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Transforming Library Management, Leveraging Data Analytics through A Strategic Approach

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ABSTRACT

In the era of digital transformation, analytics has emerged as a critical enabler across industries, including library management. Libraries, now evolving into knowledge management centres, face dynamic user needs and operational challenges. This paper explores the role of data analytics in enhancing library services, improving decision-making, and addressing contemporary challenges. It outlines the types of analytics applicable to libraries, the analytical environment, and strategies for overcoming operational constraints. Practical examples and case studies illustrate how analytics can be effectively integrated into library operations to optimise resources and strengthen user engagement.

Keywords: *Analytics, Business Insights, Library Analytics, Library Queries, Analytical Environment.*

1. INTRODUCTION

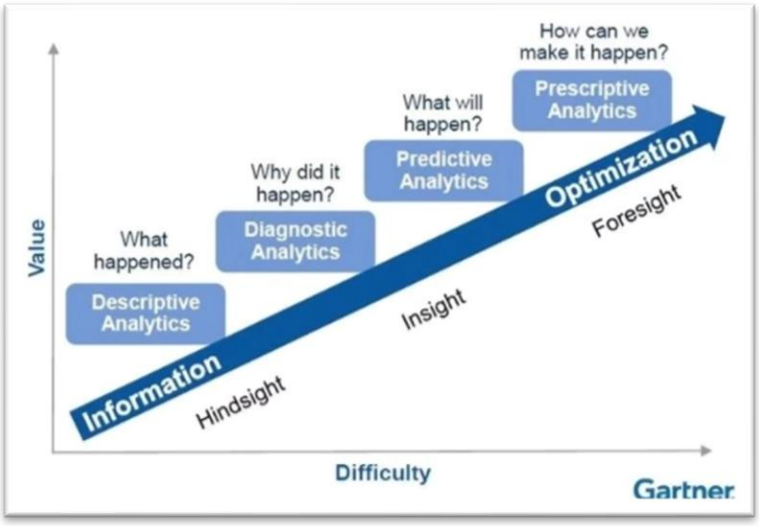
1.1 Libraries are transitioning from traditional repositories to digitally enabled knowledge hubs that serve global users via remote and online services. This evolution requires robust data strategies to manage diverse inputs and deliver personalized, high-quality services. In large-scale ecosystems, systematic data collation and analysis are pivotal for deriving actionable insights about user behavior, service utilization, and resource relevance. Analytics, defined by SAS Institute Inc. as "an encompassing and multidimensional field that uses mathematics, statistics, predictive modeling, and machine-learning techniques to find meaningful patterns and knowledge in recorded data," provides the foundation for evidence-based decision-making in libraries.

Historically, libraries relied on surveys, feedback, and usage studies. Modern analytics advances this with real-time processing, forecasting, and recommendations, enabling personalization, proactive resource management, and improved operational efficiency.

1.2 Analytics in Libraries–an Overview

Traditional business intelligence techniques mainly concentrate on historical data, while analytics enable insightful perceptions, forecasts, and prescriptive patterns derived from real-time data processing. Analytics serves as the foundation for personalized value enhancement by fostering a better understanding of customer needs and preferences. It offers profound insights and valuable indicators that, when acted upon, can dramatically transform or precisely realign the full spectrum of services provided. The subsequent sections will illustrate, through examples, how analytics can be effectively integrated into library operations. The more complex an analysis is, the more value it brings. Through all these types, one can go deep into data in search of a much needed and fact-based insight.

2. CONCEPTUAL FRAMEWORK OF ANALYTICS IN LIBRARIES



The complexity of analysis correlates with the value derived, enabling libraries to move from basic reporting to advanced decision-making. (Please refer Fig.1)

2.1 Types of Analytics

Libraries apply analytics to uncover the true value of data. Gartner (2016) identifies four types:

i. **Descriptive analytics:** Provides insights into past performance using logs and dashboards.
ii. **Diagnostic analytics:** Explores causality through comparisons and drill-downs.
iii. **Predictive analytics:** Forecasts outcomes using statistical and machine learning models.
iv. **Prescriptive analytics:** Recommends actions by optimizing alternatives and constraints.

3. ANALYTICAL ENVIRONMENT IN LIBRARIES

Libraries face challenges such as limited physical space, declining visitor numbers, financial constraints, and rising expenses. Implementing an analytical environment offers several benefits:

i. **Enhanced reporting:** Valuable insights into library operations.
ii. **Patron understanding:** Deeper knowledge of user needs and preferences.
iii. **Vendor management:** Optimized resource allocation and procurement.
iv. **Risk mitigation:** Improved decision-making on resource addition or removal.
v. **Service innovation:** Opportunities to redesign processes and introduce new services.

4. DATA SETS FOR LIBRARY ANALYTICS

Libraries generate diverse datasets that support descriptive, diagnostic, and predictive analytics:

i. New additions and weeding data
ii. Transaction logs with user information
iii. Reference query records
iv. Online resource usage reports
v. OPAC search logs
vi. Feedback and complaints
vii. Expenditure analysis
viii. User surveys and profiles
ix. Membership data
x. Stock verification
xi. Footfall statistics

Systematic collection and analysis of these datasets enable libraries to identify problem areas and plan targeted interventions.

Benefits of an analytical environment include:

i. Enhanced reporting and insight
ii. Deeper understanding of patrons and information needs
iii. Optimized vendor and resource management
iv. Improved risk mitigation through add/remove decisions
v. Opportunities for service innovation and process redesign

5. CASE STUDIES AND EXAMPLES

5.1 QlikSense Visualization

We'll describe a practical use case using **QlikSense** for visualization:

i. Phase 1: Descriptive Analytics
   - Reference queries by geography/domain
   - Query type categorization and frequency
   - Location-wise priority queries

Libraries can leverage visualization tools such as QlikSense to analyze reference queries:

i. **Reference queries by geography/domain**
ii. **Query type categorization and frequency**
iii. **Location-wise priority queries**

Diagnostic analytics further identify reasons for low resource utilization, such as lack of awareness or inadequate content, and inform corrective action plans.

5.2. Example of Analytics in Libraries

This section takes the person who reads through practical use cases of applying combination of types of analytics aligned to library's objective. Data and Analytics service for library begins by visualizing available data in a meaningful way to make it analyzable for a specific purpose. Qliksense software is used to visualize the data better.

Here now, sample data has been created to see how analytics can be applied on the given set of data to derive useful inferences. In the following demonstration, sample library reference query data have been generated.

Phase 1) Descriptive Analytics

The available dataset is mapped to specific purpose and visualization is created.

i. Reference queries by geography and domain
ii. Query type categorization and frequency
iii. Location wise queries as per priority

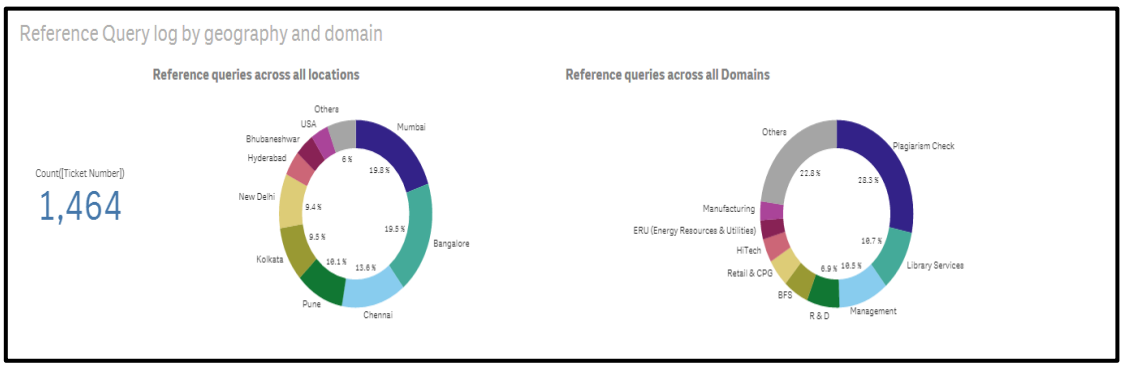


Figure 1: Reference Queries by Geography and Domain

Observation: 1464 available tickets for the quarter. One can read from the data that the number of tickets was more at Mumbai branch. Plagiarism tickets were raised more in this quarter followed by other queries.

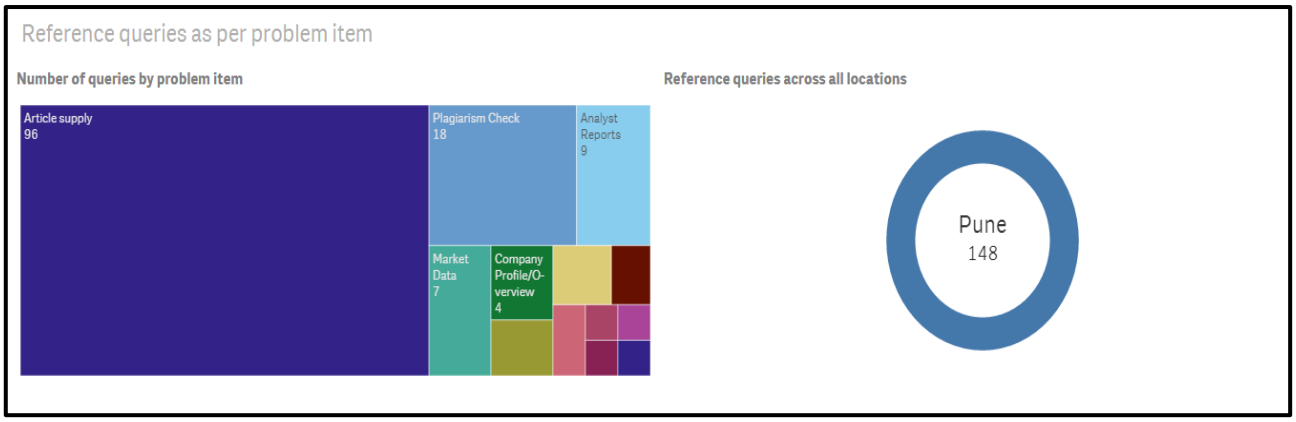


Figure 2: Query Type Categorization and Frequency

Observation: From the dashboard mentioned, it can be understood that from Pune, article queries were mostly asked, followed by plagiarism and market data queries.

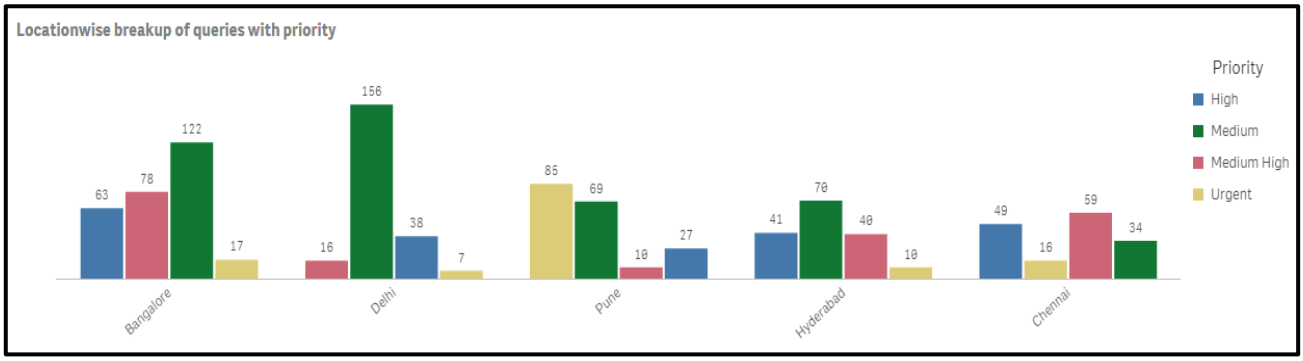


Figure 3: Location wise queries as per priority

Observation: From the mentioned dashboard, it was understood that the highest number of queries were logged from Bangalore. Urgent queries were highest at Pune.

Phase 2) Diagnostic analytics

Taking into account the goals of the library, one can evaluate the results of descriptive analytics by posing thorough questions, thereby gaining improved insights to formulate the necessary action plan.

The following are two examples from Libraries reference query log.

Example 1 is discussed in detail with available data and outcome of analytics.

Example 1)

i. Objective: To optimize resource usage

ii. Problem statement: Analyze the reason for high or low utilization of a particular subject / resource

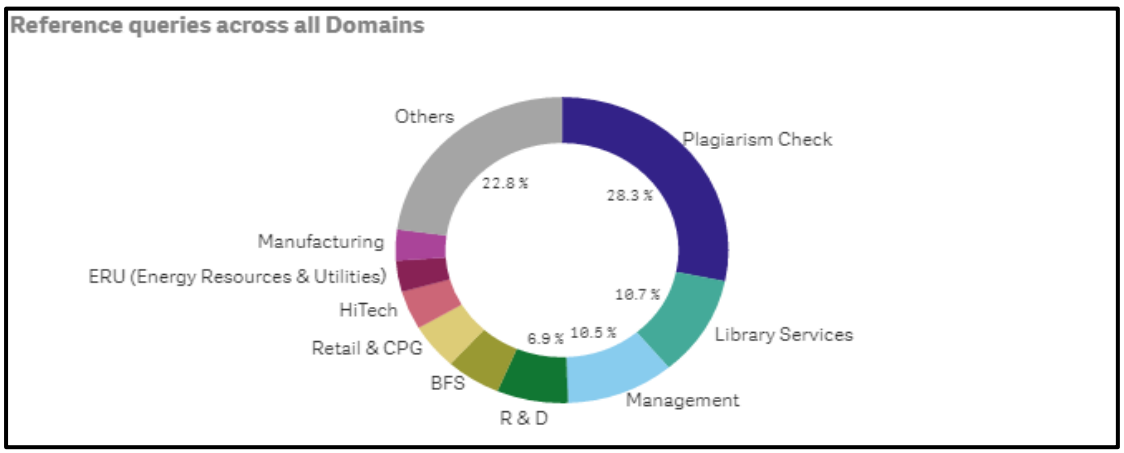


Figure 4: Library Reference Queries across All Domains

i. Diagnosing the outcome: Reasons for low utilization
   a. Absence of skilled librarians
   b. Absence of relevant content available
   c. Absence of adequate resources available
   d. Absence of awareness for resources

ii. Action plan aligned to defined objective: If a librarian's skill set is the problem, appropriate training sessions can be conducted. If poor content is the prominent reason, discontinue resources, replace with new ones.

Example 2)

i. Objective: To recognize the efforts of performing librarians, ensuring their continued engagement over an extended period, and to inspire those who are not performing.

ii. Problem statement: Librarian's individual performance analysis

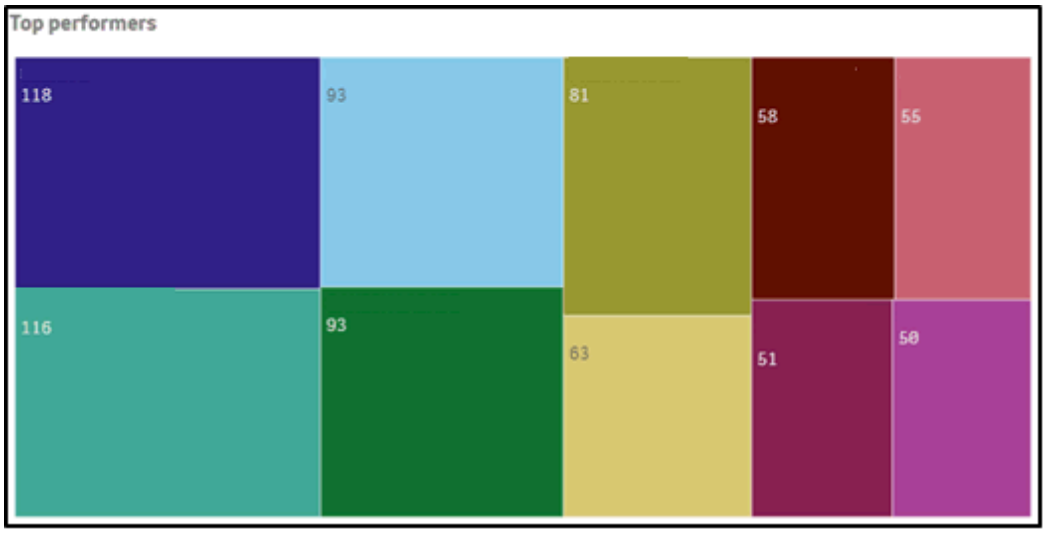


Figure 6: Top Performing Librarians involved in resolving library queries

i. Diagnosing the outcome:
   a. Parameters contributing to high performance
   b. parameters contributing to low performance

ii. Action plan aligned to defined objective:
   a. Maintain motivation among top performers and strive to keep them engaged.
   b. Leverage their abilities to foster the growth of others.
   c. Create personalized learning plans for those who are not performing well.

Phase 3) Predictive analytics- This represents the third stage of analytics. Further predictive analytics can be conducted by employing more sophisticated analytical models. This approach will assist in forecasting certain future needs as outlined here.

i. Training needs for library staff

ii. Develop cross-functional team

iii. Resources using trends like during which period or which resources are likely to be unused. Depending upon the patterns, one can take decisions about discontinuing existing resources or adding new resources.

5.3 Library Impact Data Project (Huddersfield, UK)

The Library Impact Data Project analyzed anonymized usage data—e-resource clicks, book loans, and gate entries—and matched these to final degree awards for 33,074 undergraduate students across eight UK universities. Findings revealed a statistically significant correlation between higher library use and higher attainment, informing targeted outreach and resource allocation (Stone & Ramsden, 2013).

6. IMPLEMENTATION ROADMAP

Stage	Description
Data Foundations	Establish ETL pipelines, harmonize identifiers, and enforce data quality across systems.
Metrics & Descriptive BI	Publish consistent KPIs (circulation, gate counts, usage, and attendance) via dashboards.
diagnostic Deep-Dives	Run cohort analyses and correlations; identify underserved segments and low-usage courses.
Predictive Models	Forecast demand, likelihood of non-use, and churn; simulate staffing and hours.
Prescriptive Actions	Optimize programming calendars, outreach sequencing, and budget reallocations.

7. KEY CHALLENGES AND PROBLEM STATEMENTS

i. Declining usage of physical collections and underuse of electronic resources
ii. Reduced event participation and limited time availability for library visits
iii. Accessibility constraints across large campuses
iv. Systematic weeding aligned with emerging technologies
v. Sustaining engagement and relationships with patrons

8. CONCLUSION

Meaningful datasets, when systematically collected and analyzed, enable libraries to enhance services, optimize resources, and strengthen patron relationships. By advancing from descriptive reporting to predictive and prescriptive decision-making, libraries can unlock transformative value. Collaboration among librarians, data scientists, statisticians, and IT professionals fosters an analytical culture that supports continuous improvement and future readiness.

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