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# DESIGNING A BUSINESS INTELLIGENCE DASHBOARD FOR DEMAND-DRIVEN INVENTORY MANAGEMENT: A CASE STUDY OF MEDIKLUG PHARMACEUTICAL DISTRIBUTION COMPANY

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**Abstract**

In pharmaceutical distribution, balancing high product variety with fluctuating demand is a constant challenge. When inventory decisions don't reflect actual customer usage, companies face a frustrating cycle of stock-outs for popular items and dusty shelves for slow-movers—eventually hurting the bottom line. Mediklug, a healthcare tech firm, faced this exact issue; despite having detailed clinic-level consumption data from their EMR system, they saw a significant revenue dip in late 2025. This study explores how to bridge that gap using Demand-Driven Supply Chain (DDSC) principles. By leveraging Business Intelligence (BI), we aimed to turn Mediklug's "data wealth" into actual insights. The research focused on three areas: identifying where demand and inventory were mismatched, building a BI dashboard to guide better purchasing, and seeing if the team would actually find the tool useful. We took a mixed-methods approach, cleaning up messy EMR data to match inventory records and interviewing the people on the front lines. The results were clear: the mismatches were systemic, but the new dashboard made demand much easier to see and manage. Most importantly, the stakeholders found the solution practical and easy to use. Ultimately, this case shows that even in complex pharmaceutical environments, BI can make "demand-driven" management a reality rather than just a theory.

**Keywords:** ***Business Intelligence Dashboard, Demand-Driven Supply Chain, Pharmaceutical Distribution Company***

## INTRODUCTION

Indonesian government are really concern about digital transformation in Healthcare system in Indonesia. This situation was reflected in Covid-19 pandemic era in 2020, Indonesian Government launched PeduliLindungi, an application that developed by PT Telekomunikasi Indonesia, Tbk collaborate with Ministry of Communication and Information (Kominfo) as the initiative to reduce the spread of Covid-19. The app serves a contact tracing and health monitoring system that helps the authorities to detect and limit virus transmission. The system collect & analyze user's data location to trace their contact history and notify the users when they are entering red zones or high-risk area (Zaki et al., 2023). Peduli Lindungi app. used by over 100 million people, this platform evolved into SATUSEHAT in 2022, aiming to centralize national health data using the HL7 FHIR standard (Heryawan et al., 2025). Furthermore, Ministry of Health Regulation No. 24 of 2022 mandated that all healthcare facilities—from major hospitals to local Puskesmas—transition from paper-based records to Electronic Medical Records (EMR) by December 2023. In this landscape, Mediklug Indonesia has emerged as a key player. As a health-tech startup, Mediklug provides a SaaS-based EMR system tailored for primary care providers and private practices. Beyond record-keeping, their platform integrates inventory management, point-of-sale, and reporting. Mediklug also operates two additional business units: a clinic operator and a pharmaceutical distributor, positioning itself at the center of Indonesia's digital health ecosystem.

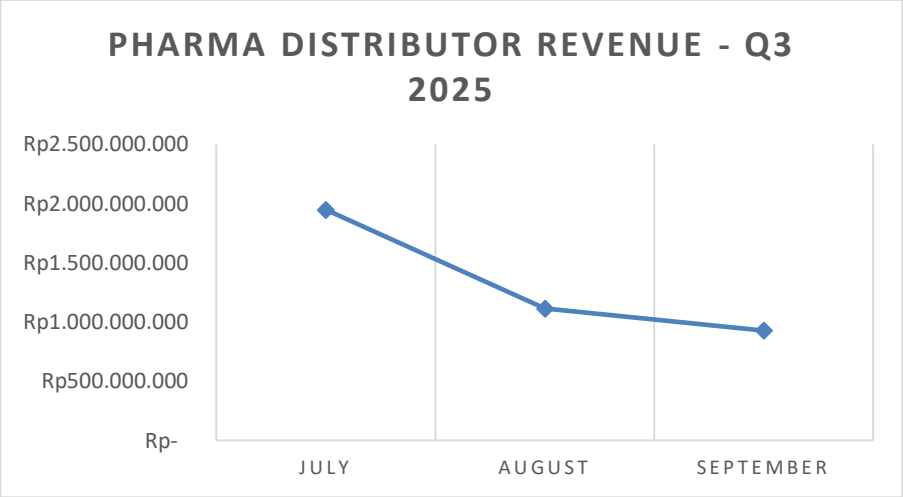


*Figure 1. Chart of Mediklug's Pharma Distributor Revenue in 3rd Queaster of 2025*

As we can see in figure 1, in period of July – September 2025, Mediklug Pharma Distributor faced critical operational challenge which is revenue declined trend. From July to September the revenue dropped more than 50%.

*Table 1. Number Of Customers and Average Basket Size in Rupiah*

| | July | August | September |
|---|---|---|---|
| **Recurring customer** | 44 | 48 | 47 |
| **New Customer** | 0 | 0 | 0 |
| **Average Basket Size (Rp)** | 16.103.810 | 9.705.997 | 7.244.492 |

As demonstrate in table 1., number of recurring customers was stable but average basket size were dropping from month to month. There was some issue in fulfilling customer demand. Mediklug Pharma Distributor cannot fulfil 100% of customer sales order causing lower revenue from previous months. Despite a stable recurring customer base, Mediklug Pharma Distributor's revenue has declined due to a shrinking "average basket size" and poor order fulfillment. The sales team is currently overstretched, struggling to acquire new clients because they are burdened with both selling and debt collection under a strict two-week payment policy. This operational strain is further aggravated by a supply chain mismatch: while Mediklug promises next-day delivery, their own suppliers have a 3–5 day lead time, making precise inventory levels vital. The core of the problem lies in fragmented technology and departmental silos. Although Mediklug's EMR system is used by 3,000 facilities, it is not integrated with the distribution unit's SCM system. This disconnect means that real-time clinic consumption data is never utilized for procurement. Consequently, the warehouse is often out of stock for high-demand items while simultaneously being clogged with dead stock—leaving the distributor unable to meet customer needs despite sitting on a wealth of unexploited data.

*Table 2. Days on Inventory (DOI) products of Mediklug Pharma Distributor July 2025*

| Days on Inventory (in range) | Total SKUs |
|---|---|
| 90 - 100 | 257 |
| 100 - 110 | 200 |
| 110 - 120 | 223 |

As we can see in Table 2. above, Mediklug Pharma Distributor has 257 products that has not been move in range of 90 – 100 days, 200 products in range of 100-110 days, 223 product in range of 110-120 days. While the customers orders couldn't be fulfilled 100%, Mediklug has a lot of dead stock products. These situations indicate that Mediklug Pharma Distirbutor has a big issue in procurement process, since they cannot meet customer expectations while there are a lot of dead stocks in the inventory. Procurement team could allocate the inventory to meet the customer demand since they rely on the sales team request and historical data to create replenishment decision.

The revenue decline trend problems are caused by several factors explained above and summarized in fishbone diagram in figure 2 below.

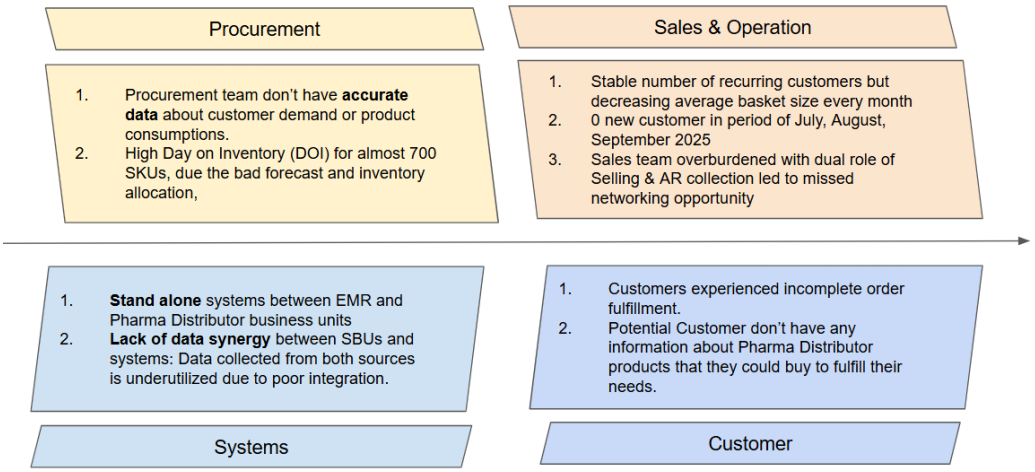


*Figure 2. Fishbone Diagram of Revenue Decline Problem*

As we can summarize from the fishbone diagram in figure 2 above, lack of integration between Mediklug EMR and Mediklug Pharma Distributor is the key problem that caused this situation. As the customer consumption data already recorded in EMR system, Mediklug Pharma Distributor procurement team could not access the data as their reference to procure the products. Data visualization or dashboard about customer consumption is needed to help operation and procurement team decide the products to buy from their suppliers. Figure 3 below show the high level overview of Mediklug Pharma Distributor & EMR business and system coverage.

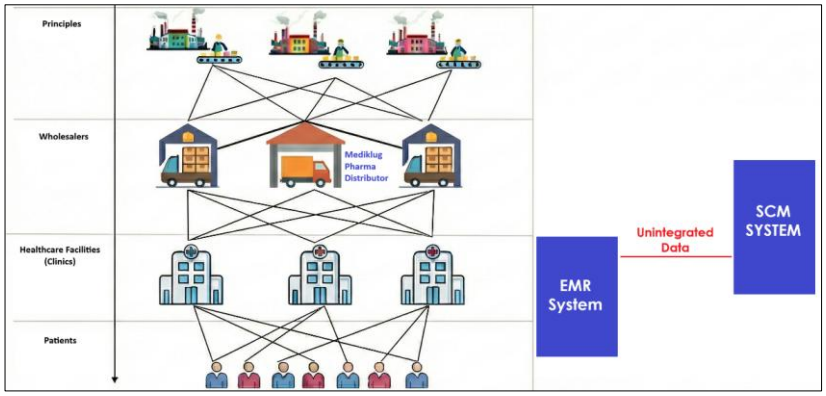


*Figure 3. Overall Mediklug Business Process and Systems Coverage*

Previous research by Kim (2005) founded that sharing information with hospitals (healthcare facilities), the wholesaler can gather more timely and exact data about inventory status and drug usage volumes of hospitals, so it can forecast the demand more accurately, which enables needed products to be supplied timely and cost-effectively.

## LITERATURE REVIEW

### 1. Demand-Driven Supply Chain (DDSC)

Demand-Driven Supply Chain (DDSC) shifts operations from a forecast-based "push" system to a "pull" system, where real-time consumption dictates supply decisions. Traditionally, organizations struggle with forecast errors as high as 53%, leading to excessive safety stocks, "firefighting" operations, and frequent stockouts (Mendes, 2011). DDSC solves this by replacing guesswork with visibility, ensuring that supply chain actions are triggered by actual demand rather than unreliable projections. According to Bvuchete et al. (2021), this is particularly vital in healthcare, where lack of visibility between clinics and warehouses often results in life-critical drug shortages. By adopting a Customer-Activated Pull System (CAPS), healthcare providers can ensure replenishment is based on what patients actually use. This requires several key capabilities: According to Mendes (2011) as well as Bvuchete et al. (2021), there are a number of important DDSC capabilities:

1. *Real Demand Visibility*, customer consumption data is the primary input to the planning.

2. *Pull-Based Replenishment.* The procurement and restocking is done when the actual consumption is realized and not projected.
3. *End-to-End Visibility.* Visibility of stock, orders and demand information across systems and partners.
4. *Information System Integration* /linking various platforms to create a single demand-supply image.
5. *Responsiveness and Agility.* Quickly reacting to changes in demand by changing inventory and replenishment decisions.
6. *Maturity Development.* An evaluation of organizational maturity, and the transition of

For Mediklug, DDSC theory provides a framework to align EMR consumption data representing real demand with SCM inventory levels. Currently, the company suffers from classic supply chain failures: misaligned stock, frequent stockouts, and systemic blindness. By adopting a consumption-based model, Mediklug can pivot from guesswork to using EMR data as the primary driver for inventory planning. This shift justifies the development of a BI dashboard designed to bridge the gap between demand and supply, enabling more responsive, data-driven decision-making.

## 2. Business Intelligence (BI) Theory

Business Intelligence (BI) provides the framework for transforming raw data into actionable insights for managerial and operational decisions. According to Turban et al. (2011), BI is more than just software; it is a comprehensive architecture and methodology that converts data into information, knowledge, and ultimately, effective action. Evolving from early Decision Support Systems (DSS), modern BI integrates several core components to drive this value chain:

- *Data Warehousing:* Consolidates data from disparate systems into a single, consistent source for historical tracking and analysis.
- *Business Analytics:* Employs reporting, OLAP, and predictive modeling to identify trends, deviations, and future outcomes.
- *Performance Management:* Utilizes KPIs, scorecards, and strategy maps to monitor organizational goals and prioritize activities.
- *Visualization & Dashboards:* Presents complex data through intuitive charts and indicators, reducing cognitive load and enabling faster situational awareness.

Wixom and Watson emphasize that Business Intelligence (BI) has evolved from a simple reporting tool into a core competitive asset. For an organization to truly be "BI-based," data must be embedded into its culture and daily routines, enabling real-time responsiveness. They categorize this evolution into three maturity levels: Departmentalized BI (siloed analytics), Enterprise Infrastructure (unified data warehousing), and Organizational Transformation (BI-driven strategy and excellence). In the context of this study, BI theory provides the blueprint for the proposed dashboard prototype. By applying ETL (Extract, Transform, Load) and data warehousing concepts, we can merge Mediklug's EMR consumption data with SCM inventory records. The resulting metrics—such as fill rates and supply gaps—represent the descriptive analytics and performance management layers of BI. Ultimately, the dashboard serves as the vital visualization layer, transforming fragmented data into the rapid, informed inventory decisions characteristic of a mature, BI-driven organization.

## 3. Conceptual Framework

The conceptual model of this research explains that the absence of integration between the Electronic Medical Record (EMR) of the customer and the Supply Chain Management (SCM) of Mediklug leads to stockouts, inventory discrepancies, and the unrealized sales opportunities.

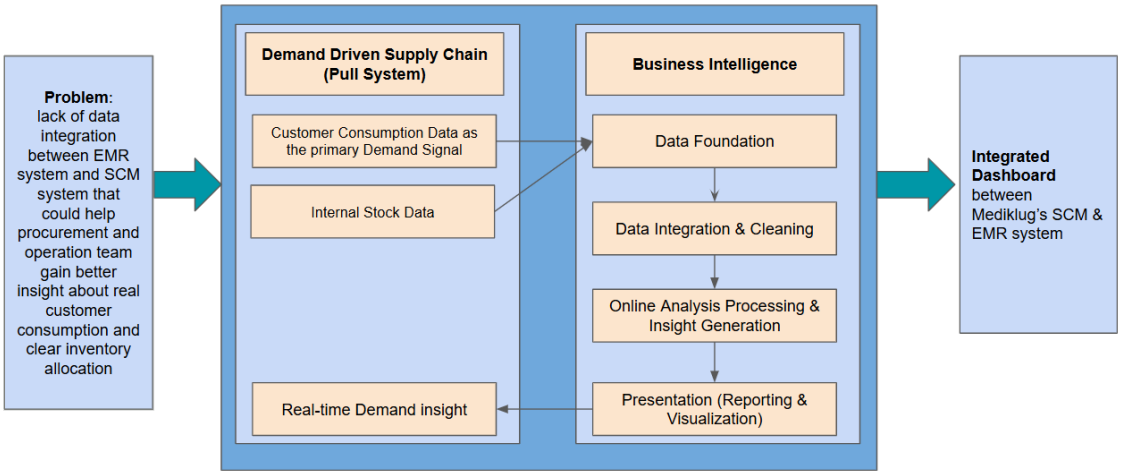


*Figure 4. Conceptual Framawork Diagram*

This issue exists due to the fact that the Pharma Distributor cannot actually get real-time consumption information of clinics and this is the actual demand signal of the pharmaceutical products. This means that the inventory planning will be based on an incomplete or late information. In response to this challenge, the framework combines the two theoretical pillars, which are, Demand-Driven Supply Chain (DDSC) and Business Intelligence (BI). The DDSC element is a position that places customer consumption information as the leading demand signal that is bolstered by internal stock information in the SCM system. A combination of these two data will enable the supply chain to create real time demand data that will be more representative of real clinic demand. This is based on the DDSC principle that the triggering of replenishment must be based on real consumption and not forecasts and assumptions.

These data inputs are then converted to actionable insights by the BI component. It consists of four layers:

1. Data Foundation, the one that creates structured and sound datasets;
2. Data Integration & Cleaning, consolidation of EMR and SCM data and making it consistent;
3. Online Analysis Processing and Insight Generation, which calculates such important metrics as demand supply gaps and stock-out rates;
4. Presentation & Visualization, presenting the findings in the form of dashboards.

The ultimate result of the framework is unified dashboard between SCM and customer EMR information of Mediklug. This dashboard offers a real-time visibility, enhances better inventory decisions, and aligns the supply chain operations with the real clinic consumption patterns.

## METHOD

### Research Design

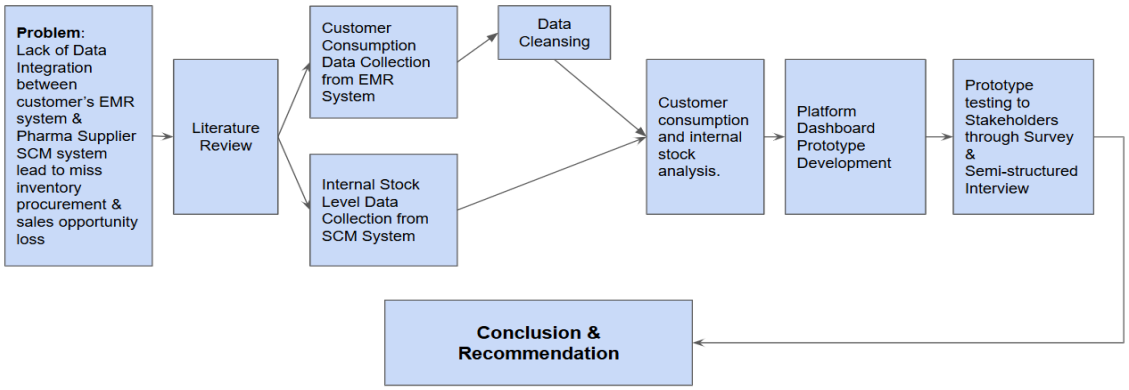


*Figure 5. Research Design*

Figure 5 above is the diagram showing the research design. This research utilizes a mixed-method case study design to tackle Mediklug's operational hurdles. Problem-driven at its core, the study focuses on developing and testing a Business Intelligence (BI) dashboard designed to support Demand-Driven Supply Chain (DDSC) decision-making. By blending quantitative operational data with qualitative stakeholder feedback, we ensure the final

solution is both technically sound and practically useful. The study plan has three phases. The former stage is based on the diagnosis of the demand-supply mismatch by means of quantitative analysis. The data of EMR consumption in the clinics of the customers acts as a proxy indicator of the real demand and SCM data is the actual availability of stocks. This methodology is compatible with the Demand-Driven Supply Chain (DDSC) theory that focuses on using real consumption data to drive replenishment and reduce stockouts (Mendes, 2011). The second step will be to create a BI dashboard prototype (quantitative findings). The dashboard will be built around the principles of BI and data visualization (Wixom and Watson, 2010) to assist decision-making with the help of systematic indicators and real-time information about the state of demand and supply. The last phase involves a qualitative assessment based on short surveys and semi-structured interviews with the working stakeholders. This phase explores the perceived utility, visualization and applicability of the dashboard.

**Data Collection Methods**

Secondary data was sourced from Mediklug's internal Electronic Medical Record (EMR) and Supply Chain Management (SCM) systems to address the study's quantitative research questions. The EMR consumption data, extracted from the Point of Sale module, captured product names, quantities, and transaction dates at the clinic level. The analysis focused on transactions from July to September 2025 across Mediklug's primary operational zones: South and East Jakarta, Bekasi City, and Bekasi Regency. Simultaneously, SCM inventory data—including product master records, real-time stock levels, and movement logs—was collected for the same period. Product master data played a critical role in harmonizing naming conventions between the EMR and inventory systems, ensuring data consistency and enabling accurate cross-system matching.

Primary data was gathered to explore stakeholder perceptions of the dashboard prototype, directly addressing the third research question. A structured Likert-scale survey was administered to the operational team, including purchasing staff and the operations manager, to assess the dashboard's perceived value. The survey evaluated key dimensions such as usefulness, data relevance, visualization clarity, decision-support capability, and overall user satisfaction. This quantitative input was augmented by semi-structured interviews with the purchasing officer and operations manager, conducted using a framework adapted from Myers (2020).These in-depth discussions aimed to uncover qualitative insights regarding the dashboard's purpose, actionability, feasibility, and alignment with specific decision-making needs.

The selected stakeholders were chosen deliberately due to their frontline roles in inventory planning and their influence over adoption decisions. Their direct involvement ensured that the feedback reflected real-world workflow integration and practical usability concerns. The combination of survey data and interview insights enabled a balanced understanding of both user satisfaction and potential barriers to implementation. This mixed-methods approach—integrating robust internal system data with user-centered validation—ensured that the findings were not only statistically sound but also grounded in the actual operational context. The alignment between technical accuracy and human-centered design was essential for building a BI dashboard that is not just informative, but truly actionable in a high-stakes pharmaceutical distribution environment.

**Data Analysis Methods**

*a. Data Cleansing*

The EMR and SCM data sets had to be cleansed and standardized on a large scale before quantitative analysis. Discrepancies between EMR free-text entries and formal distributor records such as varying abbreviations, spelling errors, word order changes, and dosage mismatches posed a significant challenge. To resolve this, similarity scores were calculated using the RapidFuzz Python library, comparing EMR entries against two reference points: the Master Data Stock-Card (July–September 2025) and the Mediklug Master Data Product list. The cleaning process followed four key steps:

1. *Standardization:* Converting all product names to uppercase and removing special characters or extra spaces.
2. *Scoring:* Using a token set ratio to measure the similarity between entries.
3. *Compilation:* Exporting matched datasets alongside their respective similarity scores.
4. *Validation:* Manually reviewing borderline or ambiguous cases to establish a reliable baseline score.

These standardized datasets formed the necessary foundation for aggregating demand and accurately identifying demand-supply gaps.

*b. Quantitative Analysis*

After the data collected from EMR and SCM system, and cleaned, the quantitative are conducted answers the Research Question number 1, devoted to the assessment of the demand patterns, availability of the stock, and the balance between demand and supply. The data were then combined and processed with the help of the descriptive

statistics means, minimum, maximum, and variability analysis after being cleaned. The key metrics analysis are aggregate of the customer consumption quantities for every product, number of customers consumed every product, aggregate of the quantities from all the products sold by each customer, number of product variance sold by each customer, inventory availability from every product, and percentage of product availability compared to customer consumption from the same period.

*c. Dashboard Prototype Development*

In order to provide the answer to Research Question 2, the BI dashboard prototype was created as a result of the indicators created by the quantitative analysis. The design of dashboards was based on the accepted BI visualization conventions of enhancing clarity, minimizing cognitive load and supporting decision making. The dashboard includes KPI displays, line and bar charts, heatmaps, and tables that point out the gaps in demand and supply, SKU risks, and customer-level trends. Microsoft Excel, Power BI, or Figma tools were applied to create mockups of the dashboard interface. The evaluation analysis will be conducted qualitatively.

*d. Survey Data Analysis*

Descriptive statistical analysis had been used to analyze quantitative survey data. The survey data were obtained through Likert-scale questions to assess the visualization and assess user perceptions of the usefulness of the dashboard, data relevance, clarity in the visualization, decision support capabilities, and overall satisfaction. Each survey items was summarized by computing the mean scores. The descriptive statistics of the user perception data analysis are suitable in exploratory evaluation exploring the system acceptance and perceived usefulness.

*e. Qualitative Analysis*

Qualitative data analysis was also performed through thematic analysis in addition to analyze the survey to complete the answers of Research Question number 3. Interview transcripts were reviewed and coded systematically to derive common themes connected to perceived usefulness, decision support value, clarity of visualization, actionability and implementation feasibility. This qualitative analysis will offer a qualitative depth of analysis that will supplement quantitative results of the survey by getting first-hand experience and expectations of the stakeholders.

## RESULTS AND DISCUSSION

### 1. Customer Consumption and Internal Inventory Level Analysis

In order to answer the Research Question number 1, author need to analyzed the customer consumption that recorded in EMR system specifically in the Point of Sale modules. After data are collected, author found that the product naming were not standardized, customers were named their product in free strings and led to difficulties to find the aggregate numbers and analyze the patterns. Author cleaned the to standardize the product names, then analyze the consumptions patterns then compared with internal inventory level on the same period. This was done to determine the extent of demand-supply mismatch, which is the central issue of Demand-Driven Supply Chain (DDSC) theory, which considers the significance of utilizing downstream demand indicators to spur upstream stock planning (Mendes, 2011).

#### *Data Cleansing Outcome*

Secondary data on customer consumption was extracted from the EMR's Point of Sale module, tracking products sold by 39 clinics across Mediklug's focus areas: South Jakarta, East Jakarta, Bekasi City, and Bekasi Regency.A significant challenge was the lack of standardization; clinic users entered product names as free-text, leading to multiple variations for a single SKU. For example, entries like "vit B comp" and "vit b complex" needed to be reconciled with the official SCM name, "VITAMIN B COMP PIM TAB 100S." To ensure accurate results, the fuzzy-matching process utilized two reference datasets: Mediklug's Stock Card master data (primary) and Product Master Data (secondary). If a customer's entry didn't find a match in the active stock card, the program searched the broader product master to minimize missed data. Given that medicine names vary by brand and composition, the program was configured to cross-check both attributes. Each match received a percentage score, and the process was repeated for July, August, and September 2025. After running the program, a manual screening established a baseline score of 76.7 for both brand and composition matches to ensure data integrity. Based on these cleaned datasets, Author calculate the aggregate of the products consumptions from every customers and also calculate the aggregate of product consumptions for each customers. Author also created ranks for top consumed products and top customers with high selling volumes. The analysis result will be explained in the next sections and the detailed tables are put in the Appendix.

***Stock Availability Analysis***

After the data cleaned and the aggregate of the products and customers selling volume were calculated, Author compared the data with internal inventory level from the same period. Mediklug Pharma Distributor never meet 100% of customers demand, the best performance was in August 2025 which stock availability reached 76.76% from customers demand but the next month in September recorded the worst performance in 54.73%, and July recorded 61.11% stock availability compared to customers demand. The data reveals that these low fulfillment rates were primarily driven by "unavailable products" (zero stock) rather than "insufficient stock" (low quantity). This distinction is critical: it suggests that the core issue is a lack of effective demand forecasting and product selection, rather than a simple failure in replenishment timing.

***Product Demand and Internal Stock Level***

Author analyze the aggregate for every product from all customer's consumption data in July, August, and September 2025. These charts represent the comparison between products consumptions and Mediklug stocks. Internal stocks represent with bar chart and customer consumption represent with line chart. These charts only shows the top 10 most selling product by customer. The complete data will be provided in the appendix.

Based on data, throughout for the periods of 3rd quarter 2025, there were several product that have huge gap between the demand and internal stock availability. For example in period of July 2025:

- Vitamin B Complex demanded only 129 but the stocks were way higher at 1,316.
- Antasida Doen demanded 89 but the stocks were 19,512
- Grantusif demanded only 31 but the stocks reached 3,612.

Mediklug has stocks on the products which are not aligned with the consumption trends of the customer, leading to working capital allocation and lost sales.

***Customer Selling Volume and Product Variance***

This analysis showed the potential customer to pursue for Mediklug in order to catch the revenue opportunity loss. The high selling volume customers with low product variance are the highest potential customers to pursue. Product variance brings out SKU breadth that is required by customers. Diluted variance but high demand would imply that a small number of products would be concentrated on whereas diluted variance but high demand would imply that there will be a wide but irregular consumption patterns. This restates the necessity to replenish data-drivenly.

***Key Issues Identified***

Based on the analysis above in period of July, August, and September 2025, Author found several key issues:

1. There were significant gap between customer consumption and stock availability in the internal inventory. High-demand products are frequently out of stock, while low-demand items sit in the warehouse, driving up Days on Inventory (DOI). This mismatch forces partial order fulfillment and shrinks the "basket size" of each sale.
2. The results show real time customer demand information didn't reach the operation team. Despite Mediklug's precise EMR records, procurement relies on outdated historical patterns rather than live consumption cues. This disconnect ensures that available insights never actually guide buying decisions.
3. Third, patterns keep showing gaps in what's stocked - especially when items come in different strengths, pack sizes, or labels. They reveal how often requested versions weren't on hand during orders, despite others sitting unused nearby. That mismatch doesn't just stall transactions, it drags down overall fill performance. Some variations pile up untouched while popular ones run empty, pointing to uneven stocking decisions that hint at deeper hiccups in how supplies move from warehouse to customer.

Mediklug Pharma Distributor was not provided with timely EMR consumption information which forms a Bullwhip Effect- lack of actual demand information results in false procurement decision (Lee et al., 1997). In the light of Demand-Driven Supply Chain, the inconsistency each month to another points out to the lack of consistent and correct demand sensing, which is a fundamental idea of Demand Driven Supply Chain (Mendes, 2011). Demand Driven Supply Chain underlines that downstream consumption cues should drive the upstream procurement and replenishment decisions.

## 2. Dashboard Prototype development

In order to fill the gap noted in Research Question, the present study created a BI-based dashboard prototype on the consumption information of EMR and stock information of Mediklug Pharma Distributor. The dashboard was

made based on the major principles of Business Intelligence (BI) (Turban et al., 2011; Wixom & Watson, 2010). The dashboard will be composed of four key elements that are in line with Demand Driven Supply chain and Business Intelligence principle integration.

**a. *Section 1: Date & Region Filter***

Date filter created to align with Demand-driven supply chain theory that require real-time customer demand data (Mendes, 2011). With this date filter feature, user could prick the relevance time to analyze the customer consumption and their inventory level. The default start date column will be 30 days before the day that user access the dashboard, and the end date column will be the day that user access the dashboard. The customer region filter created to help users filter the data from specific area of focus. By default, the customer region filter will select all the Mediklug Pharma Distributor coverage areas, South Jakarta, East Jakarta, Bekasi City, and Bekasi Regency. This filter section placed on the top of the dashboard and user's setting on these filters will affect the result of all data in the dashboard. According to demand-driven supply chain literature, the variability of demand may vary by location and group of customers and hence demand localization is necessary instead of aggregation (Mendes, 2011). In business intelligence (BI) point of view, the regional filtering increases the analytical relevance, resulting in the fact that users can concentrate on particular areas of operations and alleviate the information overload (Turban et al., 2011; Wixom & Watson, 2010).

***b. Section 2: Inventory Readiness for Customer Demand***

Figure 6 is inventory readiness to customer consumption chart design. This section uses a pie chart to categorize inventory into three critical states of Available Stocks which full alignment between supply and demand, Insufficient Stocks which partial availability, forcing the team to prioritize specific customers and Unavailable Products which zero stock for requested items.

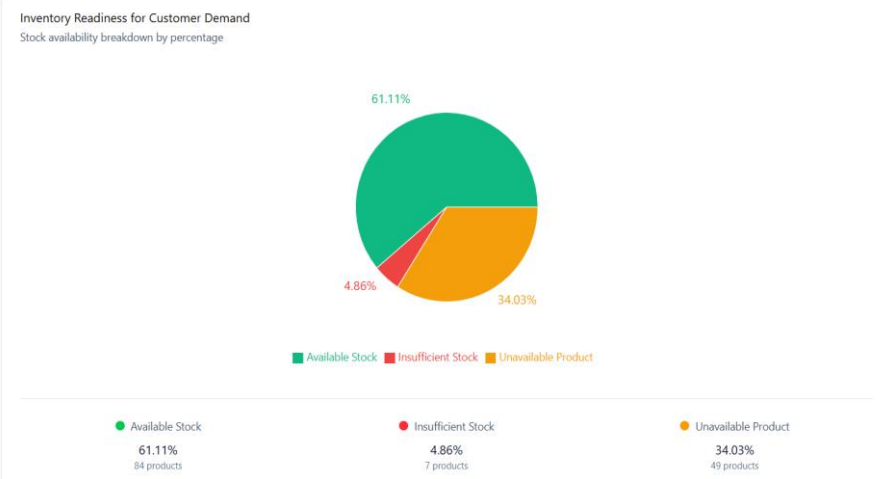


*Figure 6. Inventory Readiness to Customer Consumption Chart Design*

In the Demand-Driven Supply Chain (DDSC) approach, such a distribution reveals a structural disconnection between the real demand indicators and inventory location. According to DDSC theory, data on customer consumption must be the driving force behind replenishment decisions in a pull-based system and not through forecasts or historical purchasing patterns (Mendes, 2011). The fact that a large percentage of items in stock is not available implies that the demand indicators obtained in the EMR system are not currently being converted into timely purchase or replenishment processes. In supply chain literature, these ratios stock-out proportions and demand coverage are essential KPIs for measuring responsiveness and service levels (Chopra & Meindl, 2016). In healthcare, these gaps are especially critical as they directly impact service continuity and customer trust. By consolidating this data into a single visual, the dashboard follows Business Intelligence (BI) best practices by highlighting "management by exception" (Wixom & Watson, 2010). Instead of sifting through spreadsheets, managers can instantly identify which products require urgent supplier negotiations or immediate replenishment. Ultimately, this component bridges the EMR SCM gap, turning operational awareness into a true demand-driven advantage. Overall, the Inventory Readiness Analysis supports the importance of the combination of EMR-based consumption data with SCM inventory data. This component facilitates the principles of DDSC of demand-driven replenishment as well as

using BI resources to achieve operational awareness and decision support by exposing fulfilment gaps at an aggregate level.

### *c. Section 3: Demand vs Stock Dashboard*

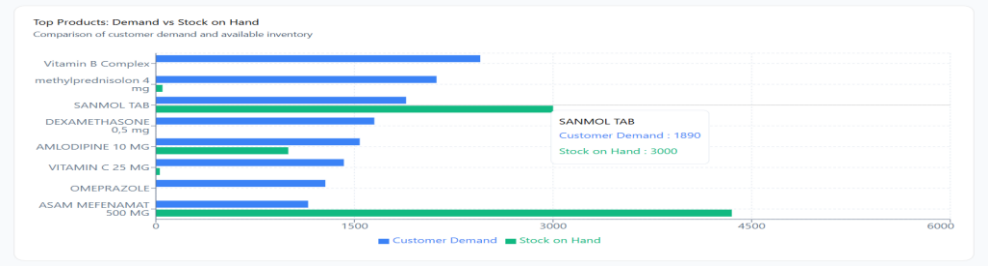


*Figure 7. Top Product Demand vs Stock on Hand Chart Design*

Figure 7 is the design of top product demanded compared to internal stock level design. This graph represents customers demand or consumption in the blue bar compared to internal stock level in the green bar on for top 10 most demanded products. This graph implemented demand driven supply chain theory that requires the customer consumption signals in to be available in real time data (Mendes, 2011). By juxtaposed the real consumption data and internal stock level, the dashboard helps users to quickly identify the demand and supply gaps, potential stock-out gaps, and possibility of overstock conditions. From Business Intelligence perspective, comparative visualization play a critical role in transforming transactional data into actionable insights for stakeholders. Clear visualization between demand and stock level help decision-makers rapidly assess inventory performance and support timely operational action such as replenishment, allocation, or sales prioritization (Turban et al., 2011; Wixom & Watson, 2010).

### *d. Section 4: Selling Volume Product Variance Analysis*

This perspective is vital for a Demand-Driven Supply Chain (DDSC) because demand isn't just about total volume but it's about variability and complexity. As highlighted by Mendes (2011), demand-driven systems must account for heterogeneous patterns where customers might share similar volumes but have completely different consumption structures. For instance, a clinic with high volume and high variance requires a much wider inventory and a more responsive replenishment model than one with a concentrated, simple product mix. On the other hand, high selling volume and low product variance clinics imply that there is a focused demand on few SKUs. This understanding can help the operation team to focus the inventory distribution needs on depth to those customers instead of breadth to help curb the unnecessary proliferation of stock and still achieve high level of service. This type of segmentation facilitates demand driven principles by matching the positioning of inventory with the actual consumption behavior instead of the forecast averages. The dual-axis chart, presented in the framework of the Business Intelligence (BI), is a decision-support tool that transforms raw transactions into strategic knowledge. Wixom and Watson (2010) hold that effective BI should allow users to uncover patterns and trade-offs across multiple dimensions in a single view. By viewing volume and variance together, managers can immediately identify high-priority accounts and spot inefficiencies in current stock distribution. Ultimately, this visualization demonstrates how merging BI functions with DDSC principles improves demand visibility and enables data-driven prioritization in pharma distribution.

### *e. Section 5: Detailed Tables*

In the last section of the dashboard, there are three related review are the integrated analysis on customer demand, inventory availability, demand-supply gaps, and fulfillment performance using DDSC-based dashboard prototype. The analysis is designed in three related views, Top Products by Customer Demand, Top Customers by Demand, and Unavailable Products, all of which are used to serve different decision-support purposes.

*Top Products by Customer Demand*

Top Products by Demand positions SKUs in terms of cumulative customer consumption within the EMR system. Under each product, there are information of the volume of demand, the current level of stock, the gap between demand and supply. And when user click on a product, it will shows the detail of the customers that consumed the product, their regional location, and their demand quantities. These features allow users to rapidly gauge the inventory preparedness with real market demand pull. In the Demand-Driven Supply Chain theory, the customer consumption information is viewed as a driving force of the primary demand signal, that must influence

decision-making on replenishment and allocation (Mendes, 2011). Products that have large negative gaps mean that there is a risk of stock-out, and missed sales opportunities whereas, those products that have positive gaps mean that there is overstock potential. This is in accordance with the DDSC principles that lay stress on pull-based planning as opposed to forecast-driven replenishment. Besides, the drill-down interaction will enable users to see which clinics and areas have the highest contribution to product demand, contributing to a more detailed prioritization. This feature enhances demand sensing and responsiveness in the operations which is one of the fundamental goals of DDSC implementation.

*Top Customers*

The Top Customers is the aggregates of the demand on a customer level and shows the total demand, product variance (SKU diversity), stock on hand, and product variance on hand. When user clicks one of the customers, it will show the detail of the products that the customers consumed and its quantity. This table ranks the customers by their consumptions or demand and shows the internal inventory readiness to accept their demand. High customers demand showing a high sales potential for Mediklug, but low fulfillment rate is an indication of structural supply constraint which can influence quality of service and long-term relations. On the other hand, customers who have high fulfilment rates demonstrate a consensus between the availability of supply and the fulfilled demand. This according to DDSC theory helps distributors to stock in similar ratios to actual consumption pattern instead of stocking uniformly or intuitively across customers (Mendes, 2011). In the Business Intelligence perspective, this visualization processes raw transactional data into actionable insights useful in supporting tactical decisions including customer prioritization, stock reallocation and service-level improvement initiatives (Turban et al., 2011; Wixom & Watson, 2010).

*Products Not Available*

The Unavailable Products identifies products with great customer demand and zero or inadequate stock levels. Then user clicks one of the product list, it will show the list of customers that consumed the product and its quantity. This table shows the opportunity lost for Mediklug since there are opportunities to sell the product with high demand but the inventory is not ready for the product. The dashboard allows the procurement and sales departments to take up more important replenishment priorities by ranking the unavailable products according to total demand and requesting customers. This kind of visibility is critical in the DDSC literature as it helps optimize the frequency of stock-out as well as enhance the resilience of the entire supply chain through matching the decisions made on supply to the real demand signals (Mendes, 2011). In addition, this perception advocates multi-functional teamwork. The data can be utilized by the procurement teams in negotiating the aggregation of demand with supplier evidence and sales teams in managing their customer expectations or offering substitute products. This is an added strength of BI systems as enablers in the organization that facilitate functionally coordinated decision-making (Wixom & Watson, 2010). In summary, this last section of the dashboard consist of three of elements illustrate the extent to which integrated EMR consumption data and inventory data, as formatted with DDSC principles and presented by the use of BI-based dashboards can serve to increase the visibility of demand, alignment of inventory and operational decision-making. The results validate that real-time, consumption-based analytics is very important in solving demand-supply discrepancies in pharmaceutical distribution situations.

*Stakeholders Perception of The Dashboard Prototype*

The prototype testing was done to determine how well the dashboard fits the information requirements, decision making processes, and operational processes of the main stakeholders in the supply chain of Mediklug. The evaluation involved a quantitative survey and qualitative semi-structured interviews which is in line with the mixed-method evaluation techniques that are widely employed in the evaluation of information system prototypes. The evaluation involved two major user roles, which included a Purchasing Officer and an Operations Manager. Both are important decision-makers because they use correct demand and inventory visibility to assist in planning procurement, operational coordination and supplier negotiation. Their feedback will give a preliminary perspective of perceived utility and integration possibility of the suggested DDSC Inventory Dashboard.

## 3. Survey Results of Quantitative Survey

The structured survey was in a 5-point Likert scale that was used to measure nine dimensions, namely purpose clarity, data relevance, decision support, visualization clarity, actionability, feasibility, perceived integration, data trustworthiness, and overall satisfaction. Generally, the respondents rated the dashboard positively in the majority of dimensions, in particular, relevance, visualization clarity, and decision support. The highest point is 4.5 scored in

several aspects such as dashboard usefulness for comparing the customer demand and inventory level, the relevance between the dashboard with user's daily work, and the easiness of the dashboard to read and the structure of the dashboard layout. The minimum rating (2.0) was in the dimension of data timeliness and reliability, which means that the interface is effective but the data pipelines under it have to be improved prior to operational deployment. This is consistent with the general articles on BI adoption, in which the data quality becomes a key factor influencing the perceived usefulness (Watson, 2009).

## 4. Qualitative Interview Result

The semi-structured interviews were thematic-coded according to the BI theory and Demand-Driven Supply Chain (DDSC) principles and incorporated subtleties in the perceptions of the users.

*Table 3. Semi-Structured Interview Results*

| No | Category | Question | Respondent 1: Purchasing Officer | Respondent 2: Operation Manager |
|---|---|---|---|---|
| 1. | Perceived Purpose | When you look at this dashboard, what do you think it is helping you do? | Our stock is easy to check, and the clinic's needs are easy to see, so it helps determine what items we should buy. | In general, it helps. We can see customer demand and our stock. For me, it's not only for procurement but also for sales—to push the sales team to sell products with high demand. For procurement, it helps keep forecasting better. |
| 2. | Perceived Purpose | Is the objective of the dashboard clear to you? | Quite clear. The usefulness is very clear. It just needs data improvements so nothing is missed. | The objective is very clear |
| 3. | Relevance of Data (BI) | Are the data elements shown (EMR demand, inventory level, gap, fill rate) the ones you actually need? | All parts are needed—not just one specific part; everything will be used. | Overall, all the data is needed. But something should be added, like sales data showing what we successfully sold/fulfilled from that demand. |
| 4. | Relevance of Data (BI) | Is there any data you wish was included but isn't here? | Overall, it's already sufficient. | Sales data showing what we successfully fulfilled. |
| 5. | Decision Support (DSS) | *Does this dashboard help you decide what to do next (e.g. reorder, prioritize a clinic, talk to supplier)?* | Agree | From the sales side, we can push specific customers and specific products. For suppliers, we can have stronger bargaining power to ask for cheaper prices because we already know customer needs. |
| 6. | Decision Support (DSS) | *Which part of the dashboard most helps you make that decision?* | All parts help, but the table section helps the most. | Overall, all data complements each other; the most needed is the bottom table. |
| 7. | Visualization & Clarity | Which visual (chart/table/indicator) was the easiest to understand? Why? | Everything is easy to understand because it's not difficult to read. | Overall, every part is easy to understand. |
| 8. | Visualization & Clarity | Was there anything confusing or too | No confusing parts; it's simple. | The design is simple and not confusing. |

| | | | | |
|---|---|---|---|---|
| | | detailed? | | |
| 9. | Actionability | If this dashboard were live, what actions would you take from it? | Future forecasting will be easier because this tool supports purchasing decisions. | Adjust our stock with existing demand (purchase). From the sales side, we can see which customers to pursue and what products they need, to sell our stock. |
| 10. | Actionability | How often would you need to see this (daily/weekly)? | Biweekly—depends on how many customers we have and to manage cash flow. | Monthly—can be compared with sales area performance. |
| 11. | Feasibility & Integration | Do you see any obstacles to using this in your current workflow? | No obstacles; this dashboard helps more with future forecasting. | No obstacles yet, but procurement can use this dashboard to decide purchasing from suppliers. |
| 12. | Feasibility & Integration | Who else in the organization should have access to this dashboard? | the sales team. | Purchasing & sales. |
| 13. | Overall Evaluation | On a scale of 1–10, how useful is this tool for inventory management? | 8 | 8 |
| 14. | Overall Evaluation | What is the one improvement that would make this dashboard more useful? | The design is okay; the data needs to be more accurate, because the most essential thing is the data. | 1) More accurate data.<br>2) Gather more data (more customers) so we can reach higher volume and negotiate cheaper prices with suppliers. |

The two interviewees demonstrated a clear understanding of the dashboard's core purpose. They emphasized that the tool effectively enables rapid recognition of customer demand patterns and current inventory statuses, facilitating better alignment between procurement activities and actual market needs. One respondent noted that the dashboard helps prioritize purchasing decisions, while the other highlighted its dual utility in both procurement and sales planning, especially in identifying high-demand products. These insights confirm that the dashboard's intended function is well communicated and strategically relevant, aligning with (Turban et al., 2011), who stress that clarity of purpose is foundational to successful decision support systems.

From a Business Intelligence (BI) standpoint, both stakeholders confirmed that the dashboard's components are highly relevant and complementary to their day-to-day operations. They agreed that all key elements—demand trends, stock levels, and replenishment signals—are essential and function cohesively. The operations manager suggested incorporating sales performance metrics to support team-level performance analysis, pointing to opportunities for future enhancement. This aligns with Wixom and Watson (2010) BI maturity model, which advocates for progressive integration of data layers to advance analytical capability and organizational insight.

Regarding decision support, both interviewees affirmed that the dashboard enables data-driven decisions on inventory allocation. They cited concrete actions—such as reordering stock, negotiating with suppliers, and prioritizing customers or products—that could be informed by the dashboard's real-time insights. One participant noted that transparent demand visibility strengthens bargaining power with suppliers. This finding strongly supports Demand-Driven Supply Chain theory (Mendes, 2011), which posits that responsiveness and efficiency are maximized when actions are triggered by actual demand signals rather than forecasts.

The dashboard's design was praised for its simplicity, intuitiveness, and readability. Both respondents found the visual elements—charts, tables, and indicators—easy to interpret without confusion, and felt they could quickly extract the needed insights. This validates adherence to core data visualization principles, particularly those emphasizing clarity, minimal cognitive load, and actionability (Few, 2013). The design successfully translates complex data into meaningful, immediate insights—a critical factor in user adoption and sustained use.

In terms of actionability and workflow integration, respondents confirmed that the dashboard could be seamlessly embedded into existing operational routines. The operations manager anticipated using it monthly, while the purchasing officer planned biweekly access, contingent on workload, customer volume, and cash flow considerations. They noted no major barriers to integration and recommended extending access to the sales team, indicating strong potential for cross-functional adoption. This aligns with best practices in change management, where low-friction integration enhances system acceptance. Overall, both stakeholders rated the dashboard highly, scoring it 8 out of 10 in usefulness. Their feedback underscores the critical link between data quality and system value: while the dashboard is perceived as valuable, both expressed concerns about the completeness of data cleansing and the need for more extensive customer data. These insights reinforce Turban et al. (2011)'s principle that even the most well-designed BI system is only as effective as the accuracy and richness of its underlying data. Future development should prioritize robust data mapping and broader data collection to maximize impact.

## CONCLUSION AND RECOMMENDATION

### Conclusion

This research has examined the customer consumption data from EMR system and internal inventory level from SCM system in Mediklug to answer the company problem in the revenue decline issued. The results answer the Research Questions as follows:

1. **How does the comparison between clinic consumption data from the EMR system and the Pharma Distributor's inventory data reveal demand–supply gaps and stock performance?**

Combination between customer consumption data from EMR system and internal company inventory data from SCM system demonstrates the gaps between demand and supply in Mediklug Pharma Distributor. In the periods of July, August, and September 2025 internal inventory couldn't meet 100% customer demand. The highest inventory readiness was in August (76.76%) and the worst was in the following month (54.73%). Insufficient product always in the lowest rank of the product availability, and the unavailable product or product out of stock was always higher than insufficient product with 34.04% in July, 18.31% in August, and 40.54% in September compared to 4.86%, 4.93%, and 4.74% for insufficient product. In details, number of stock for several products that available was not aligned with customer demand. Several products are way far exceeded the customer consumptions and some of the products were far below the customer consumption.

Integrating data across both systems reveals precise customer consumption down to the SKU level, offering strategic benefits for both procurement and sales. For procurement, these insights refine purchasing decisions, optimize budget allocation, and strengthen bargaining power with suppliers. Simultaneously, the sales team can leverage consumption patterns to offer more relevant products tailored to specific customer needs. The results prove that the data integration between of EMR and SCM data serves as a powerful demand indicator, exposing the discrepancy between real customer needs and available stock. This supports the core of Demand-Driven Supply Chain (DDSC) theory: real-world demand signals must be the foundation of inventory planning. Ultimately, the lack of such integration is a primary driver of inventory inefficiency and missed sales opportunities.

2. **How can a Business Intelligence (BI) based dashboard be designed to visualize EMR and SCM data, supporting more responsive and data-driven inventory management?**

The design of the dashboard driven by Business Intelligence can be useful in the operation decision-making to manage the pharmaceutical inventory preparedness by converting multi-source data of complex nature into actionable information. This research involves the dashboard prototype in which the data of customer demand, stock levels, gap between demand and supply, and fulfilment measures will be incorporated into one decision-support interface. The dashboard starts with date and region filter which set the default value to today until last 30 days and the region set to all Mediklug Pharma Distributor coverage area. Then followed with Top Products chart that shows most consumed products in terms of quantity volume compared with internal stock level, the visualization is in bar charts. This chart shows the inventory readiness compared with customer demand volume. The next visualization is pie chart of Inventory Readiness for Customer Demand. This visualization is a general information shows the KPI performance of internal inventory compared to customer consumption. The last chart is Top customer in terms of sales volume and their product variance. This chart visualizes with combo chart which are bar chart for the customer consumption volume and line chart for the variance of the products. This chart represents the potential customer to pursue by the sales team in order to pursue high quantity of sales volume. The last part of the dashboard are there tables that consist of tables of rank of consumed products and its details, rank of customers with their selling volume and product variance, and rank of unavailable products in the inventory compared to customer consumption.

Major visual elements, including demand/stock compartments, inventory preparedness indicators, most demanded products, and product out of stock, allow users to easily see which SKUs are important and required, focus on decisions related to inventory replenishment, and plan inventory better. Analytical flexibility is also enriched by the presence of the dynamic filters, including the time period and customer region, and this enables the decision-making process to be in accordance with the demand-driven principles. These results show that BI dashboards can be used as reporting systems as well as operational decision-support systems, which is aligned with Business Intelligence theory, which focuses on integrating and visualizing data and generating insights to make managerial decisions.

**3. How do operational stakeholders perceive the usefulness and feasibility of the proposed BI dashboard in improving their inventory-related decision-making?**

The operational stakeholders see the proposed dashboard prototype as practical, applicable and useful in the support of the inventory management activities. Findings of the survey show that the average rating on the dimensions of perceived usefulness, clarity and visualization, and overall satisfaction are high. These results are further supported by semi-structured interview data where the respondents indicate that the dashboard allows them to know customer patterns of demand, identify inventory loops, and make quick procurement and allocation decisions. Another key feature mentioned by the stakeholders was the clarity of the dashboard, its easy design, and realistic conformability to current operation processes. The proposed changes were oriented on the accuracy of data and a wider scope of data coverage more than on the interface design, which means that the conceptual and the functional design were highly acceptable. In general, the analysis shows that the developed dashboard prototype can be considered as the user-satisfying decision-support tool, which proves the relevance of the Business Intelligence concepts to the situation in the realm of demand-driven pharmaceutical distribution.

**Recommendation**

Considering the results from the secondary data analysis and the result from the primary data analysis, the following are recommendations that can be proposed for the implementation:

1. Mediklug should implement the demand-driven inventory planning approach by systematically integrated the EMR system and SCM system, specifically customer sales module from the EMR system with the internal stock module in the SCM system. The analysis showed that inventory decision based on historical data only led to product mismatch between the real customer demand and internal inventory led to the decreasing of customer basket size and high Days on Inventory of the products.
2. Implement the proposed dashboard prototype to be developed into a real dashboard application that integrated the data from EMR system and SCM system in order to help the operational team get the real time demand insight. The survey and interview results showed that the dashboard could help the operational team to get better data in term of inventory allocation and identifying customer needs.
3. Enhance data quality for the dashboard. The current data cleansing method are doubted by the stakeholders. In the implementation and development of the dashboard, data quality is critical. In the development phase, Mediklug should implement better data cleansing method or could involve the operational team to clean the data manually
4. Expand the access of the dashboard. Based on the stakeholder survey and interview results, the dashboard should be accessible for other functions such as sales and commercial team. These initiatives could reduce the silos operational and also help the sales team to get better insight about the customers demand.
5. Enhance the integration of the system to help customer create a seamless order to Mediklug. After the development and implementation of the integrated dashboard, the next development could be customer-centric replenishment system. Future development should help customer to get better information and understanding about the product fulfilment from Mediklug.

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