THE APPLICATION OF THE INFORMATION TECHNOLOGY IN THE PROCURING AGENCIES OF BHUTAN

LEKI JUNGNEY

An Independent Study Submitted to the Graduate School of Naresuan University
in Partial Fulfillment of the Requirements
for the Master of Science in Logistics and Digital Supply Chain - (Plan B)
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for Master of Science in Logistics and Digital Supply Chain - (Plan B)
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ABSTRACT

This study investigates the integration of information technology devices, such as radio frequency identification (RFID), in the inventory management processes of budgetary bodies to enhance efficiency and reduce costs and time. By employing sensors, RFID, GPS, cameras, and wearables the sensor-integrated spectacles, the research aims to improve the performance of procuring agencies economically, environmentally, and socially. The methodology employed in this research involves a value stream mapping method-based survey questionnaire conducted in two phases, focusing on process time and Triple Bottom Line (TBL) perspectives. Analysis of the data gathered leads to the formulation of a process improvement plan, with a particular focus on visualizing and analyzing the impact on the TBL. The findings indicate a need for improvement in the current inventory management process. The inventory processes are identified as value-added activity (VA), non-value-added activity (NVA), and necessary non-value-added activity (NNVA). Using this tool, waste in the value stream can be determined, and new processes can be proposed to reduce waste. As a result, total working time is reduced by 27 %, and the VA is increased by 8.36%. There is a notable difference of 4 minutes and 54 seconds in process time between the current manual process and the IT-based process, along with a disparity of 11 staff members required in the process. Utilization of technology results in significant improvements, with competencies increasing by 50 %, profitability by 80.90 %, and waste reduction by 99.95 %, as evidenced by the study's effect on TBL.

Recommendations include the facilitation and coordination of information technology infrastructure development to enhance the existing structure. Digitalization within procuring agencies is proposed to improve efficiency and accuracy in various inventory management tasks, including receiving, record-keeping, and stock management. Additionally, the study highlights the importance of ensuring the sustainability and effectiveness of the new system, despite potential barriers to investment in infrastructure. In conclusion, the research underscores the transformative potential of digitalization in procurement agencies, offering opportunities for increased efficiency, transparency, and sustainability.

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CHAPTER I

INTRODUCTION

Background and Significance of the study

Information technology involves computing technologies with the help of hardware and integrating or sharing data with other devices connected to the internet. In 1985, Fred Davis suggested that technology is an acceptable model to examine the mediating role and network for the ease of using systems externally as success indicators (Legris et al., 2003). It refers to the use of software, networks, computers, and other technologies like radio frequency identification, the internet of things, sensors, automatic storage and retrieval systems, and many others for the store and warehouse process, transmission, and retrieval of products. Information technology includes settings related to the field of computer systems, software, programming languages, data, and information sharing. It also determines buyer-vendor coordination for replenishment decisions in real retail stores for refilling and helps save time and money (Chiralaksanakul & Sukhotu, 2016). Information technology-based inventory management is crucial in reducing working time, saving costs, and minimizing resource waste due to the lapses of excess inventory and surplus (Rubel, 2021). Some researchers also use technologies in inventory management for the control and monitoring of real-time. It has replaced the manual inventory process system with a computerized inventory system by using radio frequency identification and made the process very fast, accurate, and effective in an organization (Adoga & Valverde, 2014; Erlangga et al., 2022). The procuring agency is an office that deals with suppliers and contractors and manages administration, procurement, and other infrastructure development based on the funds provided by the government. The procurement agency takes charge and responds to procurement management of goods at large, works, and services in the agencies. In Bhutan, the procuring agency handles the operation of procurement under the procurement sector and it's driven by procurement rules and regulations. The agency functions the operation based on the thresholds prescribed in procurement rules and regulations differently to ministries, districts, and local levels, and the inventory process was similar. The contractual and procurement power is vested in respective agencies within one fiscal year based on the budget ceiling. The inventory management process in the procuring agencies starts from the receipt of the goods till it is handed over to the end-users, the process is wholly manual and needs digitalization. Further, technology integrations are found to be a must by the royal command during the 114th National Day, 2021. His Majesty emphasized the need for technology like artificial intelligence, metaverse, virtual reality, quantum computing, machine learning, deep learning, robotics, science genomics, biotech, and nanotech. He also emphasized his concern about whether the Bhutanese can use or be aware of them in the transformative world. The inventory management process in a broader concept involves the received process, record process, stock process, and issues process handled by the purchasing authority. Figure 1 is an overview of the inventory flow process portrayed as follows;

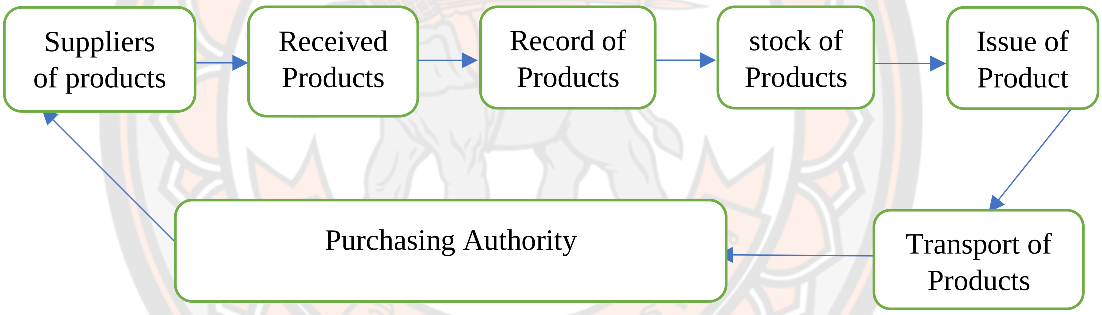

Figure 1 The flow of the inventory management process in procuring agency

Figure 1 describes the store inventory management process in the agencies. After the goods are transported and delivered to the purchaser’s premises, officials receive them by counting pallets, maintaining notes, and checking the loads. Gradually, the recording process involves stocking in the register by counting quantities and verifying the prices by referencing the order list. The next steps include stocking in the store by staging and stacking based on the product type, followed by issuing products and goods to end users based on their needs and requisitions promptly. If any discrepancies such as deviations from specifications, misplacements, or pilferage are found, the goods are listed and transported back to the supplier for resupply.

Currently, the inventory management process is entirely manual and paper-based in terms of receiving, recording, stocking, and issuing goods until they reach the end user in the agency. Therefore, an IT-based procurement inventory management process is vital and found to be effective, as it helps enhance efficiency from a cost perspective and reduces time. The Royal Audit Authority has also reported on the importance of implementing reverse logistics as soon as possible to minimize waste and contribute to the financial well-being of the country (Namgay & Pelden, 2022). Hence, there is a need for a new digitalized model to improve processes, minimize risks, and reduce environmental impacts. The triple bottom line (TBL) can serve as an accounting methodology in organizations, enabling the identification, measurement, and allocation of environmental and social costs related to organizational activities. It provides managers with strategies and techniques for managing performance across these three dimensions (Onyali, 2014).

This research focuses on studying the current inventory processes and illustrating the flow of operations via the value stream mapping (VSM) model. With this model, bottlenecks in the process can be identified, and information technology, such as radio frequency identification, can be adopted in the new working process system. The implementation of this new system should reduce bottlenecks and working time while improving efficiency in the inventory process. However, since most workers in the inventory process are blue-collar workers with limited computer skills, the impact of process improvement is analyzed based on the triple bottom line (TBL) framework, considering economic, social, and environmental perspectives. Recommendations will be provided, including the need for training. Using the TBL framework, the new inventory working system is expected to be more sustainable in the long run.

Research Objectives

1. Study the current inventory management process in the procuring agency of Bhutan.
2. Propose ways to apply information technology in procuring agencies of Bhutan.
3. Analyze the effect of information technology on the procuring agencies of Bhutan.

Scope of the Study

This research was focused on the current inventory management process of the Paro district administration. The sample size for the current inventory research is official, representing the target group or a similar process nature. Data was collected in January 2024, using a questionnaire. The data was about A-group items classified by ABC analysis in detail during normal, peak, and off-peak times of the process. It was analyzed using the VSM model, and a questionnaire model was used to study the effect on the TBL in terms of human resource competencies, waste reduction, and profitability of IT to the organization after IT-based inventory management is enforced. The expected outcome was to increase efficiency in process management in terms of time, cost saving, and waste reduction.

CHAPTER II

LITERATURE REVIEW

Section I: Information Technology

The technology involves machines, the Internet, and ICT equipment that have been providing direct communications, either in telegraph or others. Voice transmission was developed in the 1830s and the 1900s, information technology started as part of the Defense Advanced Research Projects Agency in 1962 and evolved into the Advanced Research Projects Agency Network in 1996 (Kramp et al., 2013). The benefits and changes of information technology were not identified in the 1980s and 1990s in terms of productivity or the improvement of services. Gradually, in recent years, researchers have found and proved that it is helpful in immediate measures, calculating consumer surplus, and contributing to the economic growth of firms or countries (Brynjolfsson & Yang, 1996). With many technologies in a row, the use of radio frequency identification devices is crucial. Kevin Ashton believed RFID was one of the technologies required for inventory tracking, scanning, and censoring people and objects. RFID is considered one of the best enabling technologies for machines to be used in the inventory management process. The different types of information technology include the following:

- Hardware: It includes the physical elements or components of computers and other related devices such as processors, memory, storage facilities, and networking equipment. For example, programmable computers and RFID equipment.
- Software: With the advancement of technology, programs, and other applications that run on computer hardware, including the operating system, productivity software, and specialized applications, are considered essential.
- Networking: Information technology helps to integrate technological protocols that enable the exchange of data between computers and other interlinked devices, both internally and externally.

- Database management systems: These are software tools that create, organize, manage, facilitate, and efficiently manage the flow and retrieval of products and processes in the system.
- Cybersecurity: It serves as measures for technologies designed and implemented to protect computer systems, such as RFID, other networking programs, and data access, from attack and damage in the long run.
- Virtualization: This type of information technology helps in creating virtualized versions of computing resources, such as servers and storage, to improve efficiency, flexibility, and scalability.
- Artificial intelligence and machine learning: This type of technology enables computers to perform tasks that typically require human intelligence, such as problem-solving and decision-making.
- The Internet of Things: This technology helps connect and enable communications between physical devices and systems, allowing them to collect data and exchange.
- Web development and enterprise resource planning: Information technologies are also tools and technologies for creating websites, and web-based applications, inclusive of all frameworks and content for management systems, and establishing integrated software solutions for managing core business processes including human, financial, and supply resources.
- Data analytics and business intelligence: These tools and processes analyze and interpret data to support decision-making within the organization.
- Cloud computing: The delivery of computing services, including storage, processing power, applications, and the internet, rather than relying on internal servers and hardware.

(Wu et al., 2013) presented that a smart warehouse system is based on technologies for information and to provide intelligent processing and leverage the traditional system through information technology. (Hamdy et al., 2018) also concluded that as it tagged all devices, computers could manage and inventory the product, and to some extent, tracking things can be done through technologies such as digital watermarking, barcodes, and QR codes. The technology includes mobile phones for building maintenance to the jet engine of an airplane and medical devices, such as a heart monitor implant, over the network. The methods used now for inventory management, either in budgetary bodies or any organization, were based on best practices in the past. However, the methods we use now don’t have digital technologies to improve efficiency in reducing cost and time. After this paper has been published and implemented, it helps managers in inventory management in terms of data accuracy, time efficiency, and work effectiveness. Inventory is to ensure the continuity of business functions, sustains, and helps in future demand forecasting against the problems experienced with changes in prices and suppliers (Sekeroglu & Altan, 2014). This research is about the applications of information technology in procuring agencies of Bhutan for the improvement of inventory management because much office equipment and items are kept idle and overstocked, which leads to financial stakes and negative effects on the economy. We see the reality of technology in private enterprises and industries; we can see the service operation is very fast and lucrative (Shafique et al., 2014).

The information technology in warehouses and stores can be made applicable for the swift flow of materials and products in receiving, issuing, stocking, and recording the products called inventory management. The classification of A, B, and C groups has been used for the inventory for the value and quantity differentiation. The challenges and issues in stock-out, obsolete items, scarcity, and order size increment the classification was used by ABC classification (Chu et al., 2008). The applications of technologies are multiple because it is adjustable to almost any technology capable of providing relevant information about its operation in terms of performance and environmental conditions. Nowadays, many companies from different sectors are adopting this technology to simplify, improve, automate, and control different processes (Rejeb et al., 2018). Since manual-based activities by humans are prone to errors, information technology is explicitly helpful for the accurate handling of the inventory process. The traditional ways of inventory processes are outdated and human error is unbelievable, so having technology-based warehouse management is very much a fundamental business requirement in the digital era. Technology devices like RFID also automate the entire inventory management process and accumulate information from different sources to other networks or to report to other agencies (Adoga & Valverde, 2014). They also use sensor shelves to transmit real-time inventory information and help to eliminate expensive, time-consuming, and mistakes by ensuring inventory levels and using original equipment. The technologies and devices used or applied would be as follows:

Radio Frequency Identification

Technology like radio frequency identification helps in the process of collaboration and exchange of information for materials components with the supply chain and is also feasible in the integration of the project management system if it works properly and effectively (Kasim et al., 2012). It enables tracking even the smallest things in the inventory management process with 5G wireless data transmission technologies for efficient and automated data collection along the process. RFID gives accurate information in terms of location, traffic, time of arrival, waiting, and normal time along the inventory components process. It can also predict or identify the exact time at which loads or packages will arrive first and then later. RFID tagging reads the most crucial package in the shipment to be opened first at the delivery point, and this technology saves time, improves the efficiency of productivity or inventory management process, and decreases the workload of inventory managers (Tao et al., 2017). The RFID technology can be effectively utilized in the inventory management system by integrating with programming languages like processing the data utilization and interactions. The basic components of the RFID process are as follows:

RFID tags: The tags should be attached to each inventory item and these tags contain unique identification information and are used for RFID readers to capture data from the RFID tags. The readers emit radio waves to communicate with the tags later.

Data processing while processing: This integrates processing and programming language focused on visual arts and data visualization and writes the code in processing to receive and process data from RFID readers,

Data processing: This integrates processing and programming languages focused on visual arts and data visualization. It writes the code in processing to receive and process data from RFID readers, allowing this processing to interact with serial data, making it suitable for receiving RFID information.

Data storage: The system stores RFID data in a database or file. This could include information such as item identification, description, quantity, and any other relevant details or information.

Inventory visualization: It creates a graphical user interface using processing to visualize the current inventory and display real-time information about items, their quantities, and any additional details.

Transaction logging: The system implements a logging system to record transactions such as item additions, removals, or updates. This helps in tracking the movement of inventory over time.

Alerts and notifications: The system uses processing to set up alerts or notifications based on inventory thresholds. For example, triggering an alert when the quantity of a particular item falls below a specified level.

Integration with other systems: It integrates the RFID processing system with other parts of the inventory management process such as order processing or supply chain management.

Security measures: The system automatically implements security measures to prevent unauthorized access to RFID data and the inventory management system.

Testing and optimization: Thorough testing ensures that the RFID processing integration works smoothly and optimizes the system for performance and reliability.

Scalability: The system is designed to be scalable so that it can handle a growing inventory and evolving business needs.

However, the specifics of implementation can vary based on the requirements of your inventory management system and the RFID technology you choose. The pictorial representation of the RFID processing machine is as portrayed below;

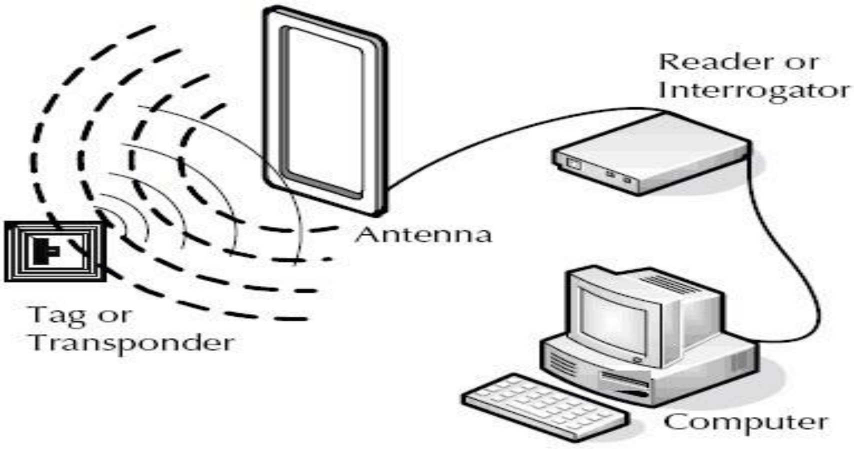

Figure 2 RFID Machine Process

To further find and effectiveness of the applicability, the RFID technology devices used in the inventory were also compared to other technology devices as illustrated below;

Table 1 The comparison of the RFID with other technology devices for integration

Sl no	Components	RFID	Barcoding System	IoT
1	Line of sight	No line	Direct lines	Connected lines
2	Durability	Durable	Not durable	Durable but excess MRO
3	Reading Rate	Multiple items	Individual items only	Individual items based on the use of devices
4	Cost	Expensive	Cost-effective	Cost-effective but expensive as well
5	Labor	Use all automation	Labor effective	Labor is effective but it various based on use of IoT equipment
6	Range	Short-range network 300 feet	Close Range	Short, medium, and long-range networks

The RFID devices are compared to other technology devices as follows;

Line of the sight

The requirement for line of sight differs significantly among RFID, barcoding, and Internet of Things (IoT) technologies:

- RFID: RFID technology does not require a direct line of sight between the RFID reader and the RFID tag for data transmission. RFID tags can be read even if they are not visible or obstructed by other objects.
- Barcoding: Barcoding technology requires a direct line of sight between the barcode label and the barcode scanner for successful scanning.
- Internet of Things (IoT): The line-of-sight requirement varies depending on the communication technology used in IoT devices.

In brief, RFID technology does not require line of sight, allowing for non-line-of-sight communication between RFID tags and readers. Barcoding technology requires a direct line of sight between the barcode label and the scanner, which can limit its application in certain scenarios. IoT technology's line-of-sight requirement varies depending on the communication technology used, with short-range technologies often requiring direct visibility and long-range technologies offering more flexibility in communication.

Durability

- Physical Wear and Tear: RFID tags are typically encased in durable materials like plastic or epoxy, making them resistant to physical damage. However, extreme conditions like high heat or moisture can affect their performance over time. Traditional barcodes can be easily scratched or damaged, affecting their readability. However, newer types like 2D barcodes are more resilient. These IoT devices vary widely in durability depending on their design and purpose. Industrial-grade IoT sensors are built to withstand harsh environments, while consumer-grade devices may be more prone to damage.

- Environmental Factors: RFID tags can withstand a range of environmental conditions, including exposure to water, dust, and temperature variations, depending on the type of tag. Barcodes: Traditional barcodes are sensitive to environmental factors like moisture and sunlight, which can degrade their quality. However, specialized materials and protective coatings can enhance their durability. The durability of IoT devices depends on their intended use case and the environmental conditions they are exposed to. Industrial IoT devices are designed to operate in rugged environments, while consumer IoT devices may have limitations.
- Longevity: Depending on the type, RFID tags can have a long lifespan, lasting several years or even decades in some cases. Traditional barcodes can degrade over time due to physical damage or environmental factors. However, newer barcoding technologies like 2D barcodes offer improved durability and longevity. The lifespan of IoT devices varies depending on factors such as usage, maintenance, and technological advancements. Industrial-grade IoT devices are designed for long-term use, while consumer-grade devices may have shorter lifespans due to rapid technological obsolescence.
- Maintenance Requirements: RFID tags require minimal maintenance once deployed. Barcodes require periodic maintenance to ensure readability, such as cleaning and inspection for damage. IoT devices Maintenance requirements vary depending on the type of device and its use case but may include software updates, battery replacement, and periodic calibration.

In summary, RFID tags generally offer high durability and longevity, followed by IoT devices, which can vary depending on their design and application. Barcodes, particularly traditional ones, are less durable but can still be effective with proper maintenance and the use of newer barcode technologies.

Reading rate

The reading rate, or the speed at which data can be collected or read from tags or devices, varies between RFID, barcoding, and Internet of Things (IoT) technologies:

- RFID: RFID technology offers high-speed data collection capabilities, allowing multiple RFID tags to be read simultaneously within milliseconds.
- Barcoding: Barcoding technology typically involves scanning individual barcode labels one at a time, resulting in slower data collection rates compared to RFID.
- Internet of Things (IoT): The reading rate of IoT systems varies depending on the communication technology used and the complexity of the data being collected.

In conclusion, RFID technology offers the fastest reading rates, allowing for rapid and simultaneous data collection from multiple tags. Barcoding technology is slower due to its sequential scanning process and reliance on manual intervention. IoT systems offer variable reading rates depending on factors such as communication technology and data processing capabilities.

Cost

The cost difference between RFID, barcoding, and Internet of Things (IoT) technologies can vary depending on several factors including the type of technology, the scale of deployment, and ongoing maintenance costs. Here's a general overview:

- RFID: Initial Cost: RFID tags and readers tend to have higher initial costs compared to barcodes due to the complexity of the technology. RFID tags can range from a few cents to several dollars per tag depending on their features and capabilities. RFID readers and infrastructure also contribute to the initial investment.
- Barcoding: Initial Cost: Barcoding systems typically have lower initial costs compared to RFID systems. Barcodes themselves are inexpensive to produce, and barcode readers are relatively affordable. However, specialized barcode types (such as 2D barcodes) and equipment for printing and scanning may incur additional costs.
- Internet of Things (IoT): Initial Cost: The cost of IoT devices can vary widely depending on factors such as complexity, functionality, and connectivity.

Industrial-grade IoT devices designed for rugged environments typically have higher initial costs compared to consumer-grade devices. Additionally, IoT infrastructure including sensors, gateways, and network connectivity contribute to the initial investment.

Generally, while RFID systems may have higher initial costs, they often offer lower ongoing costs and higher durability compared to barcoding systems. Barcoding systems have lower initial costs but may incur higher ongoing costs due to maintenance and replacement of labels. IoT systems can vary widely in cost depending on the complexity and scale of deployment, with ongoing costs related to maintenance, connectivity, and data management.

Labor

The labor requirements differ significantly between RFID, barcoding, and Internet of Things (IoT) technologies due to their distinct operational characteristics:

- RFID: RFID systems generally require less manual labor compared to barcoding systems because RFID tags can be read automatically without direct line-of-sight.
- Barcoding: Barcoding systems are more labor-intensive compared to RFID systems because each barcode must be scanned manually, requiring human intervention.
- Internet of Things (IoT): The labor requirements for IoT systems vary depending on the complexity of the deployment and the type of devices used.

RFID systems generally require less manual labor compared to barcoding systems due to their automation capabilities and reduced maintenance requirements. Barcoding systems are more labor-intensive because they rely on manual scanning of barcode labels. IoT systems fall somewhere in between, with labor requirements varying depending on deployment complexity and ongoing maintenance needs.

Range

When comparing the range capabilities of RFID, barcoding, and Internet of Things (IoT) technologies, there are significant differences in their operational ranges:

- RFID: RFID technology operates within a limited range, typically ranging from a few centimeters to several meters, depending on the frequency used and the type of RFID system (passive or active).
- Barcoding: Barcodes are limited to short-range scanning, typically requiring direct line-of-sight and proximity to the barcode scanner. The effective range of barcode scanning is usually limited to a few centimeters to a few meters.
- Internet of Things (IoT): IoT devices can operate over a wide range, from short-range to long-range, depending on the communication technology used (e.g., Wi-Fi, Bluetooth, cellular, LPWAN).

In conclusion, RFID technology offers a range that can vary from short to long distances, depending on the frequency and type of RFID system used. Barcoding is limited to short-range scanning within proximity to the scanner. IoT technology offers flexibility in range, from short-range to long-range communication, depending on the communication technology and infrastructure deployed.

Time

Time efficiency varies across RFID, barcoding, and Internet of Things (IoT) technologies in terms of setup, data collection speed, and overall operational efficiency:

- **RFID**: RFID systems may require more time for initial setup compared to traditional barcoding systems due to the installation of RFID readers, antennas, and infrastructure. However, advancements in plug-and-play RFID solutions have reduced setup times significantly.
- **Barcoding**: Barcoding systems typically have shorter setup times compared to RFID systems since they involve the printing and placement of barcode labels and the installation of barcode scanners. However, large-scale deployments may still require significant setup time.

- **Internet of Things (IoT)**: The setup time for IoT systems varies depending on factors such as the complexity of the deployment, the type of devices used, and the network infrastructure. Plug-and-play IoT devices and cloud-based platforms have reduced setup times for many applications.

In summary, RFID technology offers fast data collection speeds and high operational efficiency, although setup time may be longer compared to barcoding. Barcoding systems have shorter setup times but may result in slower data collection speeds and less operational efficiency compared to RFID. IoT systems offer real-time monitoring and data analytics capabilities, with setup times and operational efficiency varying depending on the complexity of the deployment and the type of devices used.

Maintenance management

Maintenance is also one of the areas where the application of information technology is most extensively used and needed is maintenance management. The combination of sensors and other multifunctional tools helps to apply disciplines and practices to extend the useful life of physical assets, guaranteeing asset reliability and availability in the warehouse and stores.

Real-time monitoring and tracking

RFID technology also provides real-time apps that offer a live status of the inventory process. This means we get the exact location and reason for delays in transit, which further aids in inventory emergency planning and making effective alternative arrangements for the process. With the network coverage of 5G data transmission installed, businesses are now exploring micro-tracking solutions to facilitate individual tracking of products and their supply chain processes.

Higher accuracy in forecasting lead times

Information technology devices like RFID provide accurate data that helps predict the proceeding demand for purchase within the lead times. This assists in assessing the time needed to assemble, process, gather, and issue, and also provides information on the causes and effects of delays in the inventory management process, and what can be removed or changed to improve the performance of the process in the model. It also identifies bottlenecks, which are essential to keep in mind during operations management because if the process is left unattended, the resulting process and process-related problems remain idle. The applications of RFID and other technology devices in the inventory process will be portrayed as follows:

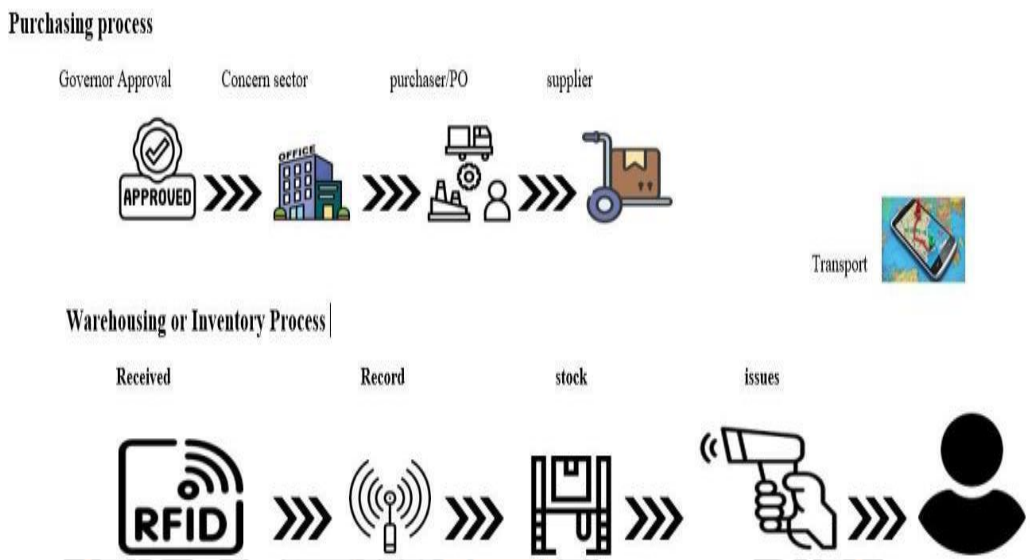

Figure 3 RFID application process in stores and warehouse

Section II: Value stream mapping

The VSM (Value Stream Mapping) is an important breakthrough for traditional value streams applied in the field of procurement management in manufacturing companies and organizations. The ability targets include the following:

a) Reduce the workload of purchasing managers.
b) Establish a more complete system of scrapping and canceling stocks.

The value streaming mapping method has been widely applied in different areas effectively upon the procurement process consideration in the public sectors (Swilley et al., 2012). With the beginning of the value addition process driven by production, operations, and inventory processes, procurement management ensures value addition in the enterprise and organization. However, the means to create value addition can use methods or tools like "value-stream mapping methods used for material, information, process, time, and service flow. VSM is also the lean management method or framework for analyzing the current scenario and designing a future scenario for the series of events that take a product, service, etc., from the beginning of the specific process until it reaches the end customer (Ketchanchai et al., 2021). The mandate of the value-stream mapping method is to identify, remove, and reduce waste in the value-stream process so that it helps in increasing the efficiency of a current or the newly modeled VSM method. Waste reduction is mainly to increase productivity by creating leaner operations management which in turn reduces waste and identifies quality assurance problems easily. Additionally, it focuses more on customer-specific order management and dealing with the new challenges faced by manufacturing, industrial, enterprise, or any organizations that are under pressure to improve productivity, efficient delivery, and quality services, while at the same time, it's focused on reducing costs to stay competitive in the market (Quan et al., 2016).

Value stream mapping (VSM) is a method for illustrating and analyzing the logic of a production process. The product flow process is where value is added for each step and gives a flow overview of material and information in a product receiving to the issuing process. This is a good processing method for understanding how operations management of inventory are connected and analyzing the process (Barber & Tietje, 2008). In this situation state, we would analyze the time taken during the flow of the product from the suppliers to stores to end-users for further utilization, which includes the waiting time for the process in the queue, waiting time in the process, and time taken shall be examined in the current state (Misra et al., 2016). Further, the future state after the new design of the process flow of the warehouse or the stores would be taken into consideration of waiting in line, process, and issue time. It will be compared, and it will focus basically on sustainability issues and its long-run strategies. The example or the model of the current process flow of inventory management is stated below;

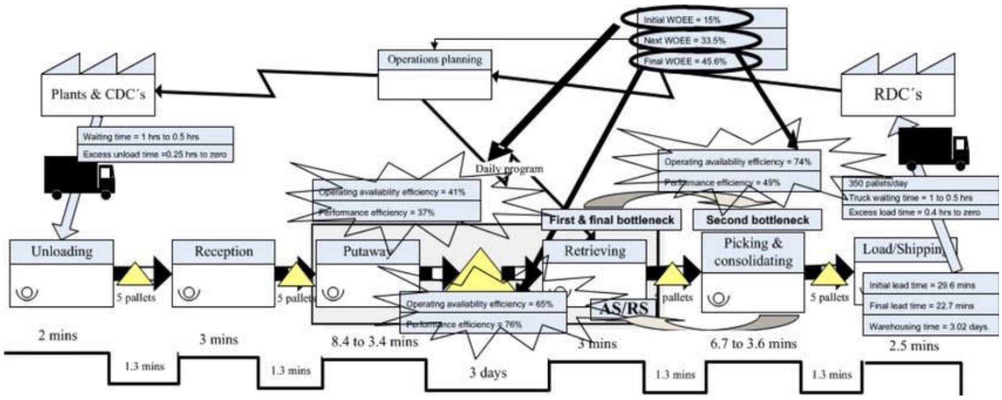

Figure 4 The current process of inventory management and lead time

The above figure describes customer demands and the reduction of transportation and warehousing costs. At the management or chain level phase, VSM identifies waste based on the application of information technology. Waste identification can be done by using value stream mapping (VSM) in the distribution process of the model illustrated in the figure. This phase consists of processes such as loading finished goods at the plant, unloading, and loading the product, including the normal and waiting process time study (Langstrand, 2016).

At the chain level, the possibility of relocating facilities was minimal, and it was intended to ensure the elimination of transportation and other associated waste in the process. Firstly, the strategy is to reduce warehousing or store waste and have a waste elimination strategy. As such, the first phase process encourages the efforts to eliminate waste are executed on the automated storage and retrieval system (Langellier et al., 2013).

The second level of VSM describes the entire operations process and its components, including unloading, receiving, stock or putting away, picking, packaging, and shipping process in the inventory. In the context of a value stream mapping (VSM) model, the operation level focuses on the specific activities, processes, and steps that occur within a particular process or operation. It provides a detailed view of how value is added and how work flows within that specific area of the overall value stream. This situation emphasizes the need for third-party logistic service providers for performance efficiency and further improvement. The handling of waste seems to happen in this two-phase process, and it was a failure. The challenge is that the goods dispatched from the retail distribution service by the truck are smaller than the ones that are served in the central distribution center or plant.

The operation efficiency is estimated to be around 41%. Around 13% of the time may be delays with system breakdowns and other corrective maintenance in the model. Other idle time may lead to pallets being incorrectly packaged without using the AS/RS system, so we can encourage using them to identify and locate them at the right position. The pallets are mixed with both perishable and non-perishable items, so after reaching need to be de-palletized in the store, and it is estimated that in the above process, the cycle would decrease by 4.2 minutes.

The warehouse or store operation efficiency and effectiveness value are now based on the efficiency factors of a bottleneck. This illustrates that about 33.5% with a performance efficiency of 49% and operating availability factor of 74% in the above VSM model. It identifies the items that will be shipped to the retail distribution centers from the orders placed by each of them and later retrieved by the AS/RS system from the second and third levels process of VSM and relocated to the first level. The equipment like the forklift operator helps to move the items to the picking and consolidation area in the retail distribution center's order that needs to be consolidated and palletized in the stores. These then moved to the shipping area and in this operation, there will be excess distance traveled by the forklift in a layout and picking procedure with waiting time starting from the efficient supply of packaging materials in the stores (Lasa et al., 2008). Therefore, in the context of a value stream model, the process is breaking down as undermentioned:

a) Unloading: This is the initial step where raw materials, components, or products are received at the production facility or the purchasing premises. Efficient unloading processes ensure that materials are quickly and safely removed from trucks or containers upon arrival.

b) Reception: After unloading, the received items are checked and inspected for quality and quantity. Any discrepancies are identified and resolved at this stage. Accurate reception ensures that the right materials are available for production or use by end-users.

c) Record: This involves documenting the details of the received materials, including quantities, specifications, and any issues discovered during the reception. Proper recording helps in maintaining accurate inventory records and tracking the flow of materials.

d) Issue: When production or need starts, the necessary materials are issued from the inventory based on production or need requirements of offices or staff. The issued materials are then used to create products or for better public service delivery. Efficient issuing processes prevent delays and ensure that materials are available when needed.

e) Put away or stock: Once the production or process of the product is complete, any unused materials or finished products are returned to the inventory. Properly organizing and storing these items ensures easy retrieval for future use and minimizes waste.

The time refers to the total time it takes for a product to move or flow through all these processes in the model, from the moment raw materials are received to the point where finished products are ready for use by end-users. By optimizing each of these steps, an organization can reduce lead times, improve efficiency, and respond more effectively to customer demands. This, in turn, can lead to cost savings, increased customer satisfaction, and a more competitive position in the market (Anwar, 2018).

The initial bottleneck flow would be studied with the help of technology devices like RFID for improvement in performance and operating efficiency. The operation of picking activity for the supply of material to end-users is an important area for improvement needed with the transportation system and inventory management inside the warehouse and stores.

To analyze the process of inventory in procurement, this research uses the value stream mapping method. The VSM can reflect all value-added and non-value-added activities during the entire procurement inventory process, including inventory management, and purchasing materials from the suppliers. In this way, the non-value-added parts can be found, reducing wastes, and delays in time can be examined within all individual procurement inventory process activities (Bakos & Kemerer, 1992).

Section III: Triple bottom line (TBL)

The TBL was first conceptualized in 1994, the triple bottom line consists of the three Ps (profit, people, and planet), by which companies should assess their bottom lines in the organization or company. Profit is the traditional bottom line of finances of any corporation, organization, and company.

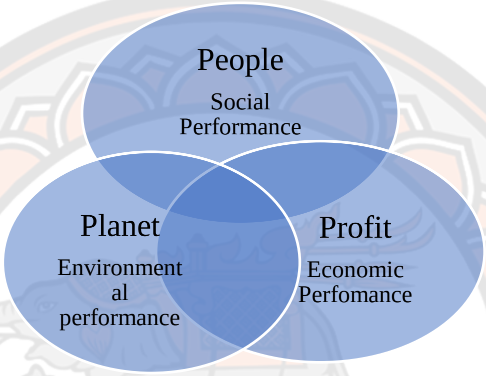

Figure 5 Triple Bottom Line figure interrelationship

In addition to profit, triple-bottom-line (TBL) businesses also measure their performance in terms of social and environmental factors. Therefore, the triple bottom line is considered one of the holistic assessment approaches for companies or organizations, encompassing economic, social, and environmental performance over time. The effect on TBL after the implementation of information technology shall be examined to reduce environmental impact, enhance people's competencies in technology, and meet profitability requirements by managing energy consumption carefully, reducing manufacturing waste, and opting for less toxic materials. A triple-bottom-line approach discourages the production of harmful or destructive products such as weapons, toxic chemicals, or battery materials. To utilize resources efficiently, organizations should adopt environmentally friendly practices such as automation in vehicles, technology, and artificial intelligence for sustainable processes in every aspect (Jayashree et al., 2021). Currently, the cost of disposing of non-degradable waste is borne financially by governments and has an environmental impact on residents near disposal sites. In the triple bottom line concept, enterprises producing products that create waste problems should be examined, and other environmentally endangering substances should be avoided by TBL companies. Long-term environmental sustainability is crucial for a business, and it often costs more to be environmentally effective over time. The applications of TBL can be further explained with the 3Ps and their related components:

People (Social and cultural aspects): This digital transformation can help improve competitiveness, handle big data at granular levels, enhance flexibility and responsiveness, and improve supply chain planning through the availability of technology devices (Schmidt et al., 2018). It is significant in the country's economy, but sustainability has not been easily measurable after extensive spending and the use of data analytic systems for future planning and target setting. Cultural acceptance also varies based on native ideas and location, affecting sustainability practices. TBL focuses on fair and ethical business practices towards employees, the community, and the region in which an organization operates. The competency of people in using technology and their acceptance of it are crucial factors for better services and sustainability.

Proft (Economic and financial aspects): Continuous changes in the logistics process model using RFID technology result from its simplicity, affordability, and security. Information technology, including the Internet of Things, provides an accurate flow of information, products, services, and processes in the market, ensuring reliability in economic aspects (Kurzak, 2012). TBL businesses ensure fair profitability perspectives, monitor labor conditions, pay fair wages, and maintain safe working environments and tolerable working hours. Financial sustainability should be a priority for every budgetary body, facilitating IT infrastructure development and improving operational efficiency while considering environmental effects.

Planet (Environmental and sustainability aspects): The environmental impact of IT infrastructure development needs examination in the long run, as fast as changing IT modes must align with environmental sustainability. Technological innovations have influenced natural resources significantly, leading to resource depletion, increased carbon dioxide emissions, and waste without sustainability approaches. However, with advancements in IT, such as IoT sensor technologies and

RFID with internet or wireless connectivity, digital innovation and sustainability have become mutually reinforcing. For example, technology is needed to manage e-waste in least-developed countries where disposal facilities are lacking. Key performance indicators and calculation models are crucial for assessing environmental sustainability.

Overall, the triple bottom line approach considers economic, social, and environmental factors, ensuring holistic business performance assessment and sustainable practices as follows;

People competencies as KPIs. The competencies, knowledge, and adaptability of an employee shall be calculated based on the data collected of the current inventory management process of those with competence and incompetence in terms of percentages illustrated below and it will be calculated later during the analysis after the data collection. The formulae for the human competencies can be as follows:

$$\textbf{People Competences} = \frac{\textbf{Total no. of Competent Respondents (Graduates)}}{\textbf{Total Respondents}} \times \textbf{100}$$

Profitability return on investment as KPIs. The normal time in the process of inventory and waiting time before the process in the inventory management process shall be calculated in the current scenario in terms of time after the data has been collected and future scenario time differences after the design of the model. This shall be examined and time can be converted into money and it can be evaluated by formulae as follows;

$$\textbf{Return on Investment} = \frac{\textbf{Net Return (Net profit)}}{\textbf{Cost of Investment}} \times \textbf{100}$$

Paper waste reduction as KPIs. To minimize the paper waste being maximum using materials, this method calculates the number of papers issued in the current scenario and the number of paper usage reduced in the future scenario after the application of information technology. In this scenario, the difference of reduction in papers issued can be examined and it can be calculated in terms of percentages of the papers reduced as follows;

$$\textbf{Return on Investment} = \textbf{100} - \frac{\textbf{Paper issued with new system}}{\textbf{Paper issued with the current system}} \times \textbf{100}$$

Effect Analysis on the TBL: The triple bottom line holds significance as a sustainable organization can promote larger organizational value. It is a business model that can generate greater process or stakeholder value than traditional shareholder-operated value. Sustainability in the environment can also influence the development of consumer-brand relationships and is socially significant. However, this is not strongly positive for fast-fashion retailers, as consumers do not possess positive brand outcomes socially. Therefore, the triple bottom line serves as a key performance indicator for forecasting sustainable efficiency. With comprehensive research methods, procuring agencies in Bhutan will apply information technology for further effectiveness and sustainability of digital technology devices when in use. For example, the absence of satellites or other reliable items in the country may impact the prosperity of the economy as a whole, without being able to fulfill the mandates of technology security. Profitability refers to the economic value created by the organization after deducting the costs or value of time in the process. It differs from traditional profitability and calculation models, representing the real economic effect the organization has on its economic environment based on analysis. Environmental sustainability, profitability, and human competence in response to technological changes are essential. Issues and discrepancies may arise if human competencies lack in information technology. Therefore, matching the KPI and the model would be analyzed through calculation and results-based processes.

Strategies to overcome problems

The strategies that involve identifying and analyzing the integration of information technology applications in the inventory management systems of different agencies using the value stream mapping method. This method visualizes the flow of materials and information within the warehouse or stores. Further application of IT helps connect physical objects to the Internet, enabling remote monitoring and control of data records and inventory. Modern-day managers face the challenge of managing performance across people, planet, and profit. Organizational performance aims to unify these processes and technologies for a unified way of managing the business.

Related Research

Computer technology is extensively utilized by numerous organizations to streamline work processes and other activities. It facilitates the collection of asset data for village asset management, securely storing it in systems to prevent loss (Widya, 2022). It has been determined that the design and analysis of automatic traffic signage inventory can be effectively managed through the utilization of RFID technology. RFID stands out as a potent tool capable of enhancing inventory accuracy, accelerating supply chain processes, and reducing time spent on circulation duties. It has been observed that RFID technology can expedite in-store checkout by up to 20%, reduce receiving time by 90%, and decrease shipping and picking time by 80% (Chen et al., 2022). With RFID emerging as a trend in the retail sector, it enables swift inventory management of large stocks, thereby promising enhanced productivity (Anssens et al., 2011). Industry 4.0 has been shown to have a significant and direct impact solely on the economic dimension of triple-bottom-line performance (Sahoo & Upadhyay, 2024). The integration of Radiofrequency Identification (RFID) technology in inventory management processes has been shown to enhance efficiency, reduce workload, and save time (Tao et al., 2017). However, it's essential to consider potential barriers and shortcomings associated with implementing RFID technology, as it could impact profitability and overall operations (Panigrahi, 2013). Integrating technology, including RFID, offers significant monetary benefits and competitive advantages in financial management (Alyahya et al., 2016). Factors affecting the triple bottom line in the Bhutanese procurement sector were examined, highlighting the impact of inventory management on profitability and the economy (Prempeh, 2015). . Interestingly, a portion of respondents expressed reluctance toward RFID-based inventory management, indicating a need for further investigation into their concerns (Hermans et al., 2011). The triple bottom line encompasses the economic, environmental, and social value of an investment, aligning with the principles of sustainable development (Hammer & Pivo, 2017). As a comprehensive supply chain management technology, the effectiveness of RFID is contingent upon its adoption (Mieling, 2014). Research findings indicate that the adoption of RFID technology in Vietnamese fashion enterprises is still in its infancy stage. Among various factors, the cost associated with deploying RFID technology emerges as a critical barrier. Despite certain identified disadvantages, the benefits derived from RFID technology outweigh these drawbacks (Nayak et al., 2022). While some debates surround the productivity improvements associated with information technology, this research demonstrates efficiency gains through model development and technology integration (Brynjolfsson & Yang, 1996). In this research, the new RFID technology-based inventory process was developed and analyzed for the effective identification then the current process. Additionally, the study addresses environmental concerns by identifying and reducing waste, aligning with global efforts towards sustainability (Choden & Soratana, 2020). The triple is learning, task-based framework, and strategy to evaluate the performances of task, group, and organization. Therefore, this is also the accountability framework to study and measure the social, environmental, and economic tasks and it can replicate the study of the performances of the organization like the inventory management process efficiency with the integration of technology devices like RFID (Slaper & Hall, 2011). The related research review and its results are summarized in Table 2;

Table 2 Summary-related research review and results of the study

Sl no	Author	Title	Results and discussion
1	(Prempeh, 2015).	The impact of efficient inventory management on profitability: evidence from selected manufacturing firms in Ghana.	Focus on the profitability after the inventory management efficiency improvement
2	Onyali, C. I. (2014).	Triple bottom line accounting and sustainable corporate performance. Research Journal of Finance and Accounting, 5(8), 195-209.	Implementation of triple-bottom-line accounting methodologies in organizations that would enable the identification, measurement, and allocation.
3	Chiralaksanakul, A., & Sukhotu, V. (2016).	An optimal order quantity with shelf-refill trips from the backroom for efficient store operations. Journal of Modelling in Management, 11(4), 967-984.	Analyzed the backroom inventory and replenishment operations
4	(Mohanraj et al., 2011)	QFD integrated value stream mapping: an enabler of lean manufacturing	Focus on the elimination of the waste and enable process streamlining and prioritize the technique for waste elimination.

5	(Sekeroglu & Altan, 2014).	The Relationship between Inventory Management and Profitability: A Comparative Research on Turkish Firms Operated in Weaving Industry, Eatables Industry, Wholesale and Retail Industry	Inventory control vs profitability
6	(Namgay & Pelden, 2022).	Accountability Scenario in Bhutan	Current lapses to ensure accountability
7	(Sugandi et al., 2018).	Efforts to improve the performance of the loading and unloading workforce at the port of Marunda, North Jakarta.	Man force and performance efficiency of them
8	(Saleh et al., 2020).	Distribution and density of Bali Cattle in South Sulawesi Province	Distribution strategy
9	(Anwar et al., 2018),	CO2 capture and storage: A way forward for a sustainable environment	Ensuring the sustainable storage system with the environment
10	(Sapsanguanboon & Sukhotu, 2015).	Sustainable Retail Supply Chain Management Practices: A Case Study of a Modern Trade Retailer in an Emerging Market	Store management practice and back store efficiency

Conclusion

Chapter two concludes with a focus on methodology and workflow processes. The third chapter will delve into how data will be collected and analyzed using methods like VSM to further improve the future inventory management system in Bhutan's procuring agencies. The use of information technology devices will ensure effective, accurate, fast, and efficient receiving, stocking, recording, and issuing of products or materials within and outside stores and warehouses, facilitating transportation flow to end users for final usage. The researcher emphasized how the triple bottom line works and what was it. It was concluded that it measures three pillars of issues in sectors like agriculture, nonprofit organization, and government, and allows for evaluation ramifications of their decision from the truly long-run perspectives.

CHAPTER III

METHODOLOGY

This chapter presents the procedure of the research study, beginning with an overview of the general methodology process flow framework. Each step of the research is described according to the research process order.

The overall procedures of the research study comprise five general steps. Firstly, the literature review and research gap analysis based on the research topic. Secondly, studying the current inventory management process for the case study. Thirdly, process improvement and data analysis. Fourthly, constructing the new model based on the current data collected and modeling the future inventory management process using information technology such as RFID. Then, analyze the effect of the improvement of the new system. Finally, providing recommendations such as training and so on. The research methodology flowchart process is examined as follows;

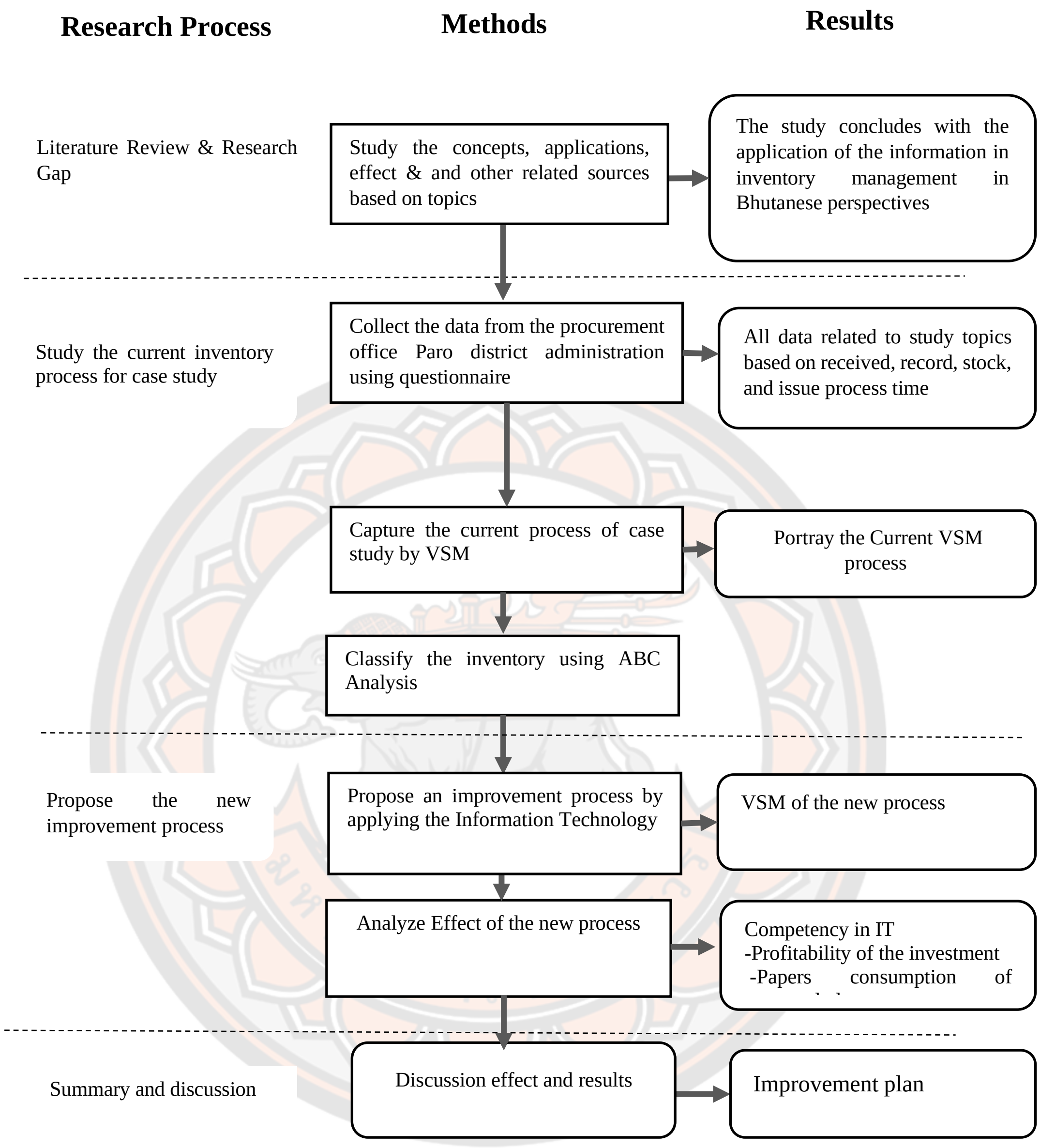

Figure 6 The process of research methodology

Literature Review and Research Gap

In this phase, the research was conducted with extensive review of existing literature related to the application of information technology devices in Bhutan and other countries. This involved examining academic articles, research papers, and other relevant sources to gain insights into how technologies like Radio Frequency

Identification (RFID) are being used across various sectors such as production, manufacturing, agriculture, and education. The review aimed to understand the concepts, applications, and impacts of these technologies, particularly in inventory management processes like receiving, recording, stocking, and issuing materials. Additionally, the review identified any gaps or areas where further research is needed, providing a basis for the study's focus on reduction of waste, increase efficiency and accuracy. Further the competences with study of current time, process and staff in the value stream map.

Study of the Current Inventory Management Process: case study

In this step, the researchers focused on understanding the current inventory management practices in the Paro district administration of Bhutan. They collected data regarding the time taken during different phases of the inventory process, including peak, normal, and off-peak times. This data collection was facilitated through an Excel-based questionnaire, which allowed for the systematic gathering of information related to the receiving, recording, stocking, and issuing of materials. Subsequently, the collected data was analyzed to gain insights into the efficiency and effectiveness of the current inventory management system. Value Stream Mapping (VSM) techniques were employed to visually represent the current state of inventory management processes, providing a comprehensive understanding of the existing workflow and potential areas for improvement.

Proposal of the new improvement process

Based on the insights gathered from the literature review and the analysis of the current inventory management process, this research proposed a new improvement process that leverages information technology. This proposed process aimed to address any identified inefficiencies or challenges in the current system by integrating technological solutions such as RFID devices. The new process was developed and validated with input from experts in procurement and inventory management. Value Stream Mapping (VSM) techniques were again utilized to illustrate the proposed improvements, providing a visual representation of how the integration of information technology could enhance the efficiency and effectiveness of inventory management practices. Overall, these three phases of the research methodology provided a systematic approach to understanding, analyzing, and proposing improvements to inventory management practices in the context of procuring agencies in Bhutan.

Table 3 List of focused groups for survey for questionnaire

Serial no.	Designation and Expertise	Agencies	Personnel
1	Store Assistant	Paro District administration	1
2	Procurement officer	District Administration, Punakha	1
3	Procurement Officer	District Administration, Samtse	1
4	Procurement Officer	Royal University of Bhutan	1
5	Procurement Officer	Thimphu Thromde/ City	1
6	Procurement Officer	Ministry of Economic Affairs	1
7	Procurement Officer	Government Technology, Thimphu	1
8	Procurement Officer	District Education Officer, Paro	1

The new model was crafted using Information Technology (IT) devices and Radio Frequency Identification (RFID), with the research aiming to assess the impact on the Triple Bottom Line (TBL) of transitioning from the current inventory management process to the future integrated model flow process. This transition involves considering variations in time throughout the process, ultimately culminating in a model ready for potential implementation. Following completion of the research study, the integrated model will undergo piloting and eventual implementation within the agencies' inventory management operations.

Discussion and conclusion

The study has reconciled the research objectives with the results obtained, emphasizing improvements in process efficiency and data accuracy resulting from the integration of IT and RFID technologies into inventory management practices. Furthermore, the study has discussed the effects and outcomes of the newly designed procurement process in comparison to the existing inventory management process.

The research methodology outlined in this study involves analyzed data collected from an examination of the current inventory process, followed by proposing a future inventory management process leveraging technology. It is anticipated that the new process will enhance inventory management efficiency. Finally, the impact of the new process on the TBL will be evaluated, with recommendations formulated to ensure the successful implementation of the new project and its further changes.

CHAPTER IV

RESULTS

This chapter presents the findings of the research, focusing on the objective of studying the current inventory management process of the Paro district administration. The data collection process related to inventory was conducted, followed by the classification of inventory items based on their value using ABC analysis. Subsequently, a new process was proposed to enhance efficiency by leveraging information technology, particularly using radio frequency identification. Finally, the impact on the triple bottom line was assessed, leading to the formulation of recommendations.

Case Study: Procuring agency

The study was conducted through data collection within the Paro district administration, which oversees the procurement of goods, works, and services for the region. Inventory operations are centralized and managed by the district procurement office. The district-level warehouse serves as the storage facility for various items, including electrical hardware, computers, stationeries, cartridges, and machinery equipment procured on an annual basis.

Classification of Inventory by ABC Analysis

Given the diverse range of procured items, a subset of 600 items was narrowed down to 100 items through ABC analysis to identify those suitable for RFID-based inventory management. The ABC analysis categorizes items based on their importance and consumption frequency, with Group A items requiring intensive control. Consequently, items such as computers and equipment, falling under the Group A category, were selected for RFID implementation to facilitate seamless flow and movement of goods between offices on a regular basis. The ABC analysis allowed for the classification of inventory items into smaller, manageable groups, with Group A items identified for stringent control measures. This classification ensures that resources are allocated efficiently, with RFID technology deployed where it can have the most significant impact on inventory management processes study.

Study the current inventory management process

The data was collected based on the group A items and studied activity process flow, paper usage, staff requirement, product flow, and time flow as illustrated by the figure below;

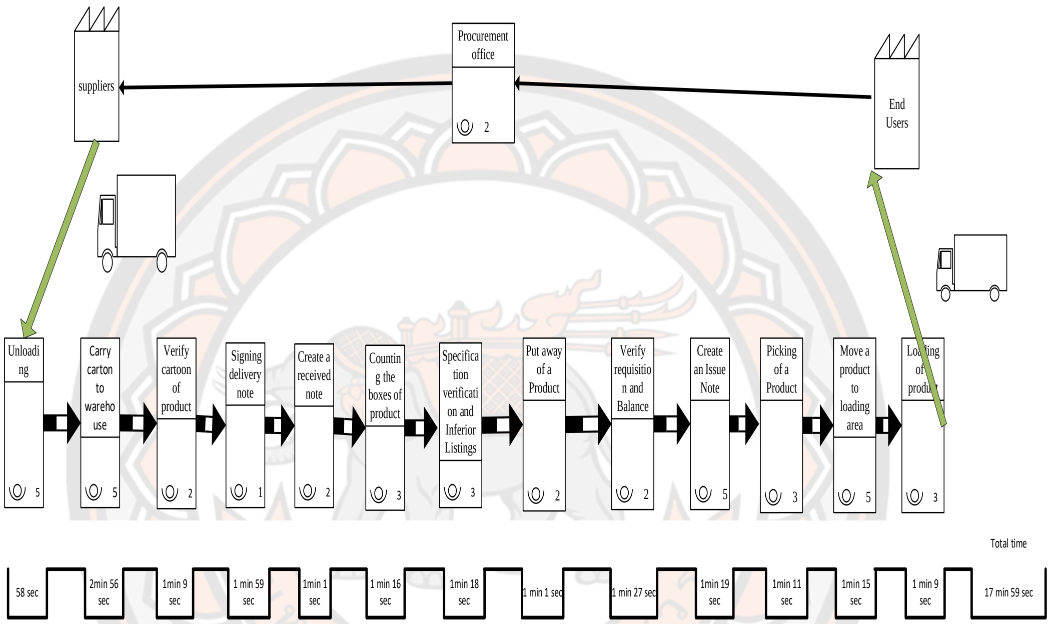

Figure 7 The current data integrated VSM of the inventory process

Figure 7 provides a comprehensive overview of the current inventory management process, detailing the time and staff requirements for each activity involved. This visualization allows stakeholders to understand the efficiency of the process and identify areas for improvement. The total time taken for the entire process is 17 minutes and 59 seconds, indicating the duration from unloading goods to loading them for transportation to end users. Additionally, the figure reveals that a cumulative 41 staff working members are involved in various activities throughout the process but the staff is at maximum level at 7 in the offices including the store in charge and office head. On the other hand, non-value-added activities, such as signing delivery notes and verifying specifications, primarily involve information flow and documentation. Although these activities do not directly impact product movement, they are still integral to maintaining accurate records and ensuring compliance with procedures. By highlighting both value-added and non-value-added activities, Figure 7 provides valuable insights into the inventory management process, enabling stakeholders to optimize efficiency, reduce waste, and enhance overall performance. The details illustration is as follows;

- Unloading: The activity where goods are unloaded at the premises of the purchaser and delivery point.
- Carry a carton of a product to the warehouse: The carton of carrying to the warehouse at the unloading site.
- Verify cartons of product: The packages and cartons are verified and counted inside the warehouse.
- Signing the delivery note: The purchaser manager ensures the receipt of the goods from the supplier.
- Create a received note: The details of goods received with quantity, rate, and amount of product are maintained.
- Counting the boxes of products: Counting the boxes of products and sorting based on their category.
- Specification verification and inferior listings: The listing of the product that is not as mandated in the specification and has defects, and follow-up to the suppliers.
- Put away a product: The stocking process of the product in the warehouse including segregation and stagging.
- Verify the requisition and balance: Seeing the stock balance details in the stock ledger and verifying quantity, and type of product requirement by end-users in requisition.
- Create an issue note: The goods details including the serial number, type of product, and quantity are mentioned and signed by both parties.
- Picking of product: The taking and picking of product from the purchaser's premises by the end users from the warehouse.
- Move to the loading area: The movement of the product to the area where the goods are loaded.

- Loading: The putting up of product in the truck for the end user delivery

Figure 8 provides a detailed overview of the current inventory management process, highlighting both the time taken and staff requirements for each activity. The total duration of the process is recorded as 17 minutes and 59 seconds, with a total of 41 staff members involved throughout the Value Stream Mapping (VSM) process. This figure elucidates the various stages of the inventory management process, starting from the receiving of goods and culminating in their loading for transportation to end users. Each activity within the process is meticulously examined, shedding light on the time taken and the personnel required to execute it efficiently. In particular, Table 3 distinguishes between value-added and non-value-added activities. Value-added activities are those that directly contribute to the flow of products within the VSM process. These activities involve the physical movement or processing of goods, such as unloading, carrying to stores, counting pallets, and issuing goods. Conversely, non-value-added activities primarily encompass information flow and documentation processes. While these activities may not directly impact the physical flow of products, they are nonetheless crucial for maintaining accurate records and ensuring compliance with procedures. It's important to note that both value-added and non-value-added activities play integral roles in the overall inventory management process. While value-added activities contribute directly to product flow, non-value-added activities are essential for supporting and facilitating the smooth operation of the entire process. By presenting a comprehensive breakdown of activities and resource requirements, Figure 8 enables stakeholders to identify areas for improvement, optimize efficiency, and streamline the inventory management process effectively.

Table 4 Value-added and non-value-added activities in the process flow

Sl. no	Activities	Time (Min)	Activity Type
1	Unloading	0:58	VA
2	Carry carton of product to the warehouse	2:56	NNVA
3	Verify cartons of the product	1:09	NNVA
4	Sign the delivery note	1:59	NVA
5	Create the received note	1:01	NVA
6	Counting the boxes of the product	1:16	NNVA
7	Specification verification and inferior listing	1:18	NNVA
8	Put away a product	1:01	VA
9	Verify requisition and balance	1:27	NNVA
10	Create an issue note	1:19	NNVA
11	Picking of a product	1:11	VA
12	Move a product to the loading area	1:15	NNVA
13	Loading of product	1:09	VA

VA: Value-added activities, **NVA**: Non-value-added activities**,**
NNVA: Necessary but non-value-added activities

These classifications help identify where value is added to the process, where tasks are necessary but don't directly add value, and where activities could potentially be optimized or eliminated to improve efficiency. Table 4 distinguishes between value-added and non-value-added activities. Value-added activities directly contribute to the flow of products within the Value Stream Mapping (VSM) process, such as unloading, carrying to stores, counting pallets, and issuing goods. Based on the information provided, out of the 13 sub-activities, 4 are considered value-added activities (VA), 2 are non-value-added activities (NVAs) and 7 are necessary non-value-adding activities (NNVA). As illustrated in Figure 7 the total cycle time in the current VSM is 17 minutes and 59 seconds in the current inventory management process and the total required in the scenario is cumulative 41 staff. but the staff is the maximum level at 7 in the offices including the store in charge and office.

$$Percentage\ of\ Value\ Added\ Time = \frac{Cycle\ Time}{Value\ Added\ Time} \times 100$$

Given:

Value-Added Time = 4 minutes 19 seconds (Total value-added time in current process)

Total Cycle Time = 17 minutes 59 seconds

First, convert all times to seconds for easier calculation.

$$Value\ Added\ Time:\ 4\ minutes \times 60 + 19\ seconds = 4 \times 60 + 19 = 259\ seconds$$

Cycle $Time:\ 17\ minutes \times 60 + 38\ seconds = 17 \times 60 + 59 = 1079\ seconds$

$$Now,\ plug\ these\ values\ into\ the\ formula:$$

$$Percentage\ of\ Value\ Added\ Time = \left(\frac{259}{1079}\right) \times 100 \approx 24.00\%$$

Proposed the new process

The study primarily focused on the utilization of information technology, particularly Radio Frequency Identification (RFID) in the inventory process following the purchasing phase. The items classified under the A group, which require stringent inventory control, were identified for RFID implementation. RFID technology enables the monitoring, tracking, and tracing of these high-priority items throughout the inventory management process. By employing RFID, the study aimed to reduce cycle times and enhance the efficiency of inventory management. This technology facilitates faster progress, leading to improvements in effectiveness and efficiency. Moreover, RFID implementation has a significant impact on accountability and accuracy in data reporting. Previously, these tasks were predominantly carried out manually, relying on paper-based systems. With RFID, the process becomes automated, reducing the likelihood of errors and ensuring greater precision in data management. The adoption of RFID technology not only enhances operational efficiency but also contributes to accountability and transparency. By automating data collection and reporting processes, RFID enables real-time monitoring and provides accurate data insights. This ensures greater accountability in inventory management practices and enhances transparency in reporting. Furthermore, the study recognizes the broader implications of RFID implementation from social, environmental, and economic perspectives. By improving efficiency and accuracy in inventory management, RFID technology positively impacts various stakeholders, including end-users. The analysis and implementation of RFID contribute to data variability, enabling better decision-making and resource allocation across social, environmental, and economic domains. Overall, the integration of RFID technology in inventory management processes leads to enhanced accountability, efficiency, and data accuracy, ultimately benefiting stakeholders across multiple dimensions.

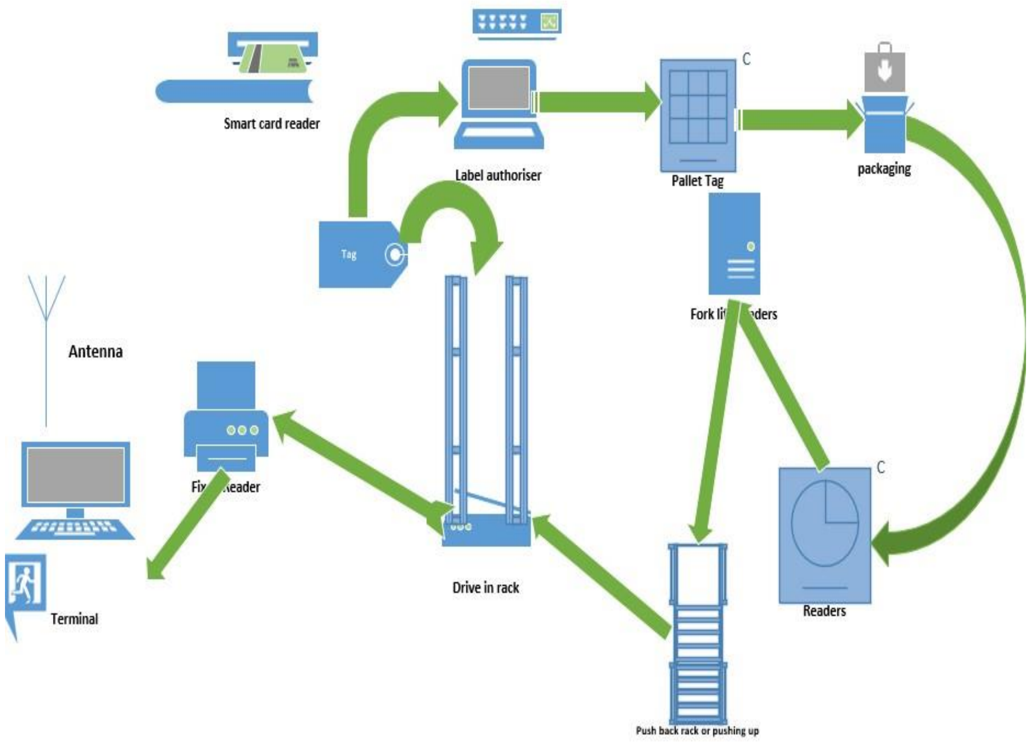

Figure 8 The RFID practical working process.

The new design model for future scenarios was visualized using the Value Stream Mapping (VSM) method, incorporating Information Technology (IT) for inventory management in agency stores and warehouses. Authorization tags, readers, and scanners are integrated into every process to enhance the efficiency of the VSM process of inventory. The data on the RFID was based on the literature reviews and working time efficiency of the RFID on inventory process in the warehouse: The next level automation articles. The range of efficiency was illustrated as illustrated below;

Table 5 The RFID real-time efficiency in inventory

Sl no	Activities	Percentages	Remarks
1	Receiving and recording	90%	Counts 20,000 items per hour
2	Stock Keep unit	63% to 95%	
3	Picking and shipping	80%	

Source: RFID in the warehouse: Next-level inventory automation (https://www.bing.com/search?q=RFID+time+taken+in+inventory+process&pc=GD01&form=GDAVST&ptag=3515)

Within the range of the efficiency level of time, the data was collected through a stopwatch based on the model and activities prescribed in the improvement process of the inventory. The utilization of Radio Frequency Identification (RFID) components in the VSM contributes to the enhancement of the integrated inventory management process compared to the present scenario.

In the model, RFID components are strategically placed and utilized throughout the inventory management process. These components include authorization tags, readers, and scanners, which facilitate real-time tracking and monitoring of inventory items. Each step of the process is mapped out, highlighting the movement of inventory items as well as the involvement of personnel as needed.

By integrating IT devices such as RFID into the inventory management process, agencies can achieve greater visibility and control over their inventory, leading to improved efficiency and accuracy. This new design model aims to streamline operations, reduce cycle times, and minimize errors in inventory management, ultimately enhancing overall organizational performance.

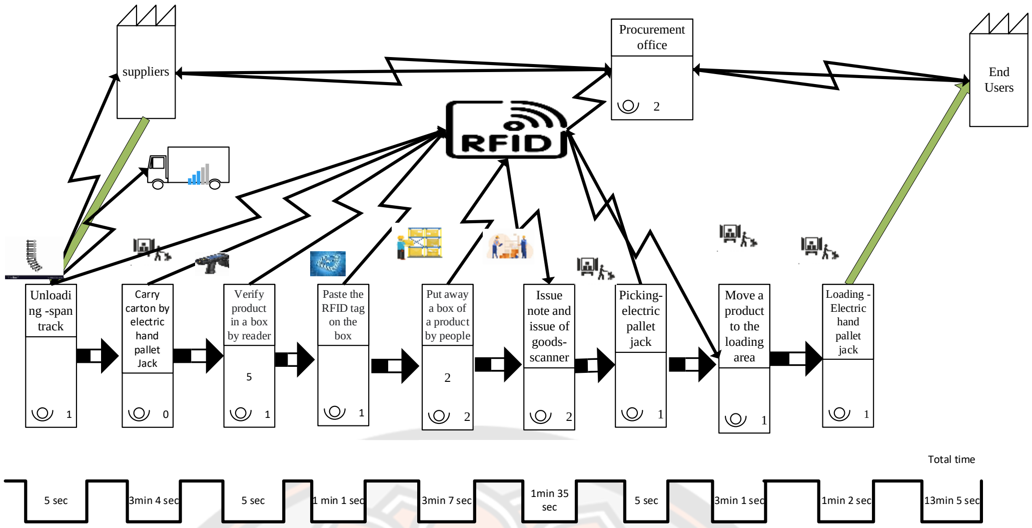

Figure 9 New VSM model

Each step in the new process describes a specific task or action taken during the process of receiving, storing, and dispatching goods.

- Unloading with Span track: Goods are unloaded at the purchaser's premises and delivery point using a span track, which is likely a type of equipment or system for efficient unloading.
- Carry two cartons of product to the warehouse by electric hand pallet jack: Using an electric hand pallet jack, the goods are transported from the unloading site to the warehouse or storage area.
- Verification of a product by a reader: Packages and cartons are verified and counted inside the warehouse using an RFID reader, ensuring accuracy in inventory management.
- Paste RFID tag on the box: RFID tags are manually applied to the products in the warehouse, likely to enable tracking and identification throughout the supply chain.
- Put away a box of product by people: Employees or warehouse staff handle the stocking process of products in the stores, including staging and segregation to ensure efficient storage and retrieval.

- Create issue note and issue of goods: A formal document, such as an issue note, is generated to record the issuance of goods, including details such as quantity, rate, and amount. This helps in maintaining accurate records of transactions.
- Picking by electric pallet jack: End users pick products from the purchaser's premises using an electric pallet jack, presumably for further distribution or usage.
- Move a product to the loading area: Using an electric hand pallet jack, products are transported from their storage location to the loading area in preparation for dispatch.
- Loading by electric hand pallet jack: Goods are loaded onto trucks using a jack, likely a span track, for transportation to the end user or final destination.

The new Value Stream Mapping (VSM) process integrates data from the hypothesis into individual process activities, focusing on the entire process from initiation to issue to the end user. Initially comprising 13 main process activities, the new VSM condenses them into 9 distinct sub-process activities, distinguishing between value-added and non-value-added activities. In this IT-based VSM process, peak, normal, and off-peak times are considered, along with the flow of products, paperwork, and staff requirements. By incorporating information technology into the process, the aim is to streamline operations, enhance efficiency, and reduce waste. This involves leveraging technology such as RFID and other IT tools to monitor and track inventory in real-time, improving visibility and control throughout the process.

The new VSM process is designed to optimize resource utilization, minimize cycle times, and improve overall productivity. By identifying and eliminating inefficiencies, organizations can achieve greater operational effectiveness and meet the demands of the modern marketplace. Figure 9 illustrates the new inventory management process, detailing the time taken and staff requirements for each activity. The total time for the process is 13 minutes and 5 seconds, with a total of 11 cumulative staff involved in all activities but the staff is the maximum level at 4 in the offices including the store in charge and office head.

The figure highlights the time taken for each activity in the receiving process, starting from loading until the products are transported to the end users. The goal of this new process is to streamline operations, reduce cycle times, and improve overall efficiency in inventory management. With fewer staff required and reduced processing time, the new process aims to optimize resource utilization and enhance productivity.

Table 6 The value-added and non-value-added activities of the new process

SL. no	Activities	Time (Min)	Activity Type
1	Unloading using span track	0:05	VA
2	Carry cartons to the warehouse by Electric hand pallet Jack	3:04	NNVA
3	Verify product in cartons in box by the reader	0:05	NNVA
4	Paste the RFID tag on the box	1:01	NNVA
5	Put away a product by people	3:07	VA
6	Create Issue Notes and Issue the goods	1:35	NNVA
7	Picking of the product by Electric and pallet jack	0:05	NVA
8	Move the product to the loading area	3:01	NNVA
9	Loading span track and electric hand pallet jack	1:02	VA

NA: Value-added activities, **NVA:** Non-value-added activities,
NNVA: Necessary but non-value-added activities

In the new inventory management process, there are a total of nine activities. Out of these, 3 activities are deemed value-added, one is classified as non-value-added, and 5 are considered non-value-added but necessary non-adding value to the process. Figure 9 shows the new VSM process where the cycle time totals 13 minutes and 5 seconds and the staff involved in the process is a total of 11. The average staff required for the new process is 2.

$$Percentage\ of\ Value\ Added\ Time = \frac{Cycle\ Time}{Value\ Added\ Time} \times 100$$

Given:

- Value-Added Time = 4 minutes 14 seconds (total value-added time)
- Total Cycle Time = 13 minutes 5 seconds

First, convert all times to seconds for easier calculation.

$$Value\ Added\ Time:\ 4\ minutes \times 60 + 14\ seconds = 4 \times 60 + 14 = 254\ seconds$$

Cycle $Time:\ 13\ minutes \times 60 + 58\ seconds = 13 \times 60 + 5 = 785\ seconds$

Thus:

$$Percentage\ of\ Value - Added\ Time = \left(\frac{254}{785}\right) \times 100 = 32.36\%$$

Therefore, the value-added percentage for the new inventory management process is 32.36%.

In both the current inventory process VSM and the future state IT-based VSM, activities are categorized into value-added and non-value-added activities based on their contribution to the service completion. Value-added activities are those that directly contribute to fulfilling customer demand and are activities that customers are willing to pay for. Non-value-added activities, on the other hand, do not directly contribute to the product or service's value and are not something customers would be willing to pay for. In the new VSM, out of the 9 identified activities, 3 were classified as value-added activities. These activities are crucial for fulfilling customer demand and adding value to the inventory management process. The details of these value-added activities were illustrated in a tabulated form in Table 4 and Table 6 to provide a clear understanding of their role and significance in the overall process.

Efficiency improvement of the new process

The improvement plan aims to enhance the efficiency and effectiveness of the inventory management process by utilizing information technology-based VSM. After analyzing the current value streaming mapping (VSM) method process, the improvement plan focuses on implementing tools and methods to further optimize the process. In the new system, the cycle time is 13 minutes 5 seconds, and the time by 4 minutes 54 seconds the time has reduced the efficiency is improved by the new process. The formulae for efficiency are;

$$Given: Redcued\ cycle\ time\ is\ 4\ minutes\ 54\ seconds$$

$$current\ process\ cycle\ time:\ 17\ minutes\ and\ 59\ seconds$$

$$Efficiency\ (\%) of\ time\ difference = \frac{Reduced\ time}{Current\ process\ \ cycle\ time} \times 100$$

$$= \frac{4\ minutes\ \times 60\ seconds + 54}{17\ minutes\ \times 60\ seconds + 59} \times 100 = 47.64\%$$

An efficiency level of 47.64 % indicates that the utilization of staff resources has also significantly improved. Efficiency level emphasis where the performance is at the peak level with the least inputs and achieved the highest level of output.

Comparison of current and RFID devices-based value stream mapping

As illustrated in Figure 7 the total cycle time in the current VSM is 17 minutes and 59 seconds in the current inventory management process and the total staff required in the scenario is 41 cumulative staff. Figure 9 shows the new VSM process where the cycle time totals 13 minutes and 5 seconds and the staff involved in the process totals 11. To compare the time efficiencies and staff percentage differences between the current and new inventory management processes, it's calculated the time efficiency improvement and the percentage difference in staff requirements. In the Current inventory VSM and RFID-enabled VSM, the total time difference taken for the inventory process is 4 minutes and 54 seconds. On the other hand, the current inventory model and the New inventory process model staff requirements differ by approximately 11 staff. In terms of the staff requirement, the current process has a total average approximately of 4 staff in the process and the total average approximately is 2 in the new process which is comparatively low.

Similarly, in the RFID-enabled VSM, the staff requirement is reduced. While the current inventory model involves 41 cumulative staff members, the RFID-enabled model requires only 11 cumulative staff members but the staff is the maximum level at 7 and 4 in the offices including a store in charge and office head in two alternative processes. This reduction in staff requirement indicates increased efficiency and effectiveness in the inventory management process with the implementation of RFID technology. Overall, the RFID-enabled VSM offers significant improvements in terms of time efficiency and staff utilization compared to the current inventory model. To compare the time efficiencies and cumulative staff percentage differences between the current and new inventory management processes, it's calculated the time efficiency improvement and the percentage difference in cumulative staff requirements.

To calculate the percentages of time reduction between the current and new inventory management processes, we'll use the following formulas;

Percentage of Time Reduction:

$$Percentage\ of\ Time\ Reduction:$$

$$Reduction\ in\ Cycle\ Time = \frac{Current\ Cycle\ Time - New\ Cycle\ time}{Current\ cycle\ time}$$

$$= \frac{(17\ minutes\ and\ 59\ \ seconds) - (13\ minutes\ and\ 5\ seconds)}{17\ minutes\ \ 59\ seconds}$$

$$= 0.27\ seconds\ \times 100 = 27\%\ of\ time\ reduction$$

Effect on Triple bottom line by information technology

To assess the effect on the Triple Bottom Line (TBL) socially, economically, and environmentally, interviews were conducted with 8 experts working in the procurement field, where large-scale procurement and inventory management are common practices. The data revealed that 87.5% of the experts were aware of technology and had utilized technology like RFID in their agencies, while 12.5% were not aware of it as shown in figure 10.

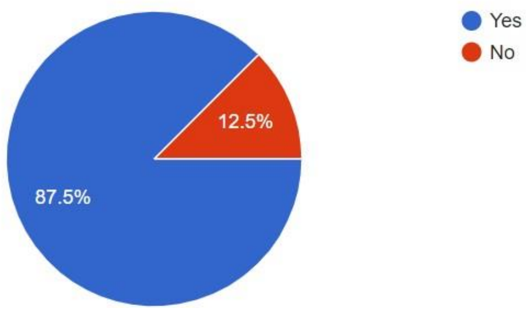

Figure 10 pie showing the awareness of the RFID technology

Regarding the practical usage of RFID technology, 50% of the respondents were familiar with it sometimes, 12.5% often, and 37.5% never used it in their career.

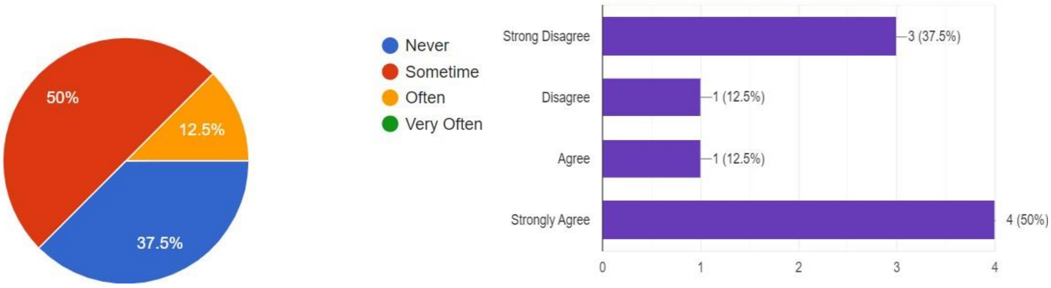

Figure 11 pie and bar graph showing the familiarity of RFID devices

All respondents expressed the need for RFID-related training, indicating a gap in knowledge and skills in utilizing this technology effectively. The histogram depicted the respondents' need for an RFID-based inventory process, with 100% of them indicating the necessity. This underscores the importance of providing comprehensive training and resources to ensure the successful implementation of RFID technology in inventory management. The efficiency in human competency may decrease initially as individuals adapt to new technology. However, the long-term benefits, such as improved time-profitability and reduced waste, can be substantial. The hypothesis calculation for these benefits can be conducted to further analyze the potential impact of RFID technology on inventory management processes.

Employees competencies: The key performance indicators (KPIs) for assessing the competency of employees can be calculated based on the data collected on the effect of the triple bottom line. One such KPI is the competency level of employees, which can be evaluated using the following calculation:

$$Social\ Competency = \frac{Total\ Number\ of\ Graduates}{Total\ Number\ of\ Respondents} \times 100$$

$Given\ the\ data$:

$$Total\ Number\ of\ Respondents\ =\ 8$$

$$Number\ of\ Graduate\ Respondents\ =\ 4$$

$$Calculating\ the\ social\ competency:$$

$$Social\ Competency = \frac{4}{8} \times 100 = 50\%$$

This means that 50% of the respondents who completed the questionnaire have a graduate-level education, while the other 50% have secondary-level education.

Additionally, regarding training related to RFID, 62.5% of respondents attended training, and 37.5% of officials have not attended any training related to information technology.

These metrics provide insights into the level of education and training among employees, which are crucial for assessing their competency in utilizing technology like RFID effectively. It shows and helps the organizations to prioritize the training and improvement of the competencies of only 37.5 % of employees to handle the RFID devices equipment before it was implemented without competencies enough to handle the technology. After the RFID implementation, the staff is reduced in the inventory management process but they can handle other procurement works and further improve the efficiency in the procurement management field. Further, it helps in increasing the income level of the organization and reprioritizes the budget for other procurement activities. With technology competencies, employees will have enhanced team collaboration, problem-solving, flexibility, leadership influences, and digital responsibility in the agencies.

Return on Investment: The profitability return on investment (ROI) is a key performance indicator (KPI) used to evaluate the financial benefits gained from an investment compared to its cost. In this case, the ROI is calculated based on the time saved in the inventory process after transitioning from the current manual-based VSM model to the information technology-based inventory process model.

To calculate the ROI, we first convert the time saved into monetary terms based on the employee's salary. The net return of the employee for both the current and future inventory processes is determined by multiplying the time saved by the employee's hourly rate. Then, the difference in net return between the two processes is calculated.

$Given$:

- $Employee's\ Net\ Pay\colon\ Nu.\ 49{,}000.00\ per\ month$
- $Active\ Working\ Hours\ per\ day\colon\ 6\ hours$
- $Total\ Working\ Days\ in\ a\ Month\colon\ 30\ days$

- $Employee's\ Salary\ per\ Hour:\ Nu.\ 272.22$
- $Employee's\ Salary\ per\ Minute:\ Nu.\ 4.58$
- $Employee^{\wedge}'s\ Salary\ per\ Second:\ Nu.\ 0.08$

$\boldsymbol{For\ the\ manual - based\ VSM\ process}$:

- $Time:\ 17\ minutes\ and\ 38\ seconds$
- $Net\ Return\ of\ Employee:\ \ 4.58 \times\ 17 + 0.08 \times 38 = 77.86 + 3.04 = Nu.\ 80.90$

Thus, the ROI for the transition from the manual-based VSM process to the information technology-based inventory process, given the provided net profit and initial investment, is approximately 80.90 %. This means that for every Nu. 1 invested, the return is approximately Nu. 80.90. Since the ROI is more than 1, it indicates that the investment in the new system does provide significant financial benefits compared to its cost. The payback period, which represents the time required for the investment to be recouped from the benefits, is calculated to be approximately 12 months.

Paper waste reduction: To assess the reduction in paper waste between the current and new inventory management systems, the percentage reduction in paper consumption can be calculated using the following formula:

$$\boldsymbol{Paper\ Consumption\ Reduction} = 100 - \frac{Paper\ issued\ with\ new\ process}{Paper\ issued\ with\ current\ process} \times 100$$

$$Paper\ issued\ with\ the\ new\ model\ system\ =\ 2$$

$$Paper\ issued\ on\ the\ current\ model\ =\ 39$$

$$Calculating\ the\ paper\ consumption\ reduction:$$

$$Paper\ Consumption\ Reduction = 100 - \left(\frac{2}{39}\right) = 99.95\%$$

This means that there is a reduction of approximately 99.95 % in paper consumption with the implementation of the new inventory management system.

This means that there is a reduction of approximately 99.95 % in paper consumption with the implementation of the new inventory management system.

Consequently, around 99.95 % of paper usage is saved, contributing to a significant reduction in paper waste. The budget utilized for the procurement of the papers can be reprioritized and used for the purchasing of other emergency items in the agency.

CHAPTER V

DISCUSSIONS AND CONCLUSIONS

Discussions

The study results indicate the impact of integrating information technology on the inventory management process, particularly after the introduction of the new RFID-enabled model. A comparison between the current and RFID-enabled value streaming mapping was conducted, focusing on peak time, normal time, and off-peak periods during the delivery of goods to the mini-warehouse. It was observed that the usual time remained consistent during the initial stage of the receiving process. In the current inventory value streaming mapping, the total time recorded was 17 minutes and 59 seconds, with the number of staff involved varying from a maximum of 5 to a minimum of 1, depending on the activities involved. The volume of product flow was found to be highest at the stock level and lowest during the receiving process, attributed to the bulkiness of certain items. Similarly, in the RFID devices-based inventory process the time taken is 13 minutes and 5 seconds with the cumulative staff requirement at 11. The flow of the information and product is as same in the current process but the two processes have differences of 4 minutes and 54 seconds which is 294 seconds.

In the TBL perspectives, regarding the awareness and utilization of technology in agencies, the study found that approximately 87.5% of officials were aware of and utilized technologies such as RFID, while 12.5% had not utilized such technologies and were unaware of them. Therefore, the government or agency can outsource and train the remaining staff and make them competent and equal to other staff in the agency for the successful usage of technology. In terms of practical usage, 50% of respondents were familiar with technology on occasion, 12.5% used it frequently, and 37.5% had never used it in their careers. Similarly, the employees get reduced after RFID application and skills are enhanced. Therefore, the staff can reprioritize to do work in other procurement management than the inventory management process. Further the income and efficiency level of procurement have a drastic increase than before.

Moreover, the study highlighted a significant need for training in RFID-related technologies, with 100% of respondents expressing a requirement for such training. The study also emphasized the necessity for an RFID-based inventory process as indicated in the histogram. Only 32.5% of respondents had attended RFID-related training, while 62.5% had not received any training related to RFID throughout their careers.

Interpretation of the Findings

While previous research focused on RFID primarily for tracking purposes, this study extends its application to various aspects of inventory management, including receiving, stocking, recording, and issuing. My research devolved into process analysis using Value Stream Mapping (VSM) to identify waste and distinguish between value-added and non-value-added activities. Over time, VSM methods can help to adapt to changes and address shortcomings in inventory management processes. While this study focuses on the applicability of technology integration in inventory management, it's crucial to consider broader implications across various fields, not just inventory processes. By comparing time differences between current and IT-based inventory processes and translating them into monetary terms, this research evaluated the profitability of organizations. Nonetheless, accuracy in data management remains crucial for warehouse operations, SKU planning, and inventory control all of which were considered in this study. This study covered the study of the time wastages along the inventory flow of the current process and prioritizes the time-reduced time by the new value stream mapping process. Technology as the emerging security and outdating of equipment, software, and data it is concerned. Recommendations for future research and policy inclusion are essential to mitigate these challenges and ensure responsible technology implementation.

Implications and contributions

This study aimed to analyze the frequency and association of variables, particularly profitability, with the adoption of information technology in Bhutanese procurement agencies. The findings revealed that the current manual inventory management process is lengthy and prone to inefficiencies, especially during peak, off-peak, and normal times. The slow progress and lack of accountability stemming from manual processes underscored the need for digitalization.

By applying information technology, particularly radio frequency identification, the study aimed to improve data security, accuracy, and efficiency in inventory management. The use of Value Stream Mapping facilitated the comparison of current and information technology-based models, enabling an analysis of their effects on the Triple Bottom Line (TBL). Implications of the research suggest a transition to digitalized inventory management, highlighting differences in process flows between manual and RFID-based systems. Moreover, it emphasizes the direct impact of technology on human resources, profitability, and waste reduction. Challenges identified include data security concerns, necessitating robust internet-based security measures. Additionally, the initial investment, maintenance, and skill updates for public procurement agencies pose significant challenges in adopting transformative technology. In summary, this study underscores the importance of digital transformation in inventory management, identifies associated challenges, and emphasizes the need for a skilled workforce and robust security measures to ensure successful implementation and long-term benefits.

Limitation and impact of discussion on previous studies context

Facilitating and coordinating training programs in information technology infrastructure development is crucial to enhance the existing structure. However, challenges related to investment can hinder environmental impact strategies within agencies. Conducting a feasibility analysis is essential to anticipate technical, economic, legal, and operational requirements for project execution. This analysis ensures the availability of manpower, finance, and labor for successful project implementation in the long term. Neglecting a thorough feasibility study may result in unemployment, economic downturns, and recessions across sectors, leading to a lack of income generation.

The applicability of the study's content is limited to its objectives and scope, as well as the internal data-driven nature of the research conducted within the researcher's workplace. Additionally, limitations in the number of respondents, methodological flaws, and insufficient studies implemented during the research may have impacted the findings. Moreover, the minimal implementation of RFID in the government sector, compared to its widespread use in industries and businesses, also limited the scope of the study.

Future Research and recommendations

Based on this research, which primarily focuses on RFID application in inventory management within warehouses and stores of agencies, there are several areas that future studies can explore:

- Transportation Management: Investigate how RFID technology can be integrated into transportation processes to improve efficiency, accuracy, and tracking of goods during transit. This could involve studying RFID tagging on vehicles, containers, or packages to optimize logistics operations.
- Demand Forecasting: Explore how RFID data can be leveraged for more accurate demand forecasting. By analyzing RFID-tagged inventory movements and customer purchase patterns, researchers can develop predictive models to anticipate future demand trends and optimize inventory levels accordingly.
- Maintenance and Repair Management: Examine the application of RFID in maintenance and repair processes within warehouses and stores. Research can focus on how RFID tags can be used to track equipment and assets, schedule maintenance tasks, and manage inventory of spare parts more effectively.
- Production Planning and Operations: Investigate the role of RFID in improving production planning and operations within inventory management. This could involve studying how RFID technology can optimize workflow processes, monitor production progress, and streamline inventory replenishment to support manufacturing activities.
- Technology Integration in Purchasing Management: Explore the integration of RFID and other advanced technologies (such as IoT sensors or AI) in purchasing management processes. Research can focus on how these technologies can enhance procurement workflows, supplier management, and inventory replenishment strategies.

By delving into these areas, researchers can further expand our understanding of how RFID and other technologies can revolutionize inventory management practices and contribute to overall supply chain optimization. The social dimension of employees' competencies in the context of information technology were interpersonal and collaborative skills required to work effectively with technology within a team or organizational setting. As technology becomes increasingly integrated into workplaces, the need for strong social competencies has grown. These competencies include:

1. **Collaboration and Teamwork:** Working across various departments requires the ability to bridge the gap between IT and other functional areas, fostering cooperation and mutual understanding. Navigating and resolving conflicts that arise from differing perspectives or misunderstandings is key to maintaining a harmonious work environment.

2. **Adaptability and Flexibility:** Employees must be open to and capable of adapting to new technologies and workflows. This includes being receptive to continuous learning and reskilling. In global and diverse workplaces, being sensitive to and respectful of cultural differences is essential for effective collaboration.

3. **Problem-Solving and Critical Thinking:** Working with others to diagnose and address technical issues requires combining technical know-how with social intelligence.

4. **Leadership and Influence:** Experienced employees can play a crucial role in mentoring less experienced colleagues, fostering an environment of growth and continuous improvement.

5. **Ethics and Responsibility:** Understanding the ethical implications of technology use and promoting responsible practices, such as data privacy and cybersecurity, is essential.

Importance in the Modern Workplace

The integration of IT into virtually all aspects of business operations means that technical skills alone are insufficient for success. Employees must be able to work effectively with others, communicate complex information, adapt to rapid changes, and navigate the ethical landscape of modern technology use. These social competencies enable employees to maximize the potential of IT, driving innovation, efficiency, and collaborative success within organizations.

Conclusions

These research findings highlighted the potential of RFID technology to significantly enhance various aspects of inventory management processes, including speed, accuracy, waste reduction, and paperless operations. By implementing RFID-based VSM models, not only can the efficiency and effectiveness of inventory processes in stores and warehouses be improved, but similar benefits may also extend to other sectors beyond inventory management. However, challenges associated with technology integration, such as a lack of competencies in handling equipment and initial investment costs, need to be addressed. Despite these challenges, the study demonstrates the feasibility and potential benefits of adopting RFID technology in inventory management. The analysis of the social, economic, and environmental impacts of RFID implementation provides valuable insights into the overall benefits and implications of technology adoption in the Bhutanese procurement sector. This information can inform decision-making processes and help prioritize budget allocations for activities that yield the highest returns.

Additionally, this research findings contributes to improve budget forecasting accuracy and optimizing resource allocation, leading to better utilization of public funds. While the effectiveness of the RFID-based VSM model may vary across different agencies, certain modifications and adjustments can be made to tailor the model to specific organizational needs and operational requirements.

Overall, your study sheds light on the transformative potential of RFID technology in enhancing inventory management processes and underscores the importance of considering technological advancements in improving efficiency, accuracy, and resource utilization in procurement operations.

Recommendation

Indeed, facilitating training and coordinating efforts to improve information technology infrastructure are essential steps in ensuring the successful adoption and utilization of RFID-based inventory systems in agencies. By enhancing technology literacy and skills among employees, organizations can maximize the benefits of technological advancements and provide faster, more efficient services to stakeholders. Given the significant link between the purchasing and inventory management processes, it becomes crucial to minimize risks, increase profitability, and establish secure and transparent procurement operations. The integration of RFID technology can contribute to streamlining these processes, but it also poses challenges, particularly regarding data security. Bhutan's reliance on satellite communication further emphasizes the importance of robust data security measures to safeguard sensitive information.

To address these challenges, the government should prioritize investments in research and development to enhance cybersecurity measures and promote awareness and education initiatives on data security among stakeholders. Additionally, fostering interoperability across agencies can facilitate seamless communication and collaboration, ensuring the effective implementation of RFID-based inventory systems nationwide. By addressing these concerns and investing in the necessary infrastructure and human capital, Bhutan can harness the full potential of RFID technology while safeguarding against potential risks.

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APPENDIX

Annexure I

The template for the data collection related to the current inventory process

	Code	Questions	Time	No. of staffs	No. papers	Volume of Product
1	R1	How many minutes do you take in the unloading during the receiving process?				
2	R2	How many minutes do you take to carry to the store in the receiving process?				
3	R3	How many minutes do you take in the verification packaging in the receiving process?				
4	R4	How many minutes do you take to sign the delivery consignment note in receving process ?				
5	R5	How many minutes do you take in writing details of a product in the received note in the receiving process?				
6	Re1	How many minutes do you take to count pallets and pieces in the recording process of a product ?				
7	Re2	How many minutes do you take in sorting in the record process?				
8	Re3	How many minutes do you take to specify which is not as per specification and mistake product in the recording process?				
9	Re4	How many minutes do you take to list inferior or defective goods in the recording process?				
10	Re5	How many minutes do you take in the finalization of the list to follow up report to the supplier by email in the recording process?				
11	S1	How many minutes do you take to put away in the Stocking Process of products?				
12	S2	How many minutes take for the segregation of goods in the stock process?				
13	S3	How many minutes do you take to stagging the goods in the stock process?				
14	S4	How many minutes to take to verify the balance of goods in the stock ledger which is listed copy in the computer?				
15	Is1	How many minutes do you take in the Receiving and verification of requisition notes in the Issuing of products?				
16	Is2	How many minutes do you take in the verification of the goods in a stock ledger in the issuing process?				
17	Is3	How many minutes do you take to make an issue note while issuing the goods in the issuing process?				
18	Is4	How many minutes you take pick the goods from store by end users?				
19	Is5	How many minutes do you take to carry from the store and load the goods in a truck for the end user?				

Annexure II

ABC Analysis Inventory List

Rank	Particulars	Unit	Cost	Total Value	% of total cost	Classification	%
1	GNSS A90 RTK FOIF A90046010053)	1	544000	544000	15.12	A	
2	Cheese/paneer Vat (500 liters)	1	268000	268000	7.45	A	
3	Bulk milk cooling tank 500 liters	2	216000	432000	6.00	A	
4	Control Panel Motherboard 999 Zone	1	179500	179500	4.99	A	
5	Display Refrigerator Double Door (1000 liter)	1	94272	94272	2.62	A	
6	TV Screen 65" Crystal UHD 4K	1	92000	92000	2.56	A	
7	Display Counter Refrigerator (500 liters)	1	83968	83968	2.33	A	
8	Display Counter Refrigerator (500 liters)	1	83968	83968	2.33	A	
9	Acer Spin 5 laptop Core -I7	1 set	80000	80000	2.22	A	
10	Electric Butter Churner	3	76608	229824	2.13	A	
11	Controller (P936130112088)	2	70000	140000	1.95	A	
12	Vacuum Packaging Machine	2	65536	131072	1.82	A	
13	Dell Latitude E5300	1	63998	63998	1.78	A	
14	(i5/8GB/51255D/13") S/n. 889XB63	1	63998	63998	1.78	A	76.90
15	Dell Latitude 5300 I5 (74BXB63)	1	63998	63998	1.78	A	
16	Dell Latitude laptop I5	1	63998	63998	1.78	A	
17	Laptop Dell Latitude	1	63998	63998	1.78	A	
18	Vacuum Packing machine import	1	62272	62272	1.73	A	
19	Laptop dell Latitude I5	1	57450	57450	1.60	A	
20	Display Refrigerator (500 liters)	3	57344	172032	1.59	A	
21	Display Refrigerator (500 liters)	1	57344	57344	1.59	A	
22	Laptop Core I-5	1	52000	52000	1.45	A	
23	Projector: Epson (X4HPO800354)	1	41500	41500	1.15	A	
24	Deep Freezer (500 liters)	2	41216	82432	1.15	A	
25	Deep Freezer (500 liters)	1	41216	41216	1.15	A	
26	Defeathering machine	1	38000	38000	1.06	A	
27	Electric Cream Separator	5	36400	182000	1.01	A	
28	Refrigerator 300 liters	1	36096	36096	1.00	A	
29	Refrigerator (300 liters)	1	36096	36096	1.00	A	
30	Mid End Laptop (I-5)	25	35850	896250	1.00	A	
31	Dell Lap Top (Core I-3)	1	35850	35850	1.00	B	
32	Milk Analyzer	2	32000	64000	0.89	B	
33	Desktop Computer I-3	50	30250	1512500	0.84	B	17.76
34	LCD Projector (S/N-BLWK32100719)	1	28900	28900	0.80	B	
35	Projector	1	28900	28900	0.80	B	

36	Foot operated hand wash station	1	26000	26000	0.72	B
37	Chaff Cutter CC-2.2	10	25,000	250000	0.69	B
38	Folding Tents large	2	21500	43000	0.60	B
39	Honey Extractor Marechera	1	20736	20736	0.58	B
40	Water Tank (3000 Letters)	1	19989	19989	0.56	B
41	HP printer (600 x600 dpi)	4	18299	73196	0.51	B
42	Gate cloth readymade Painted	2	17500	35000	0.49	B
43	Readymade Gate cloth small	1	17500	17500	0.49	B
44	HP LaserJet Printer (M1136)	2	15888	31776	0.44	B
45	HP LaserJet Pro Printer (M1136)	1	15888	15888	0.44	B
46	HP LaserJet Pro Printer (M1136)	1	15888	15888	0.44	B
47	HP LaserJet Pro Printer (M1136)	1	15888	15888	0.44	B
48	Vacuum Cleaner	1	15625	15625	0.43	B
49	HP Printer DH	2	14999	29998	0.42	B
50	HP Printer (DH) heavy duty)	1	14999	14999	0.42	B
51	Sintex (2000 liters)	2	12900	25800	0.36	B
52	Water Tank (2000 liters)	1	12900	12900	0.36	B
53	Active speaker	1	12700	12700	0.35	B
54	Automatic debeaked	3	12000	36000	0.33	B
55	Heater	1	12000	12000	0.33	B
56	Folding Tents Medium	1	11500	11500	0.32	B
57	water dispenser hot n cold	16	10750	172000	0.30	B
58	His Majesty Prostrate	3	10000	30000	0.28	B
59	Vacuum Cleaner WD3 (1.629-820)	2	10000	20000	0.28	B
60	WD3 (1.629 -820)	1	10000	10000	0.28	B
61	Battery charger	1	10000	10000	0.28	B
62	Battery	1	10000	10000	0.28	B
63	Wooden Shel Design	7	9500	66500	0.26	B
64	Revolving Chair	1	9500	9500	0.26	B
65	Chair High Back	1	9490	9490	0.26	B
66	Chair High Revolving chair	1	9390	9390	0.26	B
67	High Revolving Chair	1	9390	9390	0.26	B
68	Steel Trunk 52"x40" x 40"	2	8700	17400	0.24	B
69	CCTV set	1	8500	8500	0.24	B
70	Weighing Balance (200 kgs)	1	8000	8000	0.22	B
71	Street Light 90 watts	4	7777	31108	0.22	C
72	Led Street light 90watts	1	7777	7777	0.22	C
73	Steel Almirah 54" x 30£ x 17"	1	7600	7600	0.21	C
74	Revolving Chair	2	7468	14936	0.21	C
75	Revolving Chair SS-855	1	7468	7468	0.21	C
76	Revolving Chair	1	7468	7468	0.21	C
77	Drawer chest (Art - 463)	1	7107	7107	0.20	C
78	Printer for Milk Analyzer	2	7078	14156	0.20	C
79	Curd Percolator with can	9	7065	63585	0.20	C
80	Rover poll	1	7000	7000	0.19	C
81	Weighing Balance (100 Kgs)	1	6809	6809	0.19	C
82	Debeaking machine	2	6500	13000	0.18	C 5.34
83	Back Ups 1100V	1 no	6500	6500	0.18	C
84	window Cloth	8	6500	5200	0.18	C
85	Non-Perforated Crate	5	6374	31870	0.18	C

86	Wall mount Heater (Euro Stand)	92	6300	579600	0.18	C
87	Wall mount Heater (2300 watts)	74	6300	466200	0.18	C
88	Led Flood light 100 watt	4	6300	25200	0.18	C
89	Green Board	3	6244	18732	0.17	C
90	Green board 1200 x 2400	3	6244	18,732	0.17	C
91	Green Board 12 x 24	2	6244	12488	0.17	C
92	Steel half Sect. Table	1	6039	6039	0.17	C
93	Hume pipe 300 mm	5	5814	29070	0.16	C
94	Led Flood Light 100 watts	2	5800	11600	0.16	C
95	Drag Net	4	5632	22528	0.16	C
96	Lamination Machine A4 Gobber	1 no	5500	5500	0.15	C
97	processor repairing	1	5200	5200	0.14	C
98	Xerox work Centre 5024	3	4800	14400	0.13	C
99	Square table DE-01	3	4775	14,325	0.13	C
100	Developer	1	4500	4500	0.13	C

Annexure III

Raw data of the current inventory management process of Paro district administration, Bhutan

Code			A load				A load			A load			Volume of Product			Peak time	Normal time	Off peak time	Average of all
1	R1	How many minutes do you take in the unloading during the receiving process?	0:00:30	0:00:29	0:00:31	0:00:59	0:00:57	0:01:02	0:01:30	0:01:27	0:01:24	0:01:23	1	5	1	0:00:31	0:01:02	0:01:30	0:01:01
2	R2	How many minutes do you take to carry to the store in the receiving process?	0:01:30	0:01:27	0:01:29	0:01:30	0:01:27	0:01:024	0:01:23	0:01:21	0:01:19	0:01:20	1	5	1	0:01:30	0:01:30	0:01:23	0:01:28
3	R3	How many minutes do you take in the verification packaging in the receiving process?	0:00:59	0:00:56	0:01:00	0:01:30	0:01:26	0:01:25	0:01:01	0:01:03	0:01:02	0:01:02	1	2	1	0:01:00	0:01:30	0:01:03	0:01:11
4	R4	How many minutes do you take to sign the delivery consignment note in receving process ?	0:00:56	0:00:53	0:00:54	0:00:57	0:00:55	0:01:00	0:01:05	0:01:04	0:01:05	0:01:04	1	1	4	0:00:56	0:01:00	0:01:05	0:01:00
5	R5	How many minutes do you take in writing details of a product in the received note in the receiving process?	0:00:59	0:00:58	0:00:56	0:01:01	0:00:57	0:00:57	0:01:00	0:01:01	0:01:02	0:01:27	1	2	2	0:00:59	0:01:01	0:01:27	0:01:09
6	Re1	How many minutes do you take to count pallets and pieces in the recording process of a product ?	0:01:27	0:01:21	0:01:29	0:01:07	0:01:05	0:01:04	0:01:17	0:01:19	0:01:17	0:01:18	1	3	1	0:01:29	0:01:07	0:01:19	0:01:18
7	Re2	How many minutes do you take in sorting in the record process?	0:01:17	0:01:15	0:01:13	0:01:19	0:01:18	0:01:19	0:01:19	0:01:21	0:01:20	0:01:22	1	3	1	0:01:17	0:01:19	0:01:22	0:01:19
8	Re3	How many minutes do you take to specify which is not as per specification and mistake product in the recording process?	0:01:01	0:01:02	0:01:01	0:00:56	0:01:00	0:00:59	0:01:00	0:01:01	0:01:02	0:01:00	1	3	1	0:01:02	0:01:00	0:01:02	0:01:01
9	Re4	How many minutes do you take to list inferior or defective goods in the recording process?	0:01:28	0:01:29	0:01:27	0:01:29	0:01:29	0:01:27	0:01:29	0:01:22	0:01:23	0:01:24	1	2	2	0:01:29	0:01:29	0:01:29	0:01:29
10	Re5	How many minutes do you take in the finalization of the list to follow up report to the supplier by email in the recording process?	0:01:21	0:01:27	0:01:27	0:01:22	0:01:23	0:01:20	0:01:27	0:01:28	0:01:27	0:01:26	1	2	1	0:01:27	0:01:23	0:01:28	0:01:26
11	S1	How many minutes do you take to put away in the Stocking Process of products?	0:01:22	0:01:23	0:01:24	0:05:01	0:01:19	0:01:17	0:01:15	0:01:17	0:01:24	0:01:25	1	5	1	0:01:24	0:05:01	0:01:25	0:02:37
12	S2	How many minutes take for the segregation of goods in the stock process?	0:01:07	0:01:05	0:01:08	0:01:03	0:01:02	0:01:19	0:01:20	0:01:18	0:01:21	0:01:19	1	3	5	0:01:08	0:01:19	0:01:21	0:01:16
13	S3	How many minutes do you take to stagging the goods in the stock process?	0:01:09	0:01:04	0:01:03	0:01:19	0:01:17	0:01:16	0:01:49	0:01:15	0:01:14	0:01:17	1	5	1	0:01:09	0:01:19	0:01:49	0:01:26
14	S4	How many minutes to take to verify the balance of goods in the stock ledger which is listed copy in the computer?	0:01:09	0:01:07	0:01:08	0:01:09	0:01:01	0:00:59	0:01:10	0:01:17	0:01:18	0:01:16	1	3	3	0:01:09	0:01:09	0:01:18	0:01:12
15	Is1	How many minutes do you take in the Receiving and verification of requisition notes in the Issuing of products?	0:01:01	0:00:59	0:00:58	0:00:57	0:01:01	0:01:02	0:01:03	0:01:16	0:01:14	0:01:013	1	1	4	0:01:01	0:01:02	0:01:16	0:01:06
16	Is2	How many minutes do you take in the verification of the goods in a stock ledger in the issuing process?	0:01:06	0:01:03	0:01:07	0:00:51	0:01:00	0:01:08	0:00:58	0:01:01	0:01:02	0:01:04	1	5	4	0:01:07	0:01:08	0:01:04	0:01:06
17	Is3	How many minutes do you take to make an issue note while issuing the goods in the issuing process?	0:01:03	0:01:01	0:01:04	0:01:00	0:01:02	0:01:15	0:01:11	0:01:14	0:01:012	0:01:12	1	1	4	0:01:04	0:01:15	0:01:14	0:01:11
18	Is4	How many minutes you take pick the goods from store by end users?	0:01:09	0:01:05	0:01:07	0:01:59	0:01:30	0:01:08	0:01:22	0:01:00	0:01:14	0:01:13	1	5	1	0:01:09	0:01:59	0:01:22	0:01:30
19	Is5	How many minutes do you take to carry from the store and load the goods in a truck for the end user?	0:01:09	0:01:07	0:01:08	0:01:35	0:01:03	0:01:11	0:01:09	0:01:25	0:01:26	0:01:28	1	5	1	0:01:09	0:01:35	0:01:28	0:01:24

Annexure IV

The Data collected was analyzed by finding the average of overall

Peak time				Normal time			Off-peak time				P	S	Pa	APT	ANT	AOPT	OA
Code	A load(Week1)			A load(Week 2)			A load(week 3)				Volume of Product	Number of staff	Number of papers	Average Peak time	Average Normal time	Average Off-peak time	Overal Average
R1	0:00:30	0:00:29	0:00:31	0:00:59	0:00:57	0:01:02	0:01:30	0:01:27	0:01:24	0:01:23	1	5	1	0:00:30	0:00:59	0:01:26	0:00:58
R2	0:01:30	0:01:27	0:01:29	0:01:30	0:01:27	0:01:024	0:01:23	0:01:21	0:01:19	0:01:20	1	5	1	0:01:29	0:01:29	0:01:21	0:01:26
R3	0:00:59	0:00:56	0:01:00	0:01:30	0:01:26	0:01:25	0:01:01	0:01:03	0:01:02	0:01:02	1	2	1	0:00:58	0:01:27	0:01:02	0:01:09
R4	0:00:56	0:00:53	0:00:54	0:00:57	0:00:55	0:01:00	0:01:05	0:01:04	0:01:05	0:01:04	1	1	4	0:00:54	0:00:57	0:01:04	0:00:59
R5	0:00:59	0:00:58	0:00:56	0:01:01	0:00:57	0:00:57	0:01:00	0:01:01	0:01:02	0:01:27	1	2	2	0:00:58	0:00:58	0:01:07	0:01:01
Re1	0:01:27	0:01:21	0:01:29	0:01:07	0:01:05	0:01:04	0:01:17	0:01:19	0:01:17	0:01:18	1	3	1	0:01:26	0:01:05	0:01:18	0:01:16
Re2	0:01:17	0:01:15	0:01:13	0:01:19	0:01:18	0:01:19	0:01:19	0:01:21	0:01:20	0:01:22	1	3	1	0:01:15	0:01:19	0:01:20	0:01:18
Re3	0:01:01	0:01:02	0:01:01	0:00:56	0:01:00	0:00:59	0:01:00	0:01:01	0:01:02	0:01:00	1	3	1	0:01:01	0:00:58	0:01:01	0:01:00
Re4	0:01:28	0:01:29	0:01:27	0:01:29	0:01:29	0:01:27	0:01:29	0:01:22	0:01:23	0:01:24	1	2	2	0:01:28	0:01:28	0:01:24	0:01:27
Re5	0:01:21	0:01:27	0:01:27	0:01:22	0:01:23	0:01:20	0:01:27	0:01:28	0:01:27	0:01:26	1	2	1	0:01:25	0:01:22	0:01:27	0:01:25
S1	0:01:22	0:01:23	0:01:24	0:01:01	0:01:19	0:01:17	0:01:15	0:01:17	0:01:24	0:01:25	1	5	1	0:01:23	0:01:12	0:01:20	0:01:19
S2	0:01:07	0:01:05	0:01:08	0:01:03	0:01:02	0:01:19	0:01:20	0:01:18	0:01:21	0:01:19	1	3	5	0:01:07	0:01:08	0:01:20	0:01:11
S3	0:01:09	0:01:04	0:01:03	0:01:19	0:01:17	0:01:16	0:01:49	0:01:15	0:01:14	0:01:17	1	5	1	0:01:05	0:01:17	0:01:24	0:01:15
S4	0:01:09	0:01:07	0:01:08	0:01:09	0:01:01	0:00:59	0:01:10	0:01:17	0:01:18	0:01:16	1	3	3	0:01:08	0:01:03	0:01:15	0:01:09
Is1	0:01:01	0:00:59	0:00:58	0:00:57	0:01:01	0:01:02	0:01:03	0:01:16	0:01:14	0:01:013	1	1	4	0:00:59	0:01:00	0:01:11	0:01:03
Is2	0:01:06	0:01:03	0:01:07	0:00:51	0:01:00	0:01:08	0:00:58	0:01:01	0:01:02	0:01:04	1	5	4	0:01:05	0:01:00	0:01:01	0:01:02
Is3	0:01:03	0:01:01	0:01:04	0:01:00	0:01:02	0:01:15	0:01:11	0:01:14	0:01:012	0:01:12	1	1	4	0:01:03	0:01:06	0:01:12	0:01:07
Is4	0:01:09	0:01:05	0:01:07	0:01:59	0:01:30	0:01:08	0:01:22	0:01:00	0:01:14	0:01:13	1	5	1	0:01:07	0:01:32	0:01:12	0:01:17
Is5	0:01:09	0:01:07	0:01:08	0:01:35	0:01:03	0:01:11	0:01:09	0:01:25	0:01:26	0:01:28	1	5	1	0:01:08	0:01:16	0:01:22	0:01:15

Annexure V

The raw data collected based on the current inventory management processs using the stop watch in the stores or warehouse of the procurement field

sl no		Peak time A load	Normal time A load	Off-peak time A load	Average P+N+O/3	No of the staff deployed	No of papers used in each acitivities
1	How many minutes do you take in the unloading during the receiving process?	0:00:57	0:00:58	0:00:59	58	5	5
2	How many minutes do you take to carry to the store in the receiving process?	0:02:09	0:02:29	0:02:58	2:56	5	1
3	How many minutes do you take in the verification packaging in the receiving process?	0:01:03	0:01:34	0:02:05	1:09	2	3
4	How many minutes do you take to sign the delivery consignment note in receving process ?	0:01:59	0:01:58	0:02:00	1:59	1	5
5	How many minutes do you take in writing details of a product in the received note in the receiving process?	0:00:59	0:01:01	0:01:03	1:01	2	3
6	How many minutes do you take to count boxes and pieces in the recording process of a product ?	0:01:15	0:01:17	0:01:16	1:16	3	2
7	How many minutes do you take to specify which is not as per specification verfication in the recording process?	0:01:17	0:01:18	0:01:19	1:18	3	3
8	How many minutes do you take to put away in the Stocking Process of products?	0:01:00	0:01:03	0:01:01	1:01	2	2
9	How many minutes to take to verify the requistion and balance of goods in the stock?	0:01:25	0:01:30	0:01:26	1:27	2	4
10	How many minutes do you take to make an issue note while issuing the goods in the issuing process?	0:01:17	0:01:19	0:01:16	1:19	5	5
11	How many minutes you take pick the goods from store by end users?	0:01:09	0:01:12	0:01:12	1:11	3	2
12	How many minutes you take for the movment of goods from after picking to loading area	1:01:59	1:01:59	1:01:51	1:15	5	2
13	How many minutes you take to load the a goods in a truck of end user?	0:01:17	0:01:22	0:01:18	1:19	3	2
					17:59	41	39

Annexure VI

New Process data collected while using the stop watch along nine integrated activies of inventory process

sl no	**Activities**	**A load(Week1)**	**A load(Week 2)**	**A load(week 3)**	**Number of staff**	**Number of papers**	**Average**
1	Unloading using span track	0:00:05	0:00:05	0:00:05	1	0	0:05
2	Carry cartons to the warehouse by Electric hand pallet Jack	0:01:02	0:01:01	0:01:01	0	0	3:04
3	Verify product in cartons in box by reader	0:00:01	0:00:02	0:00:02	1	0	0:05
4	Paste RFID tag on the box	0:00:20	0:00:19	0:00:21	1	1	1:01
5	Put away a product by people	0:00:17	0:00:19	0:00:19	2	0	3:07
6	Create Issue Note and Issue the goods	0:00:17	0:00:19	0:00:19	2	1	1:35
7	Picking of product by Electric and pallet jack	0:00:22	0:00:21	0:00:25	1	0	0:05
8	Move the product to the loading area	0:00:02	0:00:03	0:00:03	1	0	3:01
9	Loading span track and electric hand pallet jack	0:00:06	0:00:11	0:00:08	1	0	1:02
					10	2	11:05

Annexure VII

The questionnaire based on the effect of the information technology on TBL

Questionnaire

The application of information technology in the procuring agencies of Bhutan

Research Objectives

1. Study the current inventory management process in the procuring agency of Bhutan.
2. Propose the ways to apply information technology in procuring agencies of Bhutan.
3. Analyze the effect of information technology on the procuring agencies of Bhutan.

This questionnaire is for the research study under the Faculty of Logistics and Digital Supply Chain, Naresuan University, Thailand. The research papers would investigate and identify the application of Information Technology in the procuring agencies of Bhutan particularly in inventory management. The questions are about 2 parts. The information shared is entirely for personal research and please keep it CONFIDENTIAL.

Part 1: Awareness of information technology
Part 2: Effect of Triple bottom line by information technology

Thanking You

Leki Jungney

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Annexure VIII

TBL questionnaire

Questionnaire ID………………

Questionnaire for "The application of the information technology in the procuring agencies of Bhutan."

Part I: Personal Information

Name: ………………………
Designation: …………………
Experience:
Education background ……………………...

Part II: Effect on the TBL-Human Resource Competency

Items	Questions	Response	Suggestions & Comments
1.	Are there any Information Technology devices utilized in your agencies?	1. Yes 2. No	
2.	Have you trained or attended any meetings related to RFID that can be used in the automation of business activities and to increase efficiency in the stores and warehouse?	1. Never 2. 1time 3. 2 times 4. More than 2 times	
3.	Have you ever been familiar with practically using information technology devices RFID before?	1. Never 2. Sometime 3. Often 4. Very often	
4.	Do you want to change the current inventory system from a manual-based to a digitalized inventory process?	1. Strongly Disagree 2. Disagree 3. Agree 4. Strongly Agree	
5.	Do you need the training to handle the RFID equipment in the inventory process?	1. Yes 2. May be 3. No 4. Don't know	