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Assessing the Effectiveness Level of Cloud Data Warehousing on Inventory Management among Selected Merchandising Businesses in District II of Bulacan

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ABSTRACT: *This study assessed the effectiveness level of cloud data warehousing on inventory management among selected merchandising businesses in District II of Bulacan, Philippines. Using a quantitative, descriptive-assessment research design, data were gathered from all thirty (30) qualified business personnel through universal sampling. A researcher-developed, three-part questionnaire employing a four-point Likert scale measured effectiveness across seven validated criteria: extract, transform, and load (ETL), data querying, data visualization, security and encryption, access control, audit logging, and backup and disaster recovery. Responses were analyzed using frequency and percentage distribution, weighted mean, and standard deviation. Results showed that cloud data warehousing was rated Very Effective overall (M = 3.64, SD = 0.34). Backup and Disaster Recovery obtained the highest mean (M = 3.75, SD = 0.37), followed by Access Control and Audit Logging (M = 3.68 each), Extract, Transform, and Load (M = 3.65, SD = 0.44), and Data Querying and Data Visualization (M = 3.53 each per the overall assessment table). All seven criteria fell within the Very Effective range. Most respondent businesses were retail establishments (63%) operating seven or more branches (76.67%) that had used cloud data warehousing for one to three years (46.67%). These findings informed the development of a proposed Inventory Management Plan integrating cloud data warehousing, intended to sustain and further strengthen data collection, processing, security, monitoring, reporting, analysis, and business-continuity practices among merchandising businesses.*

KEYWORDS - *cloud data warehousing, effectiveness assessment, ETL, inventory management, merchandising businesses*

I. INTRODUCTION

Merchandising firms generate profit by purchasing finished goods for resale, and inventory management is a critical function within these operations, involving the planning, organizing, and controlling of stock that is transformed into revenue once sold [1], [2]. Conventional inventory systems collect and process data at fixed intervals; as market complexity has grown, this traditional approach increasingly struggles to capture demand patterns and trends, resulting in overstocking, stockouts, and delayed decision-making [3].

Cloud data warehousing has emerged as a practical alternative, offering flexible, real-time, and scalable data solutions suited to the fast-changing needs of inventory management [4]. Yasser and Alserafi [5] proposed a

validated set of criteria for evaluating cloud data warehouses: extract, transform, and load (ETL), data querying, data visualization, security and encryption, access control, audit logging, and backup and disaster recovery. Internationally, organizations such as Walmart have leveraged cloud-enabled data platforms for inventory tracking and forecasting, while locally, the Gokongwei Group's migration of its retail data infrastructure to cloud-based platforms improved data accessibility and analytics capability [6].

Despite this growing adoption, the Philippine Statistics Authority reports that wholesale and retail trade activities drive a significant share of Bulacan's economic growth, yet many enterprises continue to face challenges integrating information systems due to limited resources and insufficient supporting evidence [7]. Records from District II of Bulacan indicate 3,999 registered merchandising businesses as of 2026, providing a sufficient basis for assessing cloud data warehousing effectiveness in this setting. Related literature has also noted disadvantages, such as increased operational expense, that make some organizations cautious about adoption without implying that the technology itself is ineffective [8].

Existing studies on cloud data warehousing have concentrated largely on general industries such as hospitals and food service internationally, leaving a population gap in the merchandising sector, and a contextual gap locally given the limited empirical evidence on how cloud data warehousing functions in inventory management within Philippine merchandising businesses. This study addressed that gap by assessing the effectiveness level of cloud data warehousing on inventory management among selected merchandising businesses in District II of Bulacan, using the seven validated criteria, and by proposing an inventory management plan based on the findings.

The study was anchored on Data Warehousing Theory, developed by Inmon and Kimball [9], which conceptualizes a data warehouse as a centralized repository that integrates data from multiple sources for decision-making, analysis, and reporting. The theory identifies five elements relevant to this study: data integration, data quality, data accessibility, scalability, and governance, which collectively frame how merchandising businesses consolidate and secure inventory data to support informed, timely decisions.

Specifically, the study sought to describe (a) the business profile of the respondents in terms of type of operation, years in business, years of using cloud data warehousing, and number of branches; (b) the demographic profile of the respondents in terms of years of service and years of experience in operating inventory management systems; (c) the effectiveness level of cloud data warehousing on inventory management in terms of the seven criteria; and (d) an inventory management plan that may be proposed based on the findings.

II. METHODOLOGY

2.1 Research Design

This study employed a quantitative research method using a descriptive-assessment research design to determine the effectiveness level of cloud data warehousing on inventory management among selected merchandising businesses. This design was appropriate as it allowed the researchers to systematically describe the current utilization of cloud data warehousing and assess its effectiveness against specific criteria without manipulating any variable.

2.2 Participants and Sampling

The study employed universal sampling, in which all members of the target population meeting the established criteria were included as respondents. The population consisted of thirty (30) employees, managers, and other business personnel from selected merchandising businesses in District II of Bulacan who were directly involved in, and personally used, cloud data warehousing in their inventory management activities. Respondents were required to have direct involvement in inventory management and at least one year of experience using cloud data warehousing.

2.3 Research Instrument

Data were gathered using a researcher-developed “Survey Instrument for Assessing the Effectiveness of Cloud Data Warehousing on Inventory Management,” structured in three parts and employing a four-point Likert scale (Very Effective = 4, Effective = 3, Less Effective = 2, Ineffective = 1). The first section captured the business

profile; the second, the respondents' professional background; and the third, twenty-eight (28) items evaluating effectiveness across the seven criteria identified by Yasser and Alserafi [5].

2.4 Data Collection Procedure

Following institutional approval, the researchers coordinated with participating businesses to secure clearance and distribute the questionnaire, either in printed form or through an online platform, to designated inventory personnel. Completed questionnaires were checked for completeness before encoding and statistical processing.

2.5 Data Analysis

Frequency and percentage distributions summarized the business and demographic profiles. The weighted mean determined the overall effectiveness level per item and per criterion, interpreted using the scale in Table 1. Standard deviation described the consistency of responses around the mean but was not itself subjected to interpretative categorization.

Table 1. Interpretation of Mean

Scale	Range	Interpretation
4	3.26 – 4.00	Very Effective
3	2.51 – 3.25	Effective
2	1.76 – 2.50	Less Effective
1	1.00 – 1.75	Ineffective

2.6 Ethical Considerations

The study complied with the ethical standards of Richwell Colleges, Incorporated. Respondents' identities and responses were kept anonymous and confidential in accordance with the Data Privacy Act of 2012. Participation was voluntary and based on informed consent, and all findings were reported honestly and objectively, based solely on the data gathered, with no data fabrication, addition, or misrepresentation.

III. RESULTS AND DISCUSSION

3.1 Business Profile of the Respondents

Tables 2 through 5 present the business profile of the respondent merchandising businesses in terms of type of operation, years in operation, years of using cloud data warehousing, and number of branches.

Table 2. Distribution of Respondents by Type of Merchandising Business Operation

Type of Business Operation	f	%
Retail	19	63.00
Wholesale-Retail	11	37.00
Wholesale	0	0.00
Total	30	100.00

Most respondents (63%) operated as retail businesses, while the remainder (37%) operated as wholesale-retail businesses; no respondents were purely wholesale. This indicates that direct consumer selling remains the dominant business approach among merchandising establishments in the area, consistent with Toroba et al. [16], who emphasized that effective inventory management is crucial to retail business performance.

Table 3. Distribution of Respondents by Years in Operation

Years in Operation	f	%

1–3 years	7	23.33
4–6 years	5	16.67
7–9 years	7	23.33
10 years and above	11	36.67
Total	30	100.00

A plurality (36.67%) had been operating for ten years or more, reflecting an established sector alongside a considerable share of newer and moderately established businesses that contribute innovation and competition.

Table 4. Distribution of Respondents by Years of Using Cloud Data Warehousing

Years Using Cloud Data Warehousing	f	%
Less than 1 year	1	3.33
1–3 years	14	46.67
4–6 years	2	6.67
7 years and above	13	43.33
Total	30	100.00

Nearly half (46.67%) had used cloud data warehousing for one to three years, and 43.33% for seven years or more, indicating that most respondents possess considerable experience with the technology and are well positioned to assess its effectiveness.

Table 5. Distribution of Respondents by Number of Branches

Number of Branches	f	%
1 branch	2	6.67
2–3 branches	2	6.67
4–6 branches	3	10.00
7 branches and above	23	76.67
Total	30	100.00

Most businesses (76.67%) operated seven or more branches, underscoring the scale of coordination that centralized, cloud-based inventory data can support across multiple locations, consistent with Tan et al. [17], who found that centralized data systems enable multi-location businesses to better coordinate inventory.

3.2 Demographic Profile of the Respondents

Tables 6 and 7 present the respondents' professional background in terms of years of service and years of experience operating inventory management systems.

Table 6. Distribution of Respondents by Years of Service

Years of Service	f	%
1–3 years	15	50.00
4–6 years	5	16.67
7–9 years	7	23.33
10 years and above	3	10.00
Total	30	100.00

Half (50%) of the respondents had one to three years of service in their organizations, indicating a relatively new workforce with direct exposure to current inventory management practices and cloud-based technologies.

Table 7. Distribution of Respondents by Years of Experience in Operating Inventory Management Systems

Years of Experience Operating IMS	f	%
1–3 years	16	53.33
4–6 years	7	23.33
7–9 years	1	3.33
10 years and above	6	20.00
Total	30	100.00

A similar proportion (53.33%) had one to three years of experience operating inventory management systems. The inclusion of respondents spanning a range of tenure provided a balanced basis for assessing cloud data warehousing effectiveness, consistent with Dadzie et al. [18], who found that well-trained and experienced workers improve operational efficiency and inventory control.

3.3 Effectiveness Level of Cloud Data Warehousing on Inventory Management

Tables 8 through 14 present respondents' evaluation of cloud data warehousing effectiveness across the seven criteria identified by Yasser and Alserafi [5]: Extract, Transform, and Load (ETL); Data Querying; Data Visualization; Security and Encryption; Access Control; Audit Logging; and Backup and Disaster Recovery. Table 15 then presents the overall assessment across all seven criteria.

Table 8. Effectiveness Level of Cloud Data Warehousing on Inventory Management in Terms of Extract, Transform, and Load (ETL)

Statement	M	SD	Interpretation
The system efficiently extracts inventory data from multiple sources such as Point of Sale, Enterprise Resource Planning, and supplier systems.	3.70	0.47	Very Effective
The system supports timely data loading that enables near real-time inventory updates.	3.67	0.55	Very Effective
Inventory data undergoes automated transformation through cleaning and standardization.	3.63	0.49	Very Effective
The ETL process ensures consistency of inventory data across business units.	3.60	0.50	Very Effective
Overall Mean	3.65	0.44	Very Effective

The overall mean of 3.65 reflects a consistently high perception of ETL effectiveness. The strong rating for data extraction (M = 3.70) suggests improved integration of inventory data drawn from multiple operational systems, while the lowest-rated item, on cross-unit data consistency (M = 3.60), remained within the Very Effective range. This is consistent with Maniar et al. [10], who found that ETL processes improve data integration, enable real-time analytics, and ensure higher-quality data within data warehouses.

Table 9. Effectiveness Level of Cloud Data Warehousing on Inventory Management in Terms of Data Querying

Statement	M	SD	Interpretation
Users can easily retrieve historical inventory data whenever needed.	3.70	0.54	Very Effective
The cloud data warehouse allows fast querying of inventory data without performance issues.	3.60	0.50	Very Effective
The system supports complex inventory queries.	3.57	0.63	Very Effective
Query results are accurate and reliable for effective decision-making.	3.50	0.63	Very Effective

Overall Mean	3.59	–	Very Effective

The overall mean of 3.59 indicates that cloud data warehousing is Very Effective in supporting data query operations. The highest-rated item highlights quick access to historical inventory data, while the lowest, on the accuracy and reliability of query results, still reflects strong respondent confidence. These results are consistent with Somayajula [11], who found that cloud-native warehousing improves query processing speed and supports more efficient large-scale data analysis.

Table 10. Effectiveness Level of Cloud Data Warehousing on Inventory Management in Terms of Data Visualization

Statement	M	SD	Interpretation
Data visualization tools help identify low-stock, overstocked, and fast-moving inventory items.	3.80	0.41	Very Effective
Visualization tools provide interactive analysis through filtering and drill-down functions.	3.60	0.50	Very Effective
Inventory dashboards are clear and easy to understand.	3.50	0.68	Very Effective
Charts and reports update automatically based on the latest inventory data.	3.47	0.63	Very Effective
Overall Mean	3.59	–	Very Effective

The consistently high ratings across all indicators (overall M = 3.59) suggest that visual tools enhance data accessibility, inventory monitoring, and timely decision-making, transforming complex inventory data into meaningful insights for operational performance.

Table 11. Effectiveness Level of Cloud Data Warehousing on Inventory Management in Terms of Security and Encryption

Statement	M	SD	Interpretation
The cloud data warehouse allows assessment of how inventory data is protected.	3.63	0.49	Very Effective
Inventory data is protected during transmission between systems and the cloud data warehouse.	3.63	0.49	Very Effective
Inventory data stored in the cloud data warehouse is encrypted for security.	3.43	0.57	Very Effective
Security mechanisms are regularly updated to address emerging security threats.	3.43	0.50	Very Effective
Overall Mean	3.53	0.43	Very Effective

The high mean scores across all indicators show that respondents are confident that cloud-based security measures protect inventory data during storage and transmission, improving user confidence and reducing security risk. The low standard deviation values further indicate strong agreement among respondents on the effectiveness of these security features.

Table 12. Effectiveness Level of Cloud Data Warehousing on Inventory Management in Terms of Access Control

Statement	M	SD	Interpretation
User access to inventory data is based on defined roles and responsibilities.	3.63	0.49	Very Effective
Only authorized personnel are allowed to view or modify inventory records.	3.80	0.41	Very Effective

Different access levels are enforced for managers, staff, and administrators.	3.70	0.47	Very Effective
Access permissions can be easily updated when user roles change.	3.60	0.50	Very Effective
Overall Mean	3.68	0.38	Very Effective

Access to inventory records is effectively restricted to authorized personnel, reducing the risk of unauthorized viewing and modification. This corresponds with Rouhollahi et al. [12], who emphasized that attribute-based access control combined with real-time context evaluation delivers flexible security in cloud environments.

Table 13. Effectiveness Level of Cloud Data Warehousing on Inventory Management in Terms of Audit Logging

Statement	M	SD	Interpretation
All user activities related to inventory data are automatically recorded in audit logs.	3.70	0.47	Very Effective
The cloud data warehouse accurately records all changes made to inventory data.	3.63	0.56	Very Effective
Audit logs can be easily reviewed when issues or discrepancies arise.	3.77	0.43	Very Effective
Audit logs help identify unauthorized or suspicious activities.	3.63	0.49	Very Effective
Overall Mean	3.68	0.39	Very Effective

Audit logs provide accessible records that can be tracked, monitored, and reviewed whenever issues or discrepancies related to inventory occur, consistent with Ali et al. [13], who found that secure audit logging enhances user trust and resistance to breaches, even from administrators.

Table 14. Effectiveness Level of Cloud Data Warehousing on Inventory Management in Terms of Backup and Disaster Recovery

Statement	M	SD	Interpretation
Inventory data in the cloud data warehouse is backed up regularly.	3.83	0.38	Very Effective
Backup processes are automated and require minimal manual intervention.	3.60	0.50	Very Effective
The cloud data warehouse can quickly restore inventory data in case of data loss or system failure.	3.83	0.38	Very Effective
Disaster recovery plans ensure minimal downtime for inventory operations.	3.73	0.45	Very Effective
Overall Mean	3.75	0.37	Very Effective

Respondents are confident in the system's ability to regularly back up inventory information and promptly restore data when disruptions occur, consistent with Prasetio et al. [14], who reported that cloud-based backup and recovery outperform traditional storage in recovery speed, scalability, and reliability.

Table 15. Overall Assessment of the Effectiveness of Cloud Data Warehousing on Inventory Management

Criterion	M	SD	Interpretation	Rank
Extract, Transform, and Load (ETL)	3.65	0.44	Very Effective	4
Data Querying	3.53	0.48	Very Effective	5.5
Data Visualization	3.53	0.44	Very Effective	5.5
Security and Encryption	3.53	0.43	Very Effective	7

Access Control	3.68	0.38	Very Effective	2.5
Audit Logging	3.68	0.39	Very Effective	2.5
Backup and Disaster Recovery	3.75	0.37	Very Effective	1
Overall Mean	3.64	0.34	Very Effective	–

Note. Data Querying and Data Visualization are reported at M = 3.53 in this overall assessment table (Table 15 of the source thesis), while the item-level discussion in Tables 9 and 10 reports an overall mean of 3.59 for both criteria (consistent with the average of their four items). This discrepancy exists in the original dataset/manuscript and should be reconciled against the raw survey data before this manuscript is finalized for submission.

Backup and Disaster Recovery obtained the highest overall rating (M = 3.75), followed by Access Control and Audit Logging (M = 3.68 each), Extract, Transform, and Load (M = 3.65), and Data Querying and Data Visualization (M = 3.53 each). Security and Encryption obtained the lowest, though still Very Effective, mean (M = 3.53). Overall, the findings suggest that cloud data warehousing provides merchandising businesses in District II of Bulacan with a reliable platform for improving inventory accuracy, operational efficiency, security, and data-driven decision-making, consistent with the criteria proposed by Yasser and Alserafi [5] and with Balogun et al. [15], who found that cloud-based data warehousing frameworks support real-time business intelligence and decision optimization.

3.4 Proposed Inventory Management Plan

Because all seven criteria were rated Very Effective rather than revealing deficiencies, the proposed Inventory Management Plan presented in Table 16 is designed to consolidate and sustain existing effective practices rather than to remediate weaknesses.

Table 16. Proposed Inventory Management Plan Integrating Cloud Data Warehousing for Merchandising Businesses

Component	Development Need	Action Plan	Timeline	Resources Needed
A. Data Collection (Data Integration)	Maintain complete, timely, and accurate collection of inventory data from all operational sources.	Collect inventory-related data from all operational sources; ensure accurate recording before processing; periodically review data completeness.	Continuous	Cloud Data Warehouse System; Source Documents; Inventory/Warehouse Personnel
B. Data Integration and Processing (ETL)	Maintain efficient ETL processes to ensure data quality, consistency, and reliability.	Extract inventory data from operational systems; transform through validation, cleansing, and standardization; load into the Cloud Data Warehouse; monitor ETL performance.	Continuous	Cloud Data Warehouse System; Database; Database Administrator; IT Personnel
C. Centralized Data Storage (Storage and Scalability)	Maintain organized and scalable centralized inventory storage.	Store processed inventory data in the Cloud Data Warehouse; monitor storage utilization and performance; ensure scalability to support business growth.	Continuous	Cloud Data Warehouse System; Database Administrator; IT Personnel
D. Inventory Data Security and	Maintain strong security measures	Implement role-based access control; apply authentication and	Continuous	Cloud Data Warehouse System;

Access Management (Security, Access Control, Audit Logging)	and controlled user access to inventory information.	data encryption; record and review audit logs; conduct periodic security reviews.		IT Security Personnel; Authorized Users
E. Inventory Monitoring and Control (Data Querying)	Maintain real-time monitoring of inventory movement and stock availability.	Monitor stock levels, inventory movement, reorder points, and stock adjustments; review inventory status regularly.	Daily/ Continuous	Cloud Data Warehouse System; Inventory/Warehouse Personnel
F. Inventory Reporting (Data Querying and Data Visualization)	Maintain timely and accurate inventory reporting to support business operations.	Generate inventory reports using querying and visualization tools; produce stock movement and performance reports; review reports regularly.	Weekly/ Monthly	Cloud Data Warehouse System; Management; Inventory Personnel
G. Inventory Analysis (Data Analytics)	Maximize the utilization of inventory analytics to support planning and operational improvement.	Analyze inventory turnover, demand trends, supplier performance, and replenishment requirements using historical and real-time data.	Monthly / Quarterly	Cloud Data Warehouse System; Management; Inventory Personnel
H. Business Continuity Management (Backup and Disaster Recovery)	Maintain reliable backup and disaster recovery procedures.	Perform automated inventory data backups; conduct periodic disaster recovery testing; review backup and recovery performance regularly.	Quarterly	Cloud Data Warehouse System; Database Administrator; IT Personnel
I. Inventory Decision-Making (Decision Support)	Maximize the use of Cloud Data Warehousing in strategic inventory decision-making.	Utilize inventory reports, dashboards, and analytical results in planning; review performance indicators; integrate findings into purchasing and replenishment decisions.	Monthly / Quarterly	Cloud Data Warehouse System; Management; Inventory Personnel

Rather than addressing deficiencies, the plan consolidates the seven Very Effective criteria into nine components spanning data collection, integration and processing, centralized storage, security and access management, monitoring, reporting, analysis, business continuity, and decision-making. Each component specifies development needs, an action plan, a timeline, and the resources required, providing merchandising businesses a practical, continuous guide for maintaining cloud-based inventory management capability.

IV. CONCLUSION

This study found that cloud data warehousing is Very Effective in supporting inventory management among selected merchandising businesses in District II of Bulacan, with an overall weighted mean of 3.64 (SD = 0.34) across seven criteria: ETL, Data Querying, Data Visualization, Security and Encryption, Access Control, Audit Logging, and Backup and Disaster Recovery. Respondents were predominantly retail businesses operating multiple branches and possessed sufficient tenure and system experience to provide informed assessments. The consistently high ratings across all criteria indicate that cloud data warehousing supports accurate data integration,

efficient information retrieval, secure and accountable data management, and reliable recovery, thereby facilitating more informed inventory decisions.

These findings provided the empirical basis for a proposed Inventory Management Plan integrating cloud data warehousing, intended to help merchandising businesses sustain and further strengthen their data collection, processing, security, monitoring, reporting, analytical, and business-continuity practices. Future research is encouraged to examine larger and more geographically diverse samples across industries to assess the longer-term effectiveness of cloud data warehousing relative to traditional inventory systems, and to reconcile the minor discrepancy noted in the Data Querying and Data Visualization means (Section 3.3) against the original raw dataset.

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