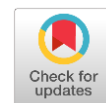




Original research

Enhancing procurement efficiency: A business process re-engineering case in frozen food retail

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ABSTRACT

Enhancing business process performance is critical for maintaining organizational competitiveness. Delays in processes often arise from the complexity of activities supporting business operations. Procurement is a key area within this context, as it plays a vital role in fulfilling operational requirements. This study focuses on analyzing the existing procurement process and evaluating the potential benefits of adopting an e-procurement system to boost efficiency. Using the Business Process Reengineering (BPR) approach, this research assesses current workflows and proposes optimized alternatives. The study outcomes include the design of a new procurement process aligned with BPR principles, aiming to minimize costs, shorten cycle times, enhance automation, and improve information accessibility and inventory management. Implementing these changes is anticipated to enhance procurement performance and operational efficiency.

1. Introduction

Improving performance, particularly process performance, is a crucial aspect of effective business operations. Business processes play a vital role in ensuring the continuity and sustainability of organizational activities [1], [2]. Identifying business processes is essential to determine the factors that have contributed to suboptimal performance. This identification is followed by performance measurement and analysis. The analysis aims to identify the characteristics of problems affecting the organization's business process performance and to evaluate the performance of each organizational unit's business processes.

In the increasingly competitive global environment [3], [4], many organizations are dissatisfied with the slowness of their business processes [5], [6], [7]. Slow processes are often the result of a series of inefficient activities or procedures, which hinder smooth operations. When business processes are slow, this is an indicator of ineffectiveness in several supporting activities [1], [2]. In addition, not all organizations have a clear understanding of their own business processes, both in terms of advantages, disadvantages, and the

reasons behind the current process design. This lack of understanding causes an inability to assess whether the existing process is running effectively or not. A better understanding of the business processes being run is essential to ensure that the process optimally supports the organization's goals.

Reference [8] conducted a study on proposed improvements to the J20 Department's business process at PT Indorama Synthetics Tbk using the Business Process Re-engineering method. The primary obstacle identified was the inefficient flow of the information system. The research findings suggest changes to the process flow, job descriptions, and the elimination of certain units, along with a proposal to design an information system in the form of application software as a solution to the identified issues. These changes are expected to achieve a process time efficiency of 65.1% and a cycle time reduction of 99.2% compared to the previous total time.

In any company, especially in the retail industry, the procurement of goods is a critical business process that plays a key role in ensuring smooth operations. An efficient procurement process directly impacts service quality and customer satisfaction [9]. A company specializing in frozen food sales has implemented a

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Standard Operating Procedure (SOP) to guide its procurement process. However, despite being in place for a long time, the SOP has yet to undergo a comprehensive evaluation of its effectiveness. This raises the question of whether the processes outlined in the SOP remain relevant and capable of optimally supporting the company's operational needs.

The procurement of goods is still conducted manually and paper-based, relying heavily on human labor. This manual process often causes delays in fulfilling requirements, disrupts smooth operations, and increases the risk of errors, such as miscommunication, misplaced documents, and data entry mistakes [10]. These challenges highlight the urgent need for improvement and modernization in the procurement process to enhance the company's competitiveness in an increasingly tight market.

To address these issues, they plan to adopt an e-procurement system to streamline and improve the efficiency of the procurement process. However, before implementing this new system, in-depth identification and analysis of the current business processes are essential. Redesigning these processes through a Business Process Reengineering (BPR) approach is expected to provide a comprehensive solution [8], [11]-[15]. BPR is a method focused on the radical redesign and fundamental rethinking of business processes to achieve significant improvements in cost, speed, quality, and service [16], [17].

Through business process modeling and analysis using the BPR approach, they can gain a clearer understanding of the current procurement workflow and potential changes with the implementation of the e-procurement system [18]. The redesigned business model resulting from this reengineering effort is expected not only to improve efficiency but also to serve as a foundation for management decisions regarding the implementation of a more integrated system in the future [19]-[25].

2. Material and method

2.1. Business processes

A business process refers to a series of procedures or activities aimed at achieving business objectives by transforming inputs into outputs to fulfill customer needs. This transformation involves the integration of people, materials, machinery, and methods. Business processes can be categorized into three main types of activities. Strategic activities involve tasks such as planning, controlling, decision-making, and setting the overall direction for the business. Operational activities focus on value-adding processes that directly address and meet customer requirements. Supporting activities play a crucial role in facilitating both strategic and operational functions, encompassing areas like logistics, finance, and information systems. This structured approach ensures that organizations can effectively deliver products or services aligned with their goals and customer expectations.

2.2. Business Process Reengineering (BPR)

BPR is a tool for analyzing and re-engineering business processes to achieve optimal work improvement goals by utilizing technology. There are two ways to apply new technology in industry; 1. Reengineering existing processes, 2. Providing new solutions with existing technology [11], [16], [26]. At this stage, the 'To-be Model' process will be created by imagining how a process would work if the Company had no obstacles. Next, define the obstacles to the Company and look for appropriate methods to minimize their impact.

3. Results and discussions

The data that has been collected is processed using several types of data testing which are taken with several types of sensors, such as pH sensors, temperature sensors, and TDS sensors.

3.1. System interest

The company is a distribution and retail business located in the Karimun district, operating in the frozen food retail sector. Product distribution occurs daily based on consumer demand through both offline and online sales systems. Frozen food products are sourced from suppliers in Batam City. The company has several departments to meet customer needs, one of which is the procurement department. Within this department, various business processes are carried out, including:

1. Purchase Request. A purchase request is a document submitted to a company containing a request to purchase goods or services needed for the company's business operations.
2. Identify the products or services the company needs. At this stage, procurement staff is needed to analyze what products or services are needed by the company.
3. Search and selection of suppliers. When the purchase request has been approved, the next stage is to find and select a supplier based on several considerations. These considerations include the quality of goods or services, the price offered, and also the reputation and accountability of the supplier itself.
4. Price negotiation. One of the vital stages in the procurement process is to obtain the products or services the company needs at the best and competitive prices. To be able to get this, a price negotiation process is needed to reach an appropriate price agreement.
5. Creation of Purchase Orders (PO). A purchase order is a document addressed to the supplier and contains a list of products or services to be purchased.
6. Three-way Matching. After the goods checking process, the next stage is three-way matching. Three-way matching itself is a process to ensure compatibility between purchase orders, shipping

documents and invoices received before making payment.

7. Payment. When everything in the three-way matching process is appropriate, the next stage is to make payment for the goods or services received to the supplier.
8. Recording the entire history of the procurement process. Record keeping is one of the important

things in the procurement process. Because, recording and archiving all procurement documents from purchase requests, POs, shipping documents, to invoices, helps the audit process and company tax calculations.

Based on the results of interviews to validate the business processes in procurement, the following is the existing business process shown in Fig. 1.

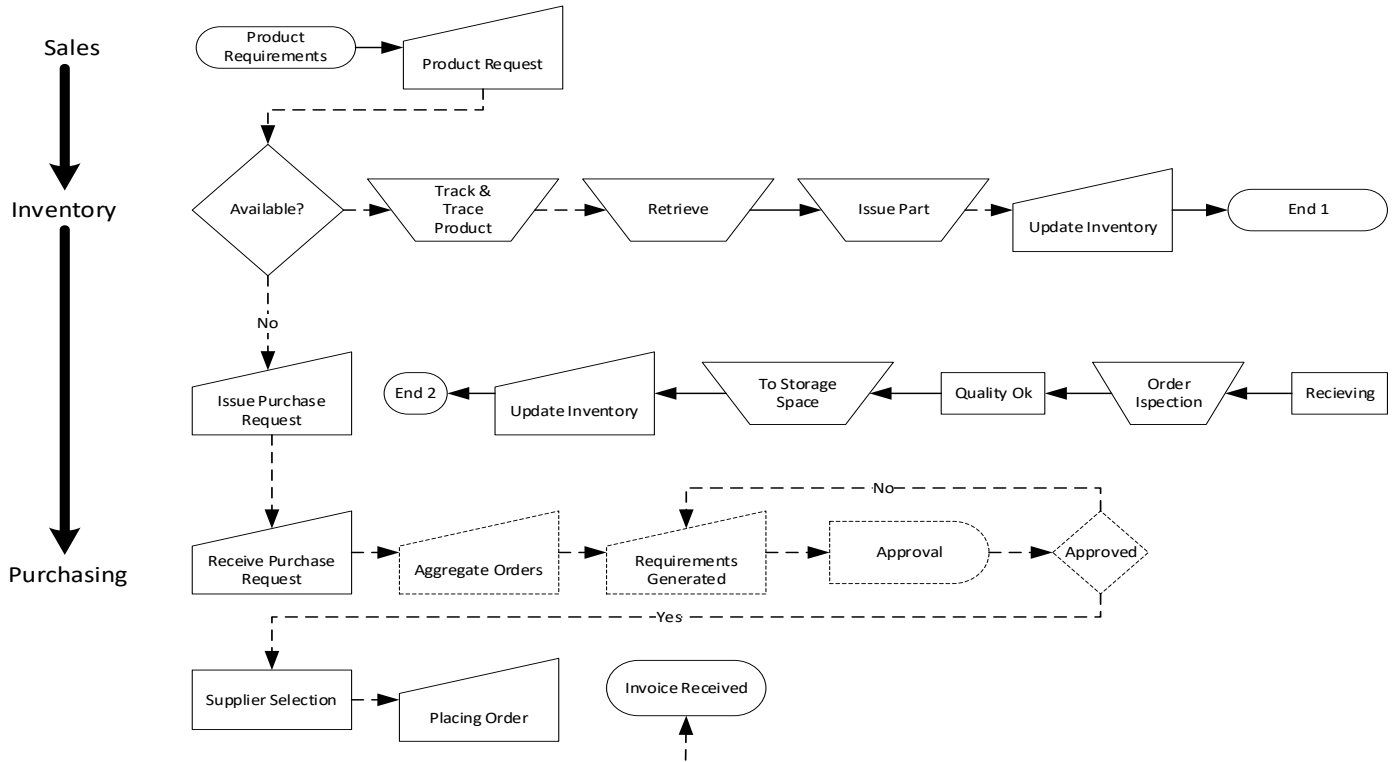


Figure 1. Existing business processes

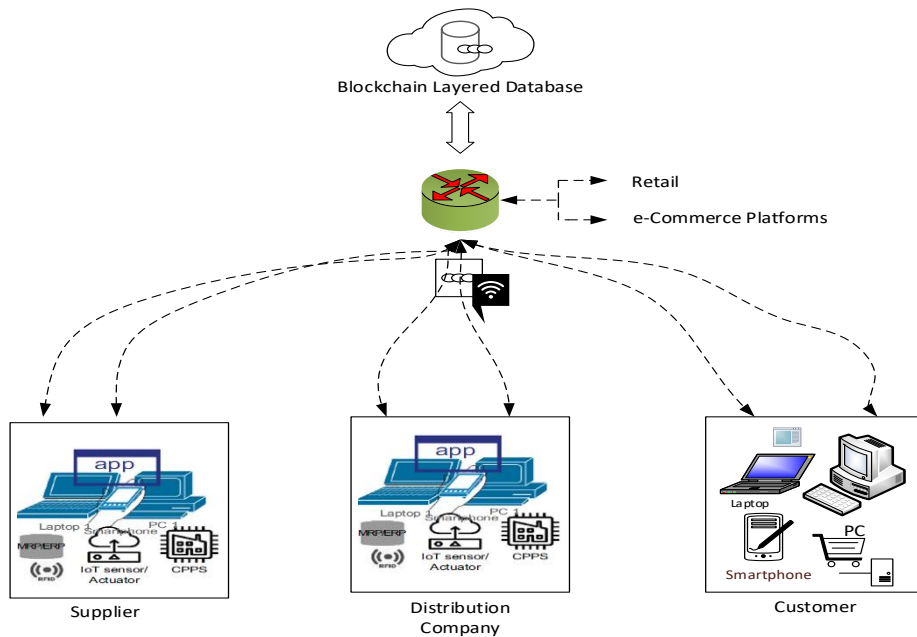


Figure 2. Integrated Business Process Redesign

3.2. Identification problem

The procurement business process, as illustrated in Fig. 1, is heavily reliant on information. Operators play a crucial role in disseminating information by collecting, processing, digitizing, and communicating it through digital systems. However, the transmission of information requires conscious effort from humans, and tracking or browsing activities in storage depends on human memory and experience, which often leads to delays. Strategic decisions, such as determining order quantities or selecting suppliers, are rarely based on factual data. Moreover, the uncertainty surrounding stock availability at first- and second-tier suppliers causes supply lead times to become highly irregular and unpredictable. Therefore, it is necessary to redesign the procurement business process with the following objectives: 1) Automation of data collection, processing, 2) Minimize uncertainty in the process, and 3) Minimize unnecessary delays due to tracking and tracking activities, order approval.

3.3. Business Process Redesign

The development of an integrated platform based on the Internet of Things (IoT) aims to improve collaboration, communication, transparency, and intelligence throughout the supply chain, particularly in the procurement process. The selection of IoT technology over other solutions is due to several key advantages that make it a more suitable choice. First, IoT allows real-time connectivity and visibility, enabling all elements of the supply chain to connect and communicate directly. This provides real-time access to information and reduces manual errors. Second, IoT supports the automation of procurement processes, such as automatic inventory updates and efficient raw material tracking, reducing dependence on human intervention and enhancing accuracy.

Furthermore, IoT improves data transparency and accuracy by enabling devices to transmit information directly, ensuring that the data received is reliable and transparent to all parties involved. Another advantage is the integration of IoT with artificial intelligence (AI), which facilitates predictive data analytics, enabling companies to forecast future needs and make faster, more accurate decisions. In terms of security, IoT aids in risk management by detecting issues early, such as delayed deliveries or supply disruptions, allowing companies to take preventive action more quickly.

In practice, IoT connects various devices, such as sensors, RFID, and GPS, across the supply chain. These devices continuously collect and transmit data to an integrated control center, where the information is analyzed to provide real-time updates on stock levels, shipping locations, and potential risks. This enables companies to optimize procurement and operations. With these benefits, IoT adoption is expected to improve efficiency, reduce costs, accelerate

procurement cycle times, and enhance competitiveness in the global market.

Fig. 2 shows a simplified representation of an information system that has been reengineered for redesigning supply chain (SC) processes. The following is an explanation of each layer in the Integrated Information Platform:

Layer 1:

- This layer consists of IoT nodes, such as RFID tags, transducers, and nanochips, integrated into physical entities like light bulbs, cars, and mobile devices, collectively referred to as "smart objects."
- These smart objects have the ability to understand, communicate, and control their own functions.
- At this level, data is independently generated, collected, processed, and transmitted using short-range communication technologies like Bluetooth or Wi-Fi.
- It establishes a connection between physical entities and the digital realm through an IoT local area network (IoT-LAN), enabling real-time information exchange and self-regulating control.

Layer 2:

- The communication infrastructure uses IoT gateways to transmit the data gathered at the perception layer, creating an IoT wide area network (IoT-WAN) for connectivity.
- This layer is responsible for distributing the valuable data to appropriate locations where it can be processed and utilized effectively.

Layer 3:

- This layer includes backend services that collect "big data" for processing and analysis.
- It utilizes advanced technologies such as artificial intelligence, big data analysis, and offers cloud-based services like Software as a Service (SaaS), Platform as a Service (PaaS), Data as a Service (DaaS), and Infrastructure as a Service (IaaS).
- The collected data undergoes algorithmic analysis to detect patterns and correlations, generating new insights and knowledge.
- It enables real-time decision-making and control through stochastic calculations and dynamic simulations.

Layer 4:

- The application layer serves as a bridge between the user and the Integrated Information Platform (IIP), enabling user interaction with the system.
- This layer provides users with access to cloud-based solutions and mobile applications, allowing them to monitor and perform various functions remotely via an intuitive, user-friendly interface.

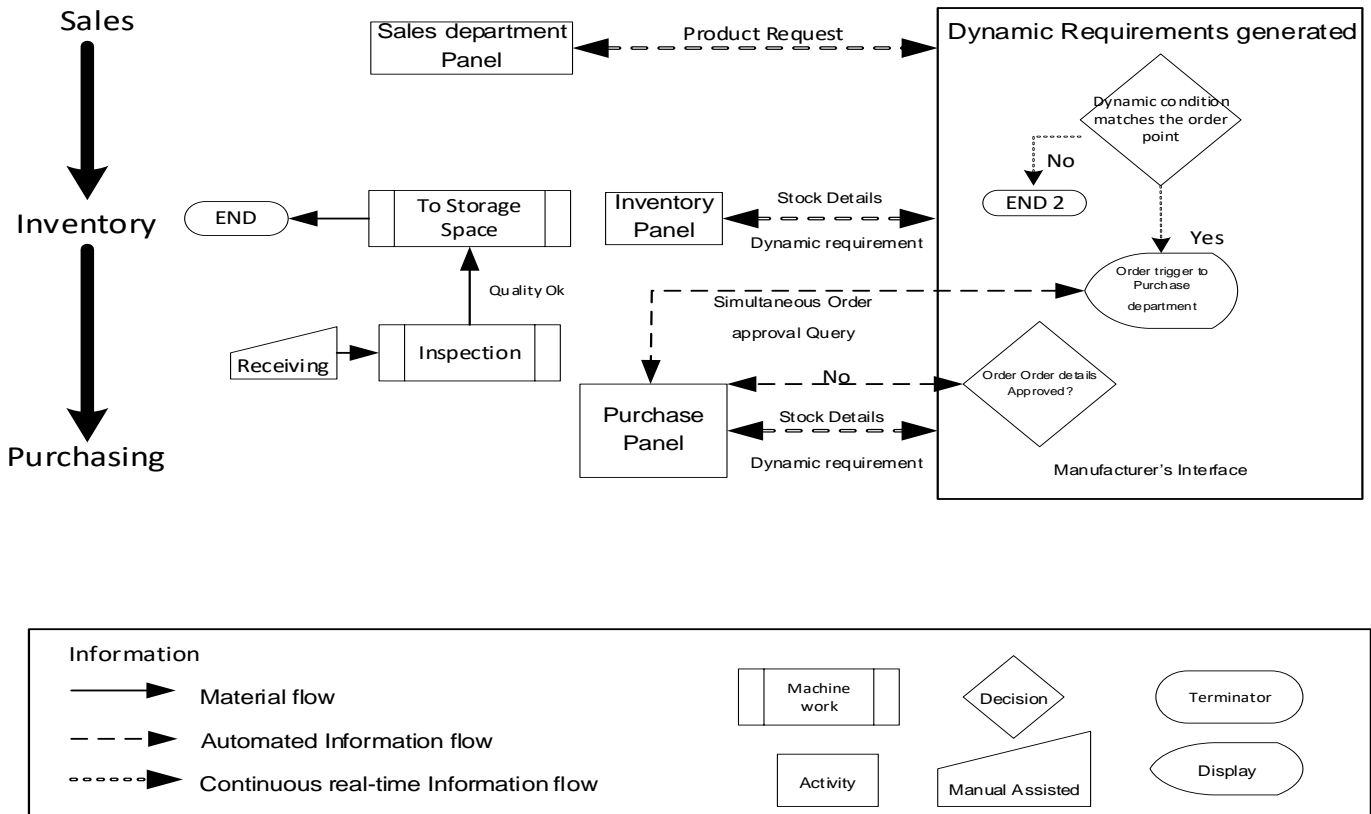


Figure 3. Procurement process flow after redesign

RFID (Radio Frequency Identification) tags serve as unique identifiers for objects. These tags function as special identifiers for physical objects, such as materials and machines. Not only do they store information related to the object, but they can also provide specific instructions or commands regarding the identified object. RFID sensors or transducers can be installed to monitor conditions, collect information, and trigger actions. Data is gathered by IoT sensor nodes, such as temperature or vibration sensors, which communicate through Machine-to-Machine (M2M) technology and provide commands via actuators. Decision-making is driven by algorithms and AI in the IIP to analyze information and determine appropriate actions. For enhanced security, transparency, and accountability, it is recommended to use Blockchain-based IoT systems for communication, data storage, contract enforcement, and payments. The redesigned procurement process flow in the case of purchasing raw materials is in Fig. 3.

The ordering process model has been digitized with e-procurement systems and is now fully automated, as shown in Fig. 3. The proposed IIP database integrates sales status and material availability (inventory department) into one platform. The IIP analysis system continuously generates material requirements in real-time and adjusts them dynamically to other variables. When a supplier's inventory falls below the dynamic requirements, the system triggers a sale to the supplier and prompts them to meet the requirement. If the dynamic requirements align with the purchasing department's reorder criteria, the system generates the order and automatically sends the approval request to

the manager, reducing approval delays and eliminating paperwork. The system also notifies suppliers of provisional order quantities for a quick response. Once approved, the order can be viewed by the supplier in their IIP interface, and the recipient begins processing it. With transparent information flow, procurement can recognize changing customer trends early, with demand visibility at the forecast point.

3.4. Discussions

The results of this study indicate that the implementation of Business Process Reengineering (BPR) in the procurement process can significantly improve operational efficiency and effectiveness. This study identified that the current procurement process still relies on manual and paper-based methods, which not only burden human resources but also slow down the workflow. By relying on manual processes, there is a high risk of errors such as lost documents, miscommunication, and delays in fulfilling needs. This can negatively impact on the company, particularly in terms of customer satisfaction and competitiveness in the market.

One of the main findings of this study is the need for automation and digitalization in the procurement process. By adopting an Internet of Things (IoT)-based platform, the company can achieve real-time visibility across the supply chain, allowing for more efficient monitoring of stock, shipping, and order processing. The IoT system enables automatic inventory updates and facilitates raw material tracking, reducing reliance on manual input and minimizing errors.

The analysis conducted shows that by implementing an e-procurement system integrated with IoT, companies can not only speed up the procurement process but also improve data accuracy and transparency. With each IoT device connected and able to communicate, the information received becomes more reliable and accurate, providing all stakeholders with equal access to the information they need. This is crucial for supporting better decision-making, especially in situations that require a quick response to changes in market demand.

In addition, the results of this study highlight the importance of data analytics in improving procurement process performance. By utilizing analytics and artificial intelligence (AI) technology, companies can predict future needs and manage inventory proactively. This capability allows the company to anticipate fluctuations in demand and optimize raw material procurement, reducing the risk of shortages or excess stock.

Overall, the redesign of the procurement process proposed in this study not only addresses existing problems but also offers a more sophisticated solution to improve operational efficiency and effectiveness. With an integrated information system, the company is expected to operate more smoothly and be more responsive to challenges in an increasingly competitive market. The implementation of this innovation is expected to not only improve procurement performance but also strengthen the company's competitiveness in the frozen food retail industry.

4. Conclusions

Digitizing procurement will change the way operations are conducted and make customization easier. The process has been redesigned to automate procurement, sales, storage, and information transmission, while eliminating uncertainty and delays. A unified information platform is proposed to enhance information visibility and coordination. Several system innovations, such as Blockchain-layered IoT systems and integrated RFID sensors, work together to build new process flows. This business model design will reduce the need for operational workers and create more interdisciplinary jobs. These changes benefit companies by reducing costs, cycle times, human labor usage, and improving the search for goods and availability of information.

For further research, it is recommended to conduct a comparative analysis of BPR standardization and IoT-based e-procurement systems across various industrial sectors. This approach will provide deeper insights into how the characteristics and challenges of each sector can affect the success of BPR and new technology implementation.

Declaration statement

Rizki Prakasa Hasibuan: **Conceptualization, Methodology, Supervision, Project Administration,**

Funding Acquisition, Data curation, Validation, Writing - Original Draft. Larisang: **Resources, Validation, Formal Analysis, Editing.**

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The author declares that this manuscript has no conflict of interest and has been processed in accordance with the provisions and policies set by the journal, in order to prevent any violation of publication ethics in any form.

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Data availability statement

The authors confirm that the data supporting the results of this study can be found in the article or accompanying supplementary materials.

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