

Data Flow Diagrams of Purchases Process and Internal Control: A Case Study

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Abstract

This study examined purchase process workflows through Data Flow Diagram (DFD) analysis, comparing current practices with standard purchase cycles as illustrated in accounting information systems literature. The research employed a qualitative methodology, conducting structured interviews with purchasing staff and systematically mapping data flows between key entities in accordance with established DFD principles. Findings revealed significant inefficiencies in the company's purchase process when compared to the standard stages of the purchase cycle. The analysis identified critical weaknesses including inadequate inventory management leading to stockouts, concentrated decision-making in supervisory roles, and insufficient automation resulting in error-prone manual processes. The created DFD model provides a foundation for future system development, including use case modeling and entity-relationship diagrams. This research contributes to practice by proposing targeted internal control measures focusing on segregation of duties, workflow automation, and enhanced inventory management systems to mitigate identified risks. Implementation of these recommendations will strengthen operational efficiency, reduce manual errors, and better position the organization to achieve its strategic objectives through improved purchasing processes.

Keywords: Purchase Process, Data Flow Diagram (DFD), Internal Control

Introduction

Every business, regardless of its size, should establish a well-defined business process to ensure efficiency and successful operations. According to Ito et al. (2020), effective corporate processes help prevent errors and streamline activities. Business processes consist of interconnected actions involving both internal and external components of an organization to achieve objectives and deliver desired outcomes. Since each organization tailors its processes to meet specific needs, a well-structured system for developing these processes can provide significant benefits (Azaro et al., 2021). Scholars have emphasized the role of business process management in enhancing organizational agility and responsiveness to market changes (Hammer, 2015).

Many companies are still hesitant to improve their business processes, as such changes depend on environmental factors and the organization's willingness to adapt (Sari & Asniar, 2015). Successful implementation of a well-designed business process requires strong support from all levels within the organization, including both leadership and operational staff. Without collective commitment, process improvements are unlikely to succeed. This aligns with findings that organizational culture significantly influences the success of business process reengineering efforts (Kotter, 2012).

Large corporations typically have well-established processes and procedures for their business activities, as they possess substantial financial resources to invest in information systems and the expertise to plan and manage operations effectively. In contrast, new and small enterprises may struggle to conduct business efficiently due to their limited scope and resources. However, implementing well-structured processes and procedures is essential, as it lays the foundation for operational efficiency and helps mitigate potential risks. Effective risk management through well-defined processes is critical, particularly for smaller enterprises (COSO, 2017).

Research shows that aligning business processes with technological advancements can drive growth, innovation, and efficiency (Sausa et al., 2011; Lumat 2023; Ved, 2023; Hamedani et al, 2024). However, many companies still delay process improvements due to environmental factors and lack of motivation (Sari & Asniar, 2015). To remain competitive, firms must recognize the value of well-structured processes and be willing to invest in information systems, which can significantly enhance operational efficiency (McKinsey & Company, 2024). Purchases are considered crucial among all the actions that take place in the organization since they not only demonstrate the relationship between the organisation and its suppliers but also the acquisition of supplies for company operations. According to Baily et al. (2000), purchasing is a vital strategic activity that ensures the timely and cost-effective acquisition of necessary commodities or services in the appropriate quantities and quality levels. Purchasing is an administrative job that oversees the flow of commodities from sourcing and supply chain management to warehousing and ultimate delivery at manufacturing sites, which at each level of this process, judgments must be made about quality, quantity, scheduling, origin, and cost.

A Data Flow Diagram (DFD) is a visual tool that illustrates how data moves through a system or process, utilizing standardized symbols such as rectangles, circles, arrows, and text labels to represent data inputs, outputs, storage points, and pathways. DFDs can range from simple, hand-drawn sketches to detailed, multi-level diagrams that provide in-depth insights into data processing. For small businesses, implementing DFDs offers a straightforward and effective method to document and analyse their business processes, leading to improved efficiency and identification of potential areas for enhancement.

This study aimed to:

1. Examine the purchasing process within the selected company.
2. Compare the company's purchasing process with existing literature.
3. Identify weaknesses and recommend internal control measures to enhance the purchasing process.

In this study, the purchase transactions of the company are analysed and the data flow diagram is used to model the data flow. A few studies have used DFD in the software development process, including the studies below:

Author(s)	The study used DFD
Muliadi, M. et al (2020)	DFD is used in designing the hotel room reservation information system
Simatupang, A.R. et al (2020)	DFD is used to analyse the Sendayan Library Information Management System (SLIMS).
Lubis, D.F.O, et al (2021)	The online orders in the supermarket and delivered to the place are analysed using the DFD.
Permatasari, H.D, et al (2020)	Analysed the tendency of a student in taking optional subjects within the scope of the computer and information system education study program.
Septiana, T. (2021)	Designed a computerized information system in the form of an online application for railway public transportation.

Endo et al. (2017) conducted a study comparing a company's purchasing procedures with existing literature to identify gaps; however, it did not utilize a Data Flow Diagram (DFD) to illustrate the purchasing process. This study aims to bridge that gap by incorporating a DFD to visually represent the company's purchasing process. Additionally, it seeks to identify weaknesses by comparing the process with literature and proposing internal control measures to mitigate potential risks. Furthermore, this study will benchmark the company's processes against the standard purchase cycle of five stages (Purchase Requisition, Purchasing, Receiving/Inspection, Accounts Payables, and Cash Disbursements) as outlined by Hall (2011) in *Principles of Accounting Information Systems* (Figure 2).

The purchasing process is a strategic function that is critical to an organization's ability to operate efficiently, manage costs, and maintain strong relationships with stakeholders (Marta Holyk, 2025). Ineffective purchasing processes can result in delayed deliveries, overspending, compliance failures, and ultimately, lost business opportunities (Akanle and Zhang, 2008; Bock & Isik, 2015). This study is relevant for micro and small enterprises, the efficient purchasing processes are important to ensure smooth business operations and maintain competitiveness. A well-managed purchasing function enables organizations to negotiate favourable prices, secure reliable supply chains, and drive innovation by collaborating closely with suppliers, directly impacting profitability and operational performance.

This study is important for businesses as it provides insights into optimizing purchasing operations through well-documented and structured processes. Streamlining workflows and reducing errors not only leads to cost savings but also helps organizations identify risks, implement effective controls, and safeguard assets and reputation. By focusing on the purchasing process and leveraging visual tools like DFDs, this research delivers practical frameworks for enhancing efficiency, reducing risks, and fostering a culture of continuous improvement (Keitemoge and Narh, 2020). The findings are particularly beneficial for

business leaders, process managers, IT professionals, and SMEs seeking to maximize the value of their purchasing activities and achieve sustainable organizational success.

Literature Review

Data Flow Diagram (DFD)

The DFD is a graphical representation of the “flow” of data through the processes. According to Luo and Tung (1999), DFD contained four basic symbols to show entity, process, data flow and data store to trace and depict the movement of information. A data flow diagram (DFD) is a process modeling technique that is frequently used in the phases of structured requirements analysis. DFDs not only graphically and organically reflect the system structure, but they also help the gradual improvement of a system (Setiayani, & Tjandra (2022), Meng, F. et al. (2010)). Data flow diagrams are used to create process models during analysis (Dennis et al, 2006). Creating a process model is crucial for visually defining needs.

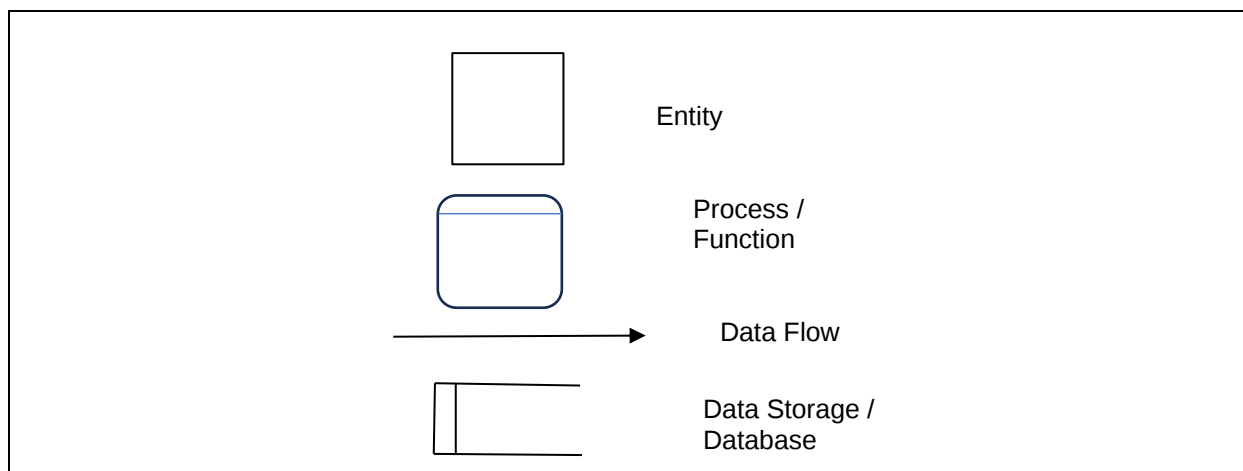


Figure 1 Symbols for DFD elements

Purchasing Process

Dias (2005) defines purchasing as coordinating suppliers to meet production needs and obtain resources at the best prices, aiming to improve company circumstances. According to Baily et al. (2005), the purchasing function aims to a) maintain a reliable flow of materials and services; b) ensure supply continuity by fostering strong relationships with suppliers and developing alternative sources to address emerging needs; c) purchase ethically, efficiently, and wisely to secure the best value for money; d) manage inventories to offer optimal service at the lowest cost to users; e) foster collaborative relationships with other departments by providing information and advice to enhance organizational effectiveness; and f) develop employees, procedures, policies, and organizational structures to achieve the set objectives (Endo, et al., 2017).

James (2011) in his book, stated that there are five subsystems in the purchase cycle. The subsystems included:

- 1) Purchase Requisition
- 2) Purchasing
- 3) Receiving / Inspection
- 4) Accounts Payable
- 5) Cash Disbursements

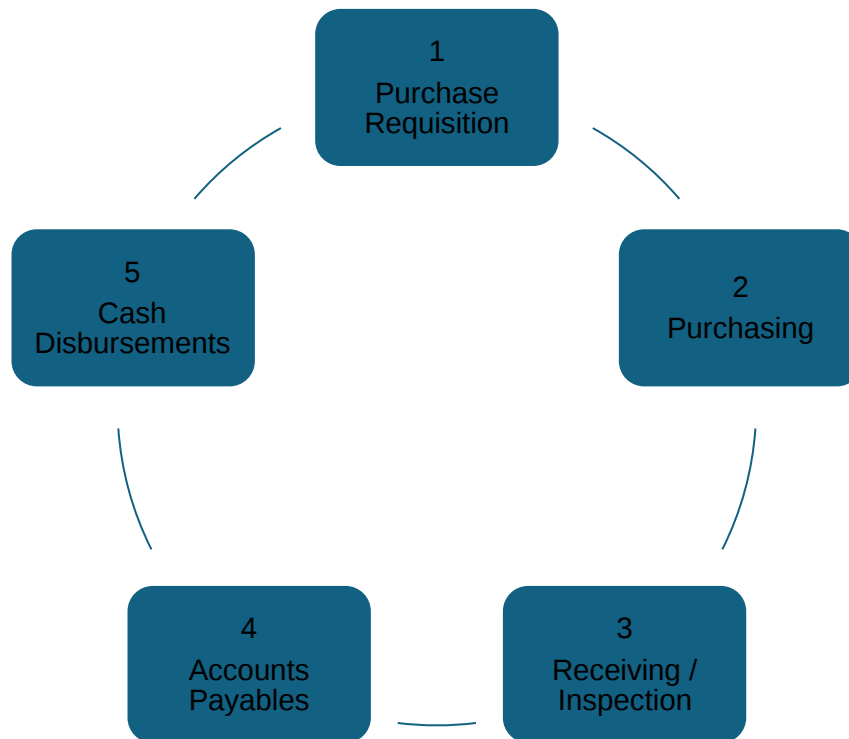


Figure 2 From James A. Hall (2011). Principles of Accounting Information Systems, Asia Edition, Cengage Learning.

Methodology

This study adopts a case study approach grounded in existing literature to build on established methodologies while addressing previous gaps and limitations. By comparing this method to earlier approaches, the research highlights the evolution of workflow reengineering and organizational coordination practices, thereby strengthening its validity and contribution to academic scholarship (Wang et al., 2024). This study applied an exploratory descriptive approach of a qualitative nature to the purchasing process. The unit of the study is a small workshop located in Puchong, Selangor. According to Gil (2017, p.117), "Once the unit case has been identified, it follows some protocols, including problem identification, case selection, methodology development, and data gathering".

A few methods used in this study to collect the data from the field include the observation of the current purchasing process, interview details, activities, and documenting the process through DFD. The observation of the purchasing process in the workshop aims to understand the whole process and compare it with the theoretical references. The interview was done with the person in charge of the purchasing process in the workshop. Once the data has been collected and analysed, a case description is created to organize the study (Yin, 2010).

The Case

ABC Workshop was established in 2000, initially as a cleaning service company. Until now, it has been one of the well-known businesses selling, fixing, producing, and customizing 4-wheel accessories. ABC Workshop aims to expand its business by opening a few branches and providing multiple services to its customers. This includes ventures into painting and car

services within the current business premises. To achieve it, ABC Workshop believes that it should focus on providing a good quality of services and goods to its customers.

For this study, the purchases in the ABC Workshop are chosen. The purchasing department in ABC Workshop is responsible for handling the purchases of materials, including the spare parts, maintenance service, and related items to perform the vehicle's repairs and maintenance. There are 2 employees in the ABC Workshop who handled the purchasing activities. The main customers of ABC Workshop consist of the 4-wheel owners.

The current purchasing processes in the ABC Workshop have identified a few weaknesses that indicate it is important to analyse the details of the purchasing process to improve the weaknesses, which are included below:

1. Inventory management remains a major challenge, often affected by inaccurate forecasting and frequent stockouts, which can negatively impact customer satisfaction and sales performance.
2. The purchasing process is lengthy, sometimes taking up to a month from order placement to final payment, leading to potential delays for both customers and suppliers and reducing operational agility and competitiveness.
3. The company relies heavily on suppliers for timely deliveries and consistent quality, making it vulnerable to risks if suppliers fail to meet standards or face operational disruptions.

Purchasing Process in ABC Workshop

At ABC Workshop, inventory levels are maintained at a minimum, with purchases typically initiated upon customer request. On average, purchase activities occur twice a month, primarily driven by customer orders for items that are either out of stock or not regularly held due to low demand. When a customer places an order for an unavailable item, the store initiates the purchasing process by first verifying inventory levels through the system. If the item is confirmed to be out of stock, the supervisor contacts the supplier to check availability. Upon confirmation, the supervisor updates the purchase journal and issues a purchase order accordingly.

Simultaneously, the customer is required to make a deposit payment. A deposit slip is issued as proof of the transaction, while cash payments are acknowledged with a formal cash bill. Depending on the urgency and delivery method, either via the supplier's transport or third-party services such as LaLa Move, the item is typically delivered to the store within one day to a maximum of one month.

Upon receipt of the goods, the supervisor receives a delivery order and invoice from the supplier. If any item is found to be defective, the supervisor initiates a return process by issuing a cancellation request, updating the inventory records, and generating a return order in the system. Once the item is ready, the customer is contacted to settle the remaining balance and schedule the installation. At this stage, a sales invoice is issued to the customer.

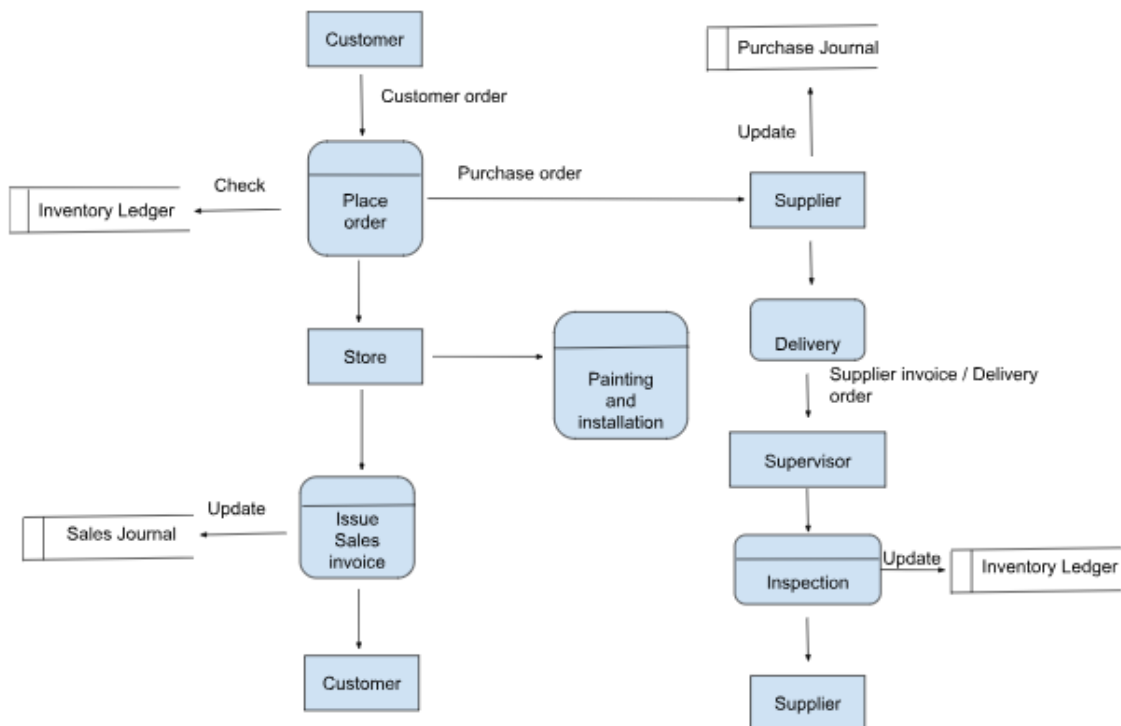


Figure 3 Purchase Dataflow Diagram for ABC Workshop, created by Author, 2024

Results

Based on the DFD described, several weaknesses have been identified in the purchase process at ABC Workshop. These include the risk of stockouts and customer service impact due to the minimal level of inventory, which can lead to delays in fulfilling orders (Sari & Asniar, 2015). Additionally, inefficiencies in the purchase process, such as the manual handling of tasks, slow down fulfillment and negatively affect overall workflow efficiency. The lack of automation and digital integration is a significant drawback, as manual record-keeping increases the risk of human error and data loss (Wang et al., 2024).

Moreover, the lack of authorization and control over activities poses a further challenge at ABC Workshop. The supervisor performs most of the critical tasks, resulting in a concentration of decision-making and operational control in a single role. This heavy workload can lead to unauthorized decision-making in the absence of sufficient checks and balances. Overloading the supervisor with multiple responsibilities limits their ability to focus on critical tasks, potentially causing slower decision-making and errors in the process (Sausa et al., 2011; McKinsey & Company, 2024).

As to compare the purchases processes in ABC Workshop with the standard flow in Figure 1, there is a lack of automation and demand forecasting tools results in inefficiency and delays in initiating purchase requisitions with the manual handling increases the risk of errors (Sari & Asniar, 2015; Wang et al., 2024). The first stage in Figure 2 is standardised, emphasizing formal documentation and approval to initiate purchase activities. On the other side, the purchasing step is heavily reliant on the supervisor, who performs most critical tasks without sufficient delegation or checks and balances. This concentration of control can lead to slower decision-making and unauthorized actions (Sausa et al., 2011; McKinsey & Company, 2024).

Inspection and receiving tasks may suffer from inefficiencies due to manual processes and lack of integration with inventory systems, increasing the risk of data loss or errors (Wang et al., 2024). Manual record-keeping in accounts payable increases risks of human error and delays in processing payments (Wang et al., 2024). ABC Workshop's process suffers from inefficiencies due to manual handling, limited automation, and concentrated decision-making. Addressing these gaps by adopting automated systems, distributing responsibilities, and integrating digital tools would align ABC Workshop's workflow closer to the ideal depicted in Figure 2.

Recommendation Problem Solving

ABC Workshop needs to take action to improve the weaknesses in its purchase process to avoid bigger issues in the future. ABC Workshop can address its weaknesses in the purchase process by implementing targeted strategies to improve inventory management, workflow efficiency, and operational control. To mitigate the risk of stockouts and enhance customer service, adopting demand forecasting tools and automating inventory tracking are essential steps. These measures ensure accurate stock levels and reduce human error (Sari & Asniar, 2015; Wang et al., 2024). Additionally, digitizing purchase processes with e-procurement systems can streamline operations, eliminate manual handling inefficiencies, and improve overall workflow efficiency (Wang et al., 2024).

Employee feedback highlighted two key issues in ABC Workshop's purchasing process: inadequate document management and lack of segregation of duties.

"Some of the documents, including invoices, are not safely kept, which leads to there is a case of the documents are missing and misplaced."

"The supervisors will have the responsibility to do all the tasks related to the purchases of goods".

Specifically, concerns were raised regarding the safekeeping of crucial documents like invoices, leading to instances of missing or misplaced records. Transitioning from manual processes to a computerized system would address this by ensuring systematic and secure storage of all relevant documents. Furthermore, the concentration of all purchasing-related tasks within the supervisor's role creates a control deficiency. Implementing proper segregation of duties and authorization protocols is essential to mitigate the risk of fraud and ensure that all transactions are appropriately reviewed and approved.

To tackle the concentration of decision-making and operational control in the supervisor's role, role-based access control (RBAC) can be implemented to distribute responsibilities and prevent overloading. Delegating non-critical tasks to specialized roles reduces bottlenecks and enhances decision-making speed while maintaining accountability (Sausa et al., 2011; McKinsey & Company, 2024). Furthermore, training employees on automation tools and leadership development programs for supervisors can enhance their ability to manage distributed responsibilities effectively (McKinsey & Company, 2024). These recommendations collectively address the identified weaknesses and position ABC Workshop for improved efficiency and resilience in its purchase process.

Conclusion

ABC Workshop has a basic purchase process in place. The manual process currently practiced contributes to a few weaknesses that may affect the business documents, process and efficiency. The current process is characterized by manual handling of tasks, minimal inventory levels, concentrated decision-making, and a lack of automation, creating bottlenecks that impact operational efficiency and customer satisfaction (Sari & Asniar, 2015). The comparison reveals that ABC Workshop lacks proper integration between stages and sufficient distribution of responsibilities, particularly with the supervisor's role being overloaded with critical tasks (Sausa et al., 2011).

To align with standard practices and improve operational efficiency, ABC Workshop should implement an integrated approach that addresses these weaknesses. This includes adopting automated inventory management systems with demand forecasting capabilities to prevent stockouts and streamline the purchase requisition stage. Additionally, implementing e-procurement systems would reduce manual handling errors and improve workflow efficiency across all five stages (Wang et al., 2024). Equally important is distributing responsibilities through role-based access controls to prevent decision-making bottlenecks and unauthorized actions. Implementing these recommendations would transform ABC Workshop's purchase process from its current inefficient state to one that mirrors the systematic flow depicted in Figure 2, ultimately enhancing operational efficiency, reducing errors, and improving customer satisfaction (McKinsey & Company, 2024).

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