analytics to work and respond to scientific challenges. Using HR data analytics, companies and employees can transform their skill level, change their employee profile and allow them to experience new things in the IT sector such as cloud computing and AI [27]. thorough analysis of analytical data can improve the individual work experience in any organization. HR analytics improve employee experience and provide innovative ways; however, it needs to ensure quality input-output data for analysis [28]. Liu, Pant and Sheng [29] argued that labour market competition is high, and employee skills are crucial. Analytics provide human capital with a predictive power to predict market dynamics. It provides predictive power skills to employees.

Knowledge-based decisions are one key outcome of using HR analytics. HR analytics can provide businesses with new scientific knowledge to find practical solutions for all problems. The use of HR powerful insights by the general managers to manage HR-related decisions within the organization is a typical example of knowledge-based decision. HR analytics expands the conventional approach towards talent management, brings innovation in decisions, and allows managers to take investment risks, increase productivity and manage sales [30;31]. Companies are using different analytics to make decisions aligned with finance, marketing, supply chain and accounting, however, they fail to make effective decisions related to HR which leads to poor performance. Using HR analytics, companies know how to make decisions by understanding some key insights related to their organization [19]. This indicates that the use of HR analytics in business leads to knowledge-based decision-making. Human capital analytics leads to innovation and growth within an organization [32]. Using HR analytics can allow businesses to use employee expertise to use big data analytics for effective R&D decision making. R&D is mostly focused on data-driven decision making, it focuses on complex data to make effective decisions for improved performance [33]. The use of HR analytics increases data-driven decision making for R&D in businesses. Analytic and data-driven decision making has more impact on the organization's performance, it provides leverage to the company managers to make quality decisions [34]. Also, the data-driven approach by companies can approach internationalization using human capital, they know that human capital is pivotal in internationalization. Human capital is one crucial source for

companies in exploiting and identifying international opportunities [35]. Data analytics can support companies to make knowledge-based decisions aligned with internationalization.

Improved company performance is the 3rd outcome of human capital analytics. Buzavaite [35] added that the effective use of human capital analytics allows the business to increase its ROI and overall company growth. His study further explained that the workforce is not a cost but an organizational asset. The workforce data in the organization can be translated into actions to increase ROI. It enables framing the overall issues in the business and conceptual modelling and help in analyzing human capital data. HCA further aids to identify the relevant data, apply different analytical tools and present a report to all the stakeholders to make effective decisions for improved performance. This can improve the company's overall performance in the shape of ROI. Also, managerial decisions are crucial for companies' improved performance. Using HR analytics, company managers can effectively manage talent and expertise within the organization. In this regard, the Human capital analytics role becomes crucial because it provides a data-driven approach. Successful businesses are using human data analytics to improve managerial decision-making processes by integrating HR functions and business analytics [36]. HR data analytics can help companies improve performance by focusing on the division of labour to minimize the value of opportunity cost and understand market characteristics [37]. This becomes easy by using HR analytics for predictive analytical decisions. For improved performance, SHRM uses HR data analytics to find retention, performance, training and development of human capital [38]. For company performance, supply chain efficiency is crucial, they can be brought using data analytics. Big data and small data analytics allow firms to bring efficiency to the supply chain management that leads to improved performance [39].

One key outcome of HR analytics is the enhancing the competitive advantage. HCA provides organizations with “predictive analytics” data for decisions [34]. Overall profitability is mainly improved by increased capital efficiency. HCA has a long-term impact on business profitability because it is the source of competitive advantage [40]. Human capital efficiency is directly aligned with its efficient use. HR analytics provides a tool and platform for HR management to use human capital efficiently. Businesses with HR analytics can trigger HCA as a tangible resource to remain in the race for corporate profitability. Using HR analytics in business can ensure the competitive advantage of the Resource-based approach. Businesses can use the Resource based view (RBV) approach to use human capital as a key source for innovation and profitability [41]. RBV can provide innovation and strategic planning insights to the managers in the company to use human capital as a resource in daily tasks to gain

competitive advantage. RBV provides theoretical value to focus on innovation and strategic planning [41]. HR big data helps companies identify the intellectual capital to foster economic development and gain a competitive advantage over their competitors [42]. Human capital analytics are crucial for organization as organizations often fail to manage data and struggles to ensure discipline, and they lack data reliability. HCA provide a competitive advantage to companies to fill this capability gap and bring professionalism internally [43]. HR analytics provides support to businesses to effectively use business intelligence tools and gain a competitive advantage in the market. The advanced analytics system allows the business to predict future activities, possible actions and the outcomes of these actions [44].

Human capital analytics reduces the probability of different risks within the business. The presence of human capital, workforce failure, and inefficient labour productivity are probable risks. To increase productivity businesses prefer using technology for HCA. The higher the technological means higher human capital efficiency (HCE) [40]. The use of HR analytics increases the HCE and reduces the risks of technological failure. Organizations more often face volatile, uncertain and risky environmental challenges, which affect their overall performance. It is pivotal for companies to ensure strategic planning for talent management to reduce human capital risks. Organizations mostly fail to reduce human capital risks and reduce financial losses [45]. In this case, HR analytics provides organizations with a data-driven analytical approach to identify key risks and make decisions. For risk reduction, different HR professional needs data analytics for accurate planning and strategic decisions aligned with performance pay, employee evaluation, talent management and performance monitoring. It tightens the link between business operations and human resource [46]. Human capital analytics reduce financial risks in the companies, and companies can effectively respond to the increased pressure in the financial market. Analytics provides a data-driven systematic approach to companies to manage investments and analyze all intangible aspects of the financial market [47].

Enhancing strategic organizational capability is another key outcome of human capital analytics. The use of HR analytics in the organization or at the governmental level helps in making strategic decisions and enhances organizational capability in the long run. For instance, Voyvoda and Yeldan [48] discussed policy intervention schemes aligned with long-term growth. The study focused on subsidization of R&D in activities within an organization to enhance the growth of human capital in the long-term. Subsidization of R&D activities in the organization is aligned with the inclusion of HR analytics to enhance the capabilities of R&D. This indicates that HCA allows the organization to enhance its strategic capabilities by

making long-term decisions such as subsidization. HR analytics allows the effective use of big-data analytics and enhances an organization's strategic capability to overcome technical issues. Big data analytics brings technical efficiency and technical progress to businesses [49]. This means using HR analytics can help in the effective management of big data to enhance the technical capacity of the business. HR analytics or big data analytics is a strong organizational capability, it fosters innovation and allows companies to identify hidden patterns that support the decision-making process [50]. Using HR data analytics can enhance the organizational capability to use big data, AI intelligence, and human artificial intelligence combined to make decision making process. It increases the firm capability to use technology and analytics together [51]. Data analytics provides data visualization to make capital management decisions [52].

5. Emerging trends and avenues for future research

The critical review and identified drivers and outcomes of human capital analytics have helped us to find three emerging trends for future researchers. These trends require an intensive approach to ensure its relationship with human capital analytics. The three emerging trends include AI-powered HR analytics, improved Data visualization and Sentiment analysis in HR analytics.

One major trend for future researchers is AI-powered HR analytics. The increased use of artificial intelligence AI requires researchers to understand its role in HR analytics to measure its performance. AI-powered HR analytics can assist organizations in processing large amounts of datasets in minimal time with a high accuracy ratio. Also, it allows the organization to identify different patterns using AI techniques. To determine the AI-powered HR analytics role in the organization, future researchers can use both AI and HR analytics combined to prove their effectiveness for businesses. Moreover, researchers can also focus on the role of AI-powered HR analytical tools in identifying applicants or workforce prediction at the time of layover or hiring. Thus, in the era of digitalization or Artificial Intelligence AI, future research in AI-powered HR analytics can be a big success for researchers.

Data visualization in HR has emerged as a crucial trend in the management field. Most HR managers are using data visualization for effective decision making. Data visualization has a significant role in HR decisions because it represents different information and HR-related data in graphical form. However, data visualization requires extra analytical and visualization skills to determine accurate visualization of the analytics. Future researchers can use data visualization as a way forward to find its role in HR analytics and management

decision making process. The literature has shown less effectiveness in data visualization; therefore, improved data visualization is mandatory. In the future, researchers can focus on the improvement of data visualization in HR analytics to ensure easy patterns and data for managers' insights. Also, researchers can identify how data visualization in HR analytics can assist managers in effective decision making. In the future, researchers can focus on employee productivity, compensations and company culture data analytics in data visualization to determine how it leads to employee engagement.

The third emerging trend in HR analytics is sentiment analysis. Future researchers can use the role of sentiment analysis as an area of research to identify sentiment analysis's role in HR analytics and employee retention strategy. Sentiment analysis is associated with the emotional tone of both written and spoken languages. For organizations, employee sentiments are crucial for engagement and retention. HR analytics can use sentiment analysis data to identify employee sentiments, the willingness to perform different tasks and their relationship with other colleagues. Future researchers can use sentiment analysis and its importance in HR analytics and for the organization. Sentiment analysis has been less explored, minimal research in this area is a way forward for future researchers. Also, researchers can focus on different aspects of sentiment analysis such as potential issues aligned with sentiment analysis or limitations that lead to different problems.

6. Conclusion

Human capital analytics has emerged as one important trend for companies to improve their performance and transform the business keeping market dynamics into consideration. The use of human capital analytics has changed the conventional HR practices in the organization. It provides a diverse and flexible decision-making platform for managers in any business. The systematic literature review helped us to identify different drivers of HR analytics that increase its importance for any organization. The drivers such as organizational culture, employee hard & soft skills, employee competencies and skilled workforce carry different impacts and support for HR analytics. It's functional role in human capital analytics depends on the business goals and objectives. Similarly, outcomes such as stronger inter-departmental relationships, improved employee experience & behaviour, knowledge-based decision-making, improved company performance, reduction in risks and enhancement of strategic organizational capability provide a major boost to HR managers to make efficacious decisions aligned with employee engagement, talent management, recruitment and performance measurement

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