Implementation of Data Warehouse in Making Healthcare Dashboard Development Using PostgreSQL Database and Kimball Lifecycle Method

[1] A.D Sawant, [2] Tuba Falak Khan, [3] Mohammad Faizan Raza, [4] Humaira Shaikh, [5] Aniket Prabhakar

1, Assistant Professor at Prof Ram Meghe College of Engineering and Management Badnera ,.,.,Student at Prof Ram Meghe College of Engineering and Management Badnera

Abstract:a

In the dynamic healthcare landscape, this research explores the variations in medicine demand and supply across regions and seasons. It investigates factors influencing medicine pricing, availability, and the impact of quality and safety on customer satisfaction. The study also delves into the effects of marketing, competition, and regulations on market share and profitability. Amidst heightened healthcare competition, the proposal advocates for a robust Data Warehouse and Business Intelligence Dashboard, utilizing PostgreSQL for healthcare data. The focus is on monitoring sales performance and optimizing medicine delivery efficiency. Embracing Data Warehouse technology empowers companies with enhanced analytical capabilities, fostering successful navigation of the complex healthcare environment.Ultimately, this research aims to equip healthcare organizations to proactively adapt, thrive, and excel in the competitive healthcare sector, leveraging data-driven decision-making for innovation and success in patient care and outcomes.

IndexTerms - Data warehouse, Business Intelligence, Kimball lifecycle, OLAP, Healthcare Sales , Analysis.

I. Introduction

In the face of escalating challenges and intensified competition in healthcare, the integration of data-driven strategies is imperative for process optimization and improved patient outcomes. This research proposes the implementation of a robust Healthcare Data Warehouse system and a sophisticated Health Business Intelligence Dashboard.The study, employing the Kimball Lifecycle method adapted for healthcare, focuses on dynamic monitoring of clinical and operational performance. By expediting data integration, the goal is to empower healthcare organizations with enhanced analytical capabilities, ensuring sustained competitiveness and excellence in healthcare delivery.Addressing key questions, the research explores variations in medicine demand and supply across regions and seasons, factors influencing medicine pricing and availability, and the impact of medicine quality and safety on customer satisfaction and loyalty. It also investigates how marketing and promotion influence customer awareness and preference, and examines the effects of competition and regulations on medicine market share and profitability.This research aims to provide valuable insights for the healthcare industry, promoting data-driven strategies that not only ensure competitive success but also advance patient care and overall healthcare excellence.

11. Related Work

Sr. No.	Database	Algorithm	Deployment	Input	Output	Future Scope	Accurac

1.	Postgresql	K-Nearest Neighbour or mean/median imputation	Cloud server	Historical sales data	potential imsights	Implement real time ingestion pipeline	93%
2	Cloud data warehouse	Access control mechanism	Healthcare Dashboard	Market Competitio n data	Recommended pricing strategies	Enhanced security and governance features - Open source language support (e.g . Spark)	95%
3	Microsoft SQL Server	FastBulk or sqoop	On-premise servers	Logistics data	Efficiency improvemen t	Integration with new features , tools and technologies	85%
4	Oracle database	B - tree, bitmap indexes	On-premise servers	Competitor analysis data	Identification of effective marketing segments	Enhanced horizontal scaling capabilities beyond current limitation	90%
5	Amazon EC2	Query Optimization algorithm	Amazon Web Services	ETL Pipeline	Aggregated data	Continued focus on ensuring data consistency and accuracy through advanced error handling replication techni ues	87%

111 Block Diagram:

Data Sources

Healthcare Data Warehouse

Health Business Intelligence Dashboard (Kimball Method)

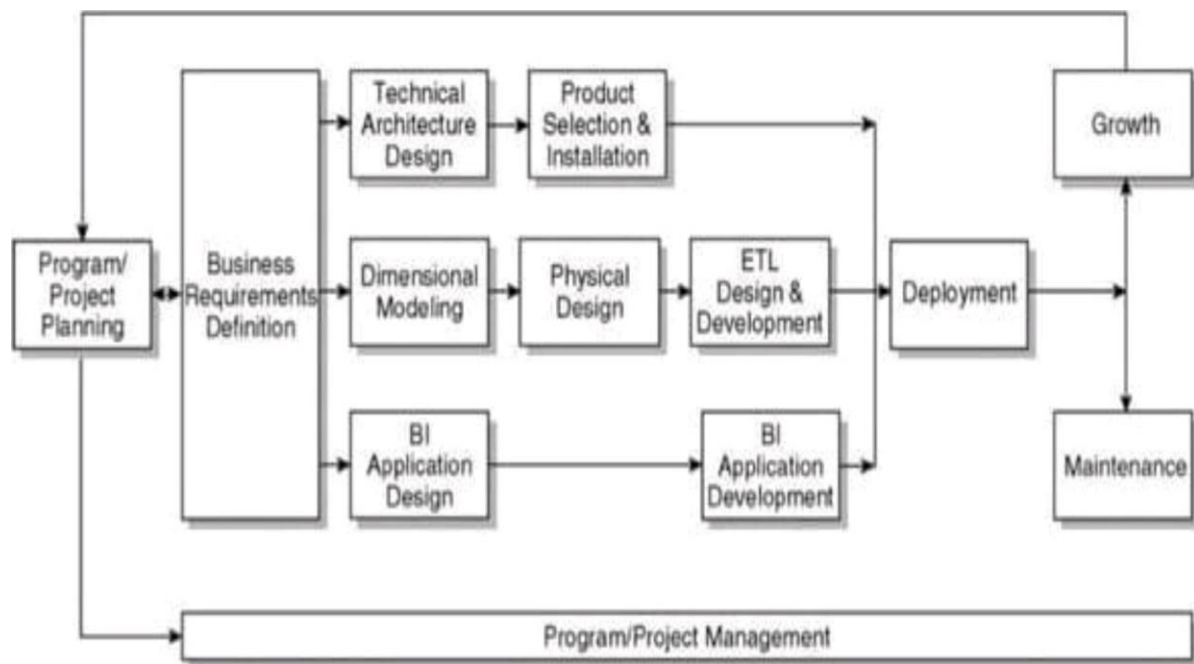Comparative Market Analysis (Regional and Seasonal)
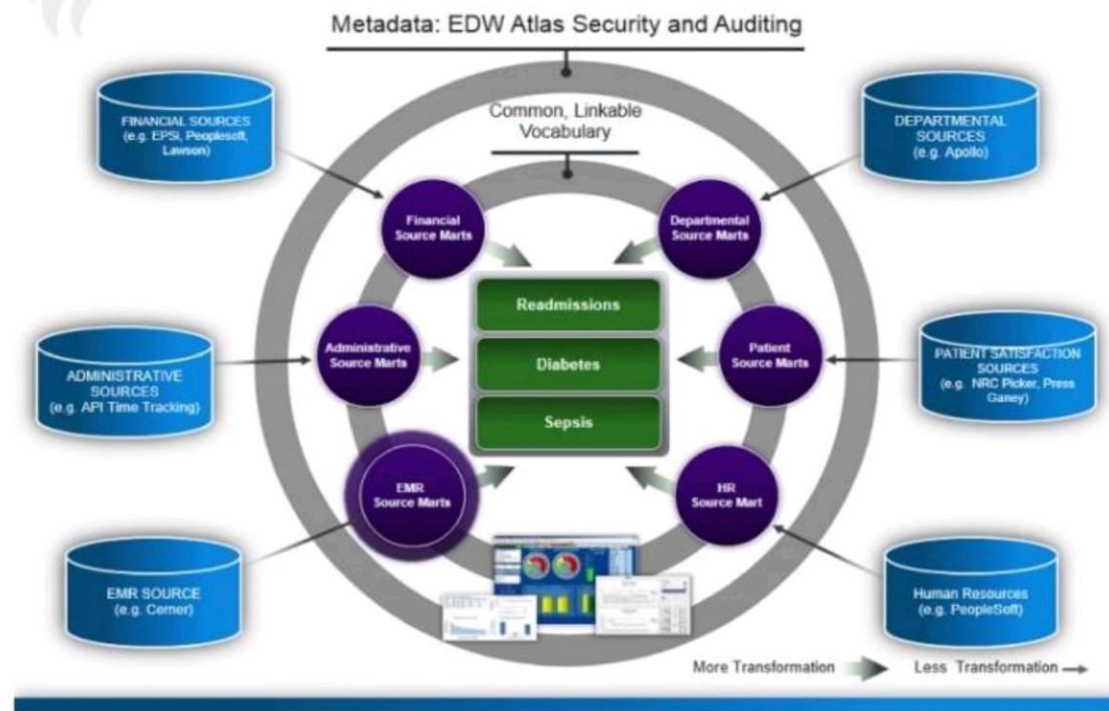
1

Regulatory and Competitive landscape Analysis

1

Iterative Refinement of Methodology

IV   Flow Approach:

V   Integrated Research Methodology for Healthcare Data Management and Analysis

1. Introduction:

- Introduce the overarching objective: Establish a robust Healthcare Data Warehouse system and apply a late-binding approach to data modeling.
- Highlight the challenges in traditional architectural models and emphasize the need for an adaptive methodology.

2. Healthcare Data Warehouse Implementation:

- Objective:Establish a robust Healthcare Data Warehouse system for comprehensive data storage and retrieval.

- Approach:lmplement the proposed Data Warehouse system utilizing PostgreSQL for healthcare data.

- Rationale: Ensure a centralized and structured repository, facilitating seamless integration and analysis of diverse healthcare data.

3. Health Business Intelligence Dashboard Development:

- Objective: Develop a sophisticated Health Business Intelligence Dashboard for dynamic monitoring of clinical and operational performance.
- Approach: Utilize the Kimball Lifecycle method adapted for healthcare.
- Rationale: The Dashboard serves as a powerful tool for insightful performance visualization, aiding decisionmakers in extracting actionable insights for optimized healthcare processes.

4. Data Integration Optimization:

- Objective:Expedite the data integration process for real-time monitoring.
- Approach:Employ the proven Kimball Lifecycle method to streamline data integration.
- Rationale:Ensure timely access to critical information, fostering seamless performance visualization and analysis.

5. Analytical Capability Enhancement:

e Objective:Empower healthcare organizations with enhanced analytical capabilities.

- Approach:Leverage advanced analytics tools integrated into the Health Business Intelligence Dashboard.

- Rationale:lmproved analytical capabilities enable organizations to derive meaningful insights, contributing to informed decision-making and strategic planning.

6. Late-Binding Approach to Data Modeling:

- Objective:lmplement a late-binding approach to data modeling in the healthcare industry.

- Approach Follow a staged process from data acquisition to the creation of data marts, emphasizing delayed binding until specific business needs arise.

- Rationale Ensure maximum flexibility for addressing diverse use cases and prevent resource wastage by adapting data models based on evolving clinical and business needs.

7. Questionnaire and Survey Design

- Objective:Collect primary data on medicine demand, supply, pricing, quality, and customer preferences. ● Approach:Develop a structured questionnaire and survey for healthcare professionals, stakeholders, and patients.

- Rationale:Gather firsthand information for a comprehensive understanding of factors influencing medicine dynamics and customer satisfaction.

8. Statistical Analysis

- Objective:Analyze collected data to draw correlations and insights.

- Approach:Utilize statistical tools to examine relationships between variables.

- Rationale:Ensure the credibility of findings and provide a quantitative basis for drawing conclusions.
9. Comparative Market Analysis

- Objective:Examine variations in medicine demand, pricing, and availability across different regions and seasons.

- Approach:Conduct a comparative analysis of healthcare markets, considering regional and seasonal factors. o Rationale:Gain insights into regional variations, contributing to a nuanced understanding of medicine dynamics.

10. Regulatory and Competitive Landscape Analysis

- Objective:Evaluate the impact of competition and regulations on medicine market share and profitability.

- Approach:Analyze regulatory frameworks and competitive landscapes in the healthcare industry.

- Rationale:Understand the regulatory and competitive environment to inform the assessment of market dynamics and profitability factors.

11. Refinement of Methodology

- Objective:Ensure the ongoing relevance and effectiveness of the research methodology.
e Approach:Regularly review and refine the methodology based on emerging insights and feedback.
o Rationale:lterative refinement allows for adaptability, ensuring the research stays aligned with the evolving dynamics of the healthcare sector.

Through this integrated methodology, the research aims to provide a comprehensive analysis of the healthcare industry's medicine dynamics, offering valuable insights for data-driven decision-making, strategic planning, and adaptable data modeling.
VI Pros :
1. Comprehensive Data Management:
- The methodology integrates a Healthcare Data Warehouse system, ensuring comprehensive data storage and retrieval.
- Late-binding data modeling allows for flexibility, adapting to evolving clinical and business needs.
2. Advanced Analytics:

- Implementation of advanced analytics tools enhances analytical capabilities, providing meaningful insights for decision-making.

- Health Business Intelligence Dashboard facilitates dynamic monitoring, aiding in optimized healthcare processes.

3.   Real-time Monitoring:

● Data integration optimization enables real-time monitoring, ensuring timely access to critical information.

● Utilization of statistical analysis contributes to credible and quantitative insights.

4.   Tailored Questionnaire and Survey Design: • Structured questionnaire and survey design allow for comprehensive primary data collection from healthcare professionals, stakeholders, and patients.

o Provides firsthand information for a nuanced understanding of medicine dynamics and customer satisfaction.

5.   Comparative Market Analysis:

● Comparative market analysis considers regional and seasonal factors, offering insights into variations in medicine demand, pricing, and availability.

● Contributes to a comprehensive understanding of medicine dynamics in different healthcare markets.

6.   Regulatory and Competitive Landscape Analysis:

● Analysis of regulatory frameworks and competitive landscapes informs market dynamics and profitability factors.

● Enables organizations to adapt strategies based on a thorough understanding of the industry environment.

7.   Iterative Refinement:

● Regular refinement of the methodology ensures ongoing relevance and effectiveness.

e Allows adaptability to emerging insights and feedback, keeping the research aligned with the evolving dynamics of the healthcare sector. Cons :

1. Complex Implementation:

● Implementing a robust Healthcare Data Warehouse system may be complex and resource-intensive. o Late-binding data modeling might require additional effort to manage evolving data structures.

2. Resource Dependency e Utilizing advanced analytics tools and developing a sophisticated Health Business Intelligence Dashboard may require significant resources.

● Real-time monitoring and data integration optimization may demand substantial investment in technology and infrastructure.

3. Data Collection Challenges

● Designing and implementing a structured questionnaire and survey may face challenges in terms of participant cooperation and data accuracy.

● Dependence on primary data collection may introduce biases or limitations in the scope of information gathered.

4. Time-Consuming Comparative Analysis

● Conducting a comparative market analysis considering regional and seasonal factors may be timeconsuming.

● Requires comprehensive data from various regions, potentially leading to delays in data gathering and analysis.

5. Complex Regulatory Landscape

● Analyzing the regulatory and competitive landscape in the healthcare industry can be intricate and may require legal expertise.

● Adapting strategies based on regulatory insights may face challenges due to the dynamic nature of healthcare regulations.

6. Data Security Concerns

● Centralized data storage in a Healthcare Data Warehouse may raise concerns about data security and privacy.

- • Integration of diverse healthcare data sources may pose challenges in maintaining data integrity and confidentiality.

7. Adaptation Challenges:

● The iterative refinement approach may encounter resistance or challenges in adapting to emerging insights. ● Continuous refinement may require additional time and resources, impacting the overall timeline of the research.

In conclusion, while the methodology presents various advantages in terms of data management, analytics, and adaptability, it also poses challenges related to complexity, resource dependency, and potential limitations in data collection and analysis.

VIl Conclusion :

In conclusion, this research advocates a strategic approach encompassing a robust Healthcare Data Warehouse, latebinding data modeling, and a sophisticated Health Business Intelligence Dashboard. These components leverage patient data for dynamic monitoring, enhancing analytical capabilities and aiding decision-making. While providing valuable insights, the methodology acknowledges challenges like complexity and resource dependency, emphasizing continuous refinement for adaptability. Ultimately, this approach positions healthcare organizations for sustained competitiveness, improved outcomes, and excellence in healthcare delivery.

References:

l. P. P. Ramadhani, S. Hadi and R. Rosadi, "Implementation of Data Warehouse in Making Business Intelligence Dashboard Development Using PostgreSQL Database and Kimball Lifecycle Method," 2021 International Conference on Artificial Intelligence and Big Data Analytics, Bandung, Indonesia, 2021, pp. 88-92, doi: 10.1109/1CAIBDA53487.2021.9689697.

2. M. Himami, A. S. Abdullah, I. Nurma Yulita and M. Suryani, "Utilization of Data Warehouse in Business Intelligence with Kimball Method at Company XYZ," 2021 International Conference on Artificial Intelligence and Big Data Analytics, Bandung, Indonesia, 2021, pp. 1-6, doi: 10.1109/1CAIBDA53487.2021.9689720.

3. B. Singhal and A. Aggarwal, "ETL, ELT and Reverse ETL: A business case Study," 2022 Second International Conference on Advanced Technologies in Intelligent Control, Environment, Computing & Communication Engineering (ICATIECE), Bangalore, India, 2022, pp. 1-4, doi: 10.1109/1CATIECE56365.2022.10046997.

4. C. A. U. Hassan et al., "Optimizing the Performance of Data Warehouse by Query Cache Mechanism," in IEEE Access, vol. 10, pp. 13472-13480, 2022, doi: 10.1109/ACCESS.2022.3148131.

5. V. S. Khatuwal and D. Puri, "Business Intelligence Tools for Dashboard Development," 2022 3rd International Conference on Intelligent Engineering and Management (ICIEM), London, United Kingdom, 2022, pp. 128-131, doi: 10.1109/1CIEM54221.2022.9853086.

6. Mehrdad Maghsoudi, Navid Nezafati, Navigating the acceptance of implementing business intelligence in organizations: A system dynamics approach,Telematics and Informatics Reports,Volume11,2023,100070,ISSN 2772-5030,https://d0i.org/10.1016/j.te1er.2023.100070.
(https://www.sciencedirect.com/science/article/pii/S2772503023000300)

7. Santanu Roy, Agostino Cortesi, Soumya Sen, Context-aware OLAP for textual data warehouses, International Journal of Information Management Data Insights,Volume 2, Issue 2,2022,100129,ISSN 2667-0968,https://d0i.org/10.1016/j.jjimei.2022.100129.
(https://www.sciencedirect.com/science/article/pii/S2667096822000726)

8. Q. T. Minh, D. T. Thai, B. T. Duc and N. H. Phat, "Designing a Data Warehouse Framework for Business Intelligence," 2022 International Conference on Data Analytics for Business and Industry (ICDABI), Sakhir, Bahrain, 2022, pp. 498-502, doi: 10.1109/1CDAB156818.2022.10041706.

9. Amelec Viloria, Genesis Camargo Acufia, Daniel Jesüs Alcâzar Franco, Hugo Hernändez-Palma, Jorge Pacheco Fuentes, Etelberto Pallares Rambal, Integration of Data Mining Techniques to PostgreSQL Database Manager System, Procedia Computer Science, Volume 155, 2019, Pages 575-580, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2019.08.080.

(https://www.sciencedirect.com/science/article/pii/S 1877050919309949)

10. Ilko Kovacic, Christoph G. Schuetz, Bernd Neumayr, Michael Schrefl, OLAP Patterns: A pattern-based approach to multidimensional data analysis, Data & Knowledge Engineering, Volume 138, 2022, 101948, ISSN 0169-023X, https://doi.org/10.1016/j.datak.2021.101948.

(https://www.sciencedirect.com/science/article/pii/S0169023X21000732)

11. Jorge Duque, Ant6nio Godinho, José Vasconcelos, Knowledge data extraction for business intelligence A design science research approach, Procedia Computer Science, Volume 204, 2022, Pages 131-139, ISSN 1877-0509, https://doi.org/10.1016/j.procs.2022.08.016.

(https://www.sciencedirect.com/science/article/pii/S 1877050922007542)

12. J.A. Nasir, M.K. Shahzad and M.A. Pasha, 2006. Data Warehouse Design for Sales Performance Analysis. Information Technology Journal, 964-969. DOI: 10.3923/itj.2006.964.969 URL: https '/scialert.net/abstract/?doi=itj.2006.964.969