

Big Data Analytics (BDA) in Libraries to Enhance Decision-Making An Exploratory Study

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المُستخلص:

تواجه الأساليب التقليدية لتحليل البيانات صعوبة بسبب الحجم الكبير والتنسيقات المتنوعة والتعقيد في مجموعات البيانات الحديثة، مما يُعيق الوصول إلى رؤى شاملة ويطغى استخراج المعلومات ذات المغزى. ومع زيادة تعقيد البيانات بشكل كبير، تفشل الطرق التقليدية في النقاط التفاصيل الدقيقة، مما يؤدي إلى تحليلات غير مكتملة وضعف فرص اكتشاف البيانات ذات القيمة. من هنا تعمل تحليلات البيانات الضخمة كبوصلة لاتخاذ القرارات في المكتبات، مما يُتيح تخصيص الموارد بشكل استراتيجي، وتقديم خدمات مخصصة، وتحسين تجربة المستخدم. من خلال اكتشاف الأنماط المتنوعة لمجموعات البيانات الضخمة، يسمح للمكتبات بتوقع الاحتياجات، وتحسين الخدمات، مما يخلق بيئة تتوافق فيها تجارب المستخدمين بشكل بديهي مع التفضيلات والطلبات المتغيرة.

تستكشف هذه الدراسة دور تحليلات البيانات الضخمة في المكتبات، مع التركيز على تأثيرها على عمليات اتخاذ القرار. كما تستعرض لأشكال استخدام تحليلات البيانات الضخمة في المكتبات من خلال استعراض آراء عينة من أمناء المكتبات العرب والأجانب في عدة دول حول العالم.





تشير النتائج إلى أن تحليلات البيانات الضخمة يمكن أن توفر الوقت والجهد في الحصول على البيانات لاتخاذ قرارات مستنيرة، وأن استخدامها في خدمات المكتبة يمكن أن يعزز تجربة المستخدم، وإعادة تعريف إدارة المعلومات، وتحسين تجارب المستخدمين، وإحداث ثورة في تخصيص الخدمات لتلبية احتياجات المستخدمين المتنوعة.

Abstract:

Traditional methods of data analysis often struggle due to the sheer volume, diverse formats, and complexity of modern datasets. Their limitations become stark when handling unstructured data, impeding comprehensive insights, and slowing down the extraction of meaningful information. As data complexities increase exponentially, traditional approaches falter in capturing nuances, leading to incomplete analyses, and missed opportunities for valuable discoveries. Big data analytics serves as the compass of decision-making in libraries, enabling strategic resource allocation, personalized services, and an enriched user journey. By deciphering patterns from vast information pools, it empowers libraries to tailor offerings, anticipate needs, and optimize services, fostering an environment where user experiences are not just improved but intuitively aligned with evolving preferences and demands. This article explores the role of Big Data Analytics in libraries, focusing on its impact on decision-making processes.

This article explores the use of big data analytics in libraries with a focus on its impact on decision-making processes as it surveys the opinions of a sample of Arab and foreign librarians in several countries around the world. The results indicate that big data analytics can save time and effort in obtaining data to make informed decisions, and its use in library services can enhance the user experience. Harnessing big data analytics in libraries will redefine information management, enhancing user experiences and revolutionizing service personalization for diverse patron needs.

الكلمات المفتاحية: تحليلات البيانات الضخمة، اتخاذ القرارات، إدارة المكتبات.

Key Words: Big data analytics, Decision-making, library management.





1.Introduction:

In an era characterized by the proliferation of digital information, the role of data in shaping the operational landscape of institutions has undergone a seismic transformation. Within this evolution, libraries and information centers have emerged as crucibles of knowledge, navigating a deluge of information to serve their patrons effectively. At the heart of this evolution lies the burgeoning field of Big Data Analytics, heralded as a catalyst for informed decision-making within these bastions of libraries (Bharadiya, 2023). According to (Cockcroft & Russell, 2018; A. Oussous, Benjelloun, F. Z., Lahcen, A. A., & Belfkih, S. , 2018), in their seminal work on the influence of data analytics in organizational decision-making, they emphasized the pivotal role of Big Data Analytics in redefining how institutions leverage information for strategic decisions. Libraries, repositories of vast information reservoirs, stand poised at the intersection of this transformative tide, grappling with the imperative to harness the power of data analytics to enhance their services and operational efficacy. In the contemporary landscape, the sheer volume of daily generated data from institutional activities has surpassed conventional management methods. Enter Big Data Analytics, revolutionizing efficient and effective data handling, becoming a cornerstone for informed decision-making. The success or failure of decisions hinges greatly on adept data organization and investment (A. Oussous, Benjelloun, Lahcen, & Belfkih, 2018), precisely. This paper endeavors to investigate and illuminate the multifaceted role of Big Data Analytics in the decision-making processes within libraries. It embarks on a comprehensive exploration, spanning the definition, significance, and inherent characteristics of big data, contextualizing its application in bolstering decision-making frameworks within library settings.

The current study delves into and surveys the opinions of (178) Arab and foreign librarians on the use of big data analytics to support decision-making in their libraries. Employing a field survey approach, the researcher navigates the





nuances of this study, conducting a web survey among librarians to fulfill its objectives. Notably, the study underscores that the integration of big data analytics empowers libraries to swiftly make decisions, grasp the current library landscape, and strategically plan for its future. Consequently, it advocates for a shift from traditional data management paradigms to the big data analytics model within libraries, aiming to maximize the potential benefits latent within their datasets. As libraries continue their metamorphosis from traditional repositories of books to dynamic information hubs, the integration of Big Data Analytics becomes not just advantageous but imperative. This study aims to elucidate the transformative potential of data analytics in libraries, drawing insights from global endeavors and surveying the perspectives of librarians—both local and international—regarding the adoption and impact of big data-driven decision-making frameworks.

literature review:

The literature review of the big data analytics topic can be approached from two aspects. The first aspect concerns the significance of its application in libraries. The study by (Bharadiya, 2023; Garoufallou & Gaitanou, 2021; A. Oussous, Benjelloun, F. Z., Lahcen, A. A., & Belfkih, S. , 2018). indicate that big data analytics enables predictive modeling, facilitating anticipatory acquisitions and personalized recommendations based on user preferences and trends. Research conducted by Nahotko, Zych, Januszko-Szakiel, and Jaskowska (2023) reveals that data-driven insights enable libraries to make well-informed decisions about space usage, service expansion, and resource optimization. Additionally, big data analytics empower libraries to optimize collection development, improve service offerings, and tailor resources to meet user needs. According to scholars (Al-Rahmi et al., 2019), big data analytics have a significant effect on various aspects of library operations. Decision support systems that utilize big data analytics aid in developing collection strategies by identifying trends, predicting demands, and optimizing resource allocation. Furthermore, insights generated by big data analytics enhance





the user experience through personalized services and recommendations, ultimately increasing engagement. Big data analytics plays a crucial role in strategic planning for libraries. On the other hand (Hamad, Fakhuri, & Abdel Jabbar, 2022) believe that the practical application of big data analytics in smart libraries meets user needs and helps find personalized content from different sources. It functions as an integrated recommender system within the educational institution, ensuring long-term satisfaction for users and financial gains for the institution. This was also confirmed Kallinikos and Constantiou (2015) Big data analytics provide value to the user community through innovative library services. In this perspective, Ball (2019) utilized data from book borrowing records and a rule-mining system to offer user recommendations. This service relies on readers past borrowing records and delivers excellent value to library patrons seeking to read their favorite books. Moreover, Chang (2018) examined the potential for long-term preservation of massive data in digital libraries by leveraging existing storage technologies and advocated the development of technologies for sustainable long-term library services and policies. The second aspect is the challenges and opportunities in implementation. Understanding big data analytics in libraries requires an understanding of its fundamental principles. Big Data, characterized by volume, speed, variety, and accuracy, presents challenges and opportunities for libraries. This influx of diverse data sources, including digital catalogs, user behavior logs, social media interactions, and circulation records, requires advanced analytics to extract actionable insights (Attaran, Stark, & Stotler, 2018). Also, Library and information science professionals are now providing online services and digital materials to library users in the digital age. They need to understand the use of analytical tools in libraries, as well as the competencies and skills required for implementing big data analytics. In this digital age, we can predict the ecosystem dynamics of information transmission technology and strategically influence by analyzing the network location trend in ICT (Shah, Naem, & Bhatti, 2023). This is confirmed by





Mutula (2016) case study (2016), which examines the experiences of various colleges and institutes at the University of Pittsburgh as they transfer their data from local environments to the cloud big data platform. The study suggests the importance of preparing and qualifying librarians to understand big data analytics, its nature of work, and its applications in library management. This aligns with what was mentioned by Anna and Mannan (2020); the implementation of big data analytics in libraries poses challenges. Issues related to data privacy, quality, and the requirement for robust infrastructure and skilled personnel are recurring concerns. Nevertheless, proactive strategies and collaborations pave the way for leveraging big data analytics to its fullest potential. Islam, Islam, and Islam (2023) confirms that big data analytics is vast, but challenges persist. Privacy concerns, data quality issues, and the need for specialized skills to use big data tools pose hurdles for libraries. Additionally, the ethical implications of data-driven decisions and ensuring equitable access to information remain focal points of discussion.

The current study aligns with previous literature on the need to invest in big data analytics to improve user experience, uncover hidden knowledge, and make informed decisions. What distinguishes it is its emphasis on strategies for investing in a consortium of libraries globally, enabling the acquisition of diverse perspectives to optimize its implementation within libraries.

In conclusion, the literature on Big Data Analytics in library decision support emphasizes its transformative potential. Big data analytics serves as a catalyst, enabling libraries to use data for strategic decision-making, personalized services, and improved user experiences. Embracing big data analytics while addressing associated challenges helps libraries navigate the changing information landscape effectively.

Methodology:

The study aimed to assess the culture of participating librarians regarding big data and its knowledge sources. It discusses methods of handling data used in libraries and their various forms. Additionally, the study identifies the resources





to which librarians' resort for decision-making support and highlights key areas where leveraging big data analytics is feasible within libraries. Furthermore, the study surveyed participants' opinions regarding the establishment of a dedicated department to support decision-making in the library and the creation of a position for a big data analytics specialist. To achieve these goals, the study adopted a quantitative method to collect data and explore the utilization of big data analytics in libraries for decision-making support. An electronic questionnaire from Google was used to gather data. Participants were reached through various social networks, including LinkedIn, Facebook, Twitter, and WhatsApp, to obtain their opinions. The primary objective of using social networks in the survey was to ensure a broad spectrum of participants and to transcend geographical boundaries. The study involved (93) Arab librarians from Egypt, Qatar, the Emirates, Saudi Arabia, and other Arab countries, along with (85) foreign librarians from Australia, Canada, India, Pakistan, the United States of America, Serbia, and Britain, totaling (178) participants.

Results and discussion:

The study aimed to address several questions, such as the culture of librarians involved in big data, their sources of knowledge, the types of data used in libraries, where they obtain it, and the areas where big data is being invested in library activities and services. Additionally, the study sought the opinions of participants on establishing a dedicated department for decision-making support within the library, as well as the creation of a job title: Big Data Analysis Specialist.

The results indicated:

- The culture of librarians with Big Data

The researcher's exploration of the topic of big data revealed that Arab librarians had limited background knowledge on the subject. Only (20) Arab librarians, or 21.5%, were found to have knowledge of big data and its benefits for libraries. In contrast, (79) foreign librarians, representing 92.9%, were more knowledgeable about the subject. The marked contrast in the treatment of the concept between Arab and foreign libraries may stem from the





novelty of the subject in the Arab library setting, the limited information available about it, and the advantages of its implementation in libraries. In contrast, the term has been directly addressed in foreign studies since 2002. This is evident from reviewing the literature of foreign scholarly output on big data, accessible in electronic databases. This indicates that foreign researchers' interest in the subject is not recent but has been longstanding.

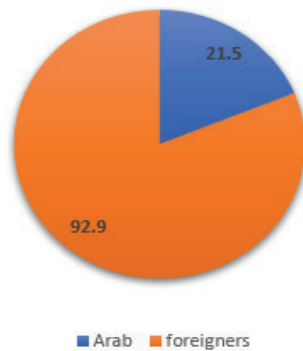


Figure 1: knowledge between Arab and foreign librarians

- Big data knowledge channels

Arab librarians involved in the study reported that their knowledge of big data came from internet, library specialists, professionals, and colleagues. In contrast, foreign librarians acquired their knowledge through conferences, internet, workshops, and databases.

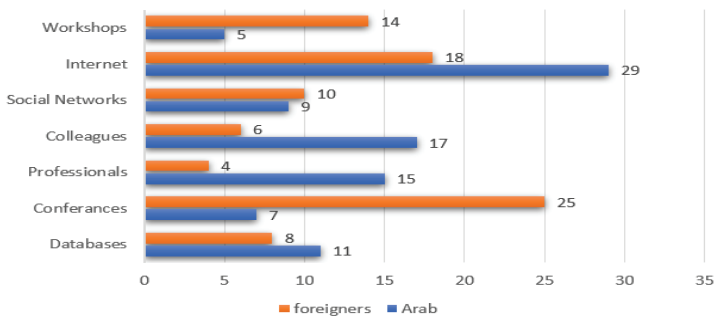


Figure 2: knowledge channels



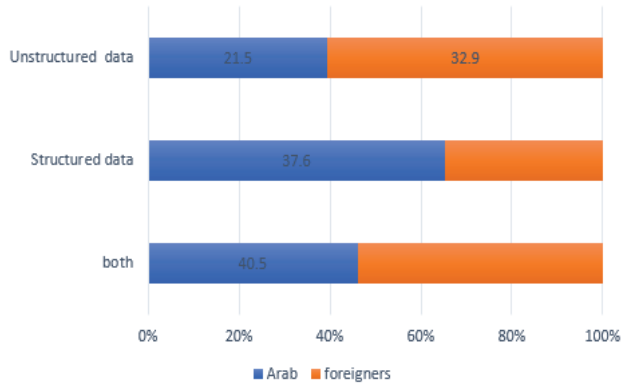


Figure 3: Data types in libraries

- **Big data Types:**

Structured data in library activities refers to info organized in a predefined format, often found in databases or spreadsheets. This data type is highly organized, allowing for easy categorization, sorting, and analysis. In libraries, structured data might include catalog entries, circulation records, or patron info stored in clear fields like name, address, and membership ID. On the other hand, unstructured data encompasses info that lacks a specific format or organization. In library activities, unstructured data can be found in sources like book reviews, social media comments, or even handwritten notes. It's often more challenging to analyze unstructured data as it doesn't fit neatly into databases or tables, requiring advanced techniques like natural language processing to derive meaningful insights.

- **Big data resources in libraries:**

The resources of obtaining big data vary within libraries, including:

- **User Interactions:** Information from library websites, online catalogs, and mobile apps, including clickstream data, session duration, and search patterns.
- **RFID and Sensor Data:** If libraries use RFID technology or sensors for inventory management or tracking foot traffic, this generates data on item movements and usage patterns.





- **Social Media and External Platforms:** Insights from library-related discussions, reviews, and engagements on social media platforms or community forums.

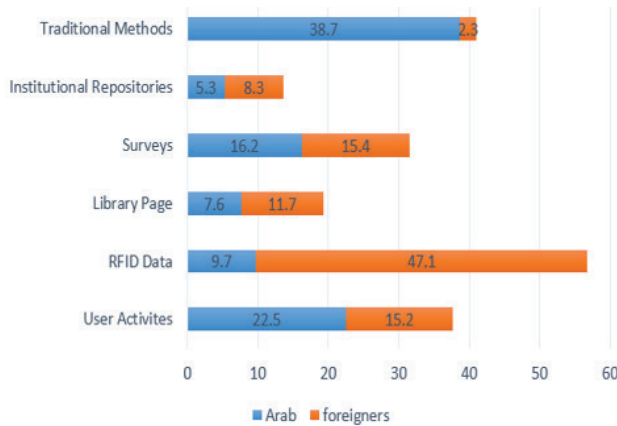


Figure 4: Big data resources

Surveys: Data collected from user surveys, feedback forms, or suggestion boxes regarding services, preferences, and satisfaction levels.

Traditional Methods :Traditional sources, such as loan records, inventory, and other paper records.

Institutional Repositories : Data generated from institutional archives or repositories, including research publications, theses, and scholarly works.

Surveys: Data collected from user surveys, feedback forms, or suggestion boxes regarding services, preferences, and satisfaction levels.

Utilizing these diverse sources of big data can help libraries improve services, understand user behavior, optimize resource allocation, and tailor offerings to better meet the needs of their patrons.



Data resources in libraries to support decision make:

The following table displays the disparities in the usage of diverse data resources in libraries among Arab and foreigner librarians to support decisions make. It implies that there exist discrepancies in their favored approaches for acquiring data and facilitating well-informed decision-making in library environments.

Table1: Data resources in libraries

Resources	Arab Librarians		Foreigner Librarians	
	Count	%	Count	%
Reference Services	14	15	12	14.1
Online Databases	2	2.1	5	8.5
OPACs	2	2.1	16	18.8
Lib Guides	6	6.4	2	2.3
Inter Library loan Services	9	9.6	17	20
Librarian Consultations	37	39.7	11	12.9
Open Data	4	4.3	12	14.1
Users Polls	19	20.4	10	11.7

The table presents the methods of data acquisition used by Arab and foreign librarians in libraries to enable informed decision-making. Notably, both groups heavily rely on Reference Services, highlighting its importance in obtaining information. However, discernible disparities emerge in the usage of other resources. Online Databases see more traction among Foreigner librarians, indicating a potential area for encouraging greater usage among Arab librarians. OPACs (Online Public Access Catalogs) stand out as significantly utilized by Foreigner librarians, signaling a strong reliance on catalog resources for information gathering. In contrast, Lib Guides show a higher utilization by Arab librarians, suggesting a preference or familiarity with this resource among this group. Additionally, Interlibrary Loan Services are notably more





utilized by Foreigner librarians, potentially reflecting a stronger need for accessing materials beyond their library's collection. The data underscores varying preferences or needs between these groups, providing valuable insights for libraries to tailor their services and resource allocation strategies accordingly.

Application areas of big data analytics in libraries

This table summarizes the application areas of big data analytics in libraries, indicating the count and percentage of Arab and foreigner librarians who are involved or interested in each respective area.

Table 2: Big Data Analytics in Libraries

Resources	Arab Librarians		Foreigner Librarians	
	Count	%	Count	%
User Behavior Analysis	10	10.7	7	12
Collection Development	34	36.5	26	30.5
Analys Log History	9	9.6	13	15.2
Personalized Services	3	3.2	5	5.8
Resource Accessibility	2	2.1	7	8.2
Risk Management	13	13.9	9	10.5
Performance Evaluation	22	23.6	18	21.1

Big data analytics has significantly transformed modern libraries, revolutionizing various aspects of their operations and services. Notably, specific areas have witnessed profound changes due to this analytical approach. User Behavior Analysis stands as a pivotal aspect, enabling libraries to delve into patrons' borrowing behaviors, preferences, and information-seeking tendencies. Through data analytics, insights gained aid in optimizing collection development, resource recommendations, and enhancing overall user experiences. Collection Development undergoes a substantial evolution through the analysis of circulation statistics, popular book genres, and resource usage patterns. This informed approach guides decisions on acquisitions, identifies emerging trends, and fine-tunes the library's collection to meet evolving demands. The application of Predictive Analytics for Demand Forecasting based on historical data empowers libraries to anticipate future resource demands, allowing for improved



stock management and better budget allocation. Personalized Services take center stage in enhancing user engagement and satisfaction by tailoring services based on individual preferences. Utilizing data analytics, libraries can recommend resources akin to previously borrowed ones, enriching user experiences. Enhanced Resource Accessibility, facilitated by big data, brings about organized information categorization, improved search functionalities, and implementation of recommendation systems. This upgrade significantly amplifies accessibility for patrons, both digitally and physically. Moreover, the integration of Risk Management and Security measures is vital. Big data analytics aids in identifying potential security threats, managing risks associated with digital resources, ensuring data integrity, and fortifying defenses against cyber threats. Finally, Performance Evaluation becomes more refined through data analysis, allowing libraries to continually improve programs, services, and staff performance through informed decisions and strategic planning.

Librarians Perspectives on Library Decision Support Department Establishment:

In surveying librarians about establishing a decision-making support department within libraries, a notable divergence emerged between Arab and foreign libraries in their support levels, with 80.6% of Arab libraries backing the idea compared to 71.9% in foreign libraries. The proponents of this department emphasized its potential as a central hub for solving technical and administrative issues, improving the organization of activities, services, and programs to align with beneficiary needs, and providing specialized consultations for librarians. Additionally, it was seen as a mechanism to manage unforeseen crises. However, opposition to the proposal centered on beliefs that librarians themselves could handle these tasks, that automated library systems could sufficiently provide data and reports, and that such a department was unnecessary, particularly in smaller libraries.



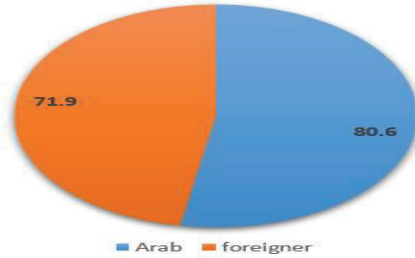


Figure 5: Participant Views

Establishing a decision support department in libraries aligns with their mission of providing information and resources to empower individuals in making informed decisions. Adjusting and fine-tuning the department's services based on user feedback and technological advancements will be crucial for its success and sustained relevance.

Big data analysis specialist in libraries:

This job title falls under specific roles for graduates of the College of Computers and Information, Software Engineering, and Business Administration. However, libraries have increasingly recognized the urgent demand for this specialization. The role entails complete responsibility for data management, including collection, analysis, and deriving conclusive values for decision-making purposes. Library employees can acquire specialized technical and professional courses in this field, enabling them to efficiently carry out the assigned tasks.

Librarians Perspectives on Data Analysis Specialist Job :

The suggestion to add the job title "Data Analysis Specialist" in libraries was widely backed by Arab (78.4%) and foreign (80%) librarians. However, one prominent reason for opposing this idea was the presence of many statistical software options that can already fulfill the same purpose. This suggests that some librarians believe this job may be unnecessary because of the availability and capabilities of current technological tools for similar analytical tasks.



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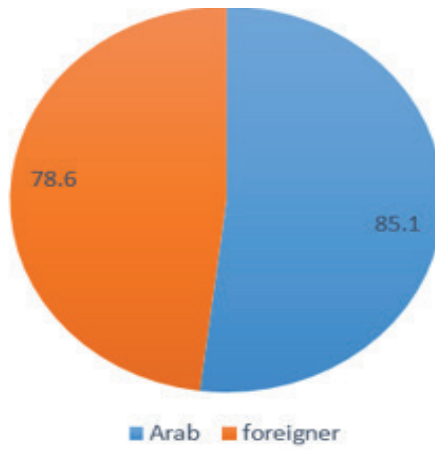


Figure 6: Participant Views about Big Data Analysis Job

Conclusion:

Big data analytics represents a significant change in how libraries operate. This research emphasizes the crucial role of data-driven insights in shaping strategic decisions, optimizing resource allocation, and creating tailored user experiences within library settings. By implementing strong analytics frameworks, libraries can anticipate patron needs and streamline acquisitions and services, leading to a more efficient and personalized approach. However, ethical considerations regarding data collection, privacy, and accessibility are still crucial, requiring a balanced approach between data usage and user protection. Embracing big data analytics in libraries indicates a forward-looking shift toward adaptive, responsive, and user-centric institutions, ready to succeed in the digital age.

Acknowledgement:

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