THE ROLE OF INTERNET OF THINGS (IOT) TECHNOLOGY IN BUILDING A REAL-TIME COSTING SYSTEM FOR ADDRESSING VARIANCES IN SUSTAINABLE SUPPLY CHAIN COSTS AND ENHANCING COST REPORTING: AN APPLIED STUDY IN THE STATE COMPANY FOR THE PHARMACEUTICAL INDUSTRY AND MEDICAL SUPPLIES

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Article history:		Abstract:
Received:	11th August 2025	This study assesses the feasibility of designing an IoT-enabled system to facilitate the construction and operation of a real-time costing system that models fluctuations in supply chain process costs and enables their real-time monitoring within a sustainable supply chain. This encourages pharmaceutical companies and other industrial companies to improve the accuracy and quality of their cost reporting, since it is an important factor in making decisions. Ministry and tax and other topics otherwise addressed in the Heaven on Earth philosophy, they are Characteristics include control over the actual benwafa. Vote Type in the State Based Company for the Pharmaceutical market and Medical Items capstone, both due to the peculiarities of the project work, and due to elements Artificial social investment. This study employed a descriptive-analytical and applied methodology utilizing a questionnaire, document analysis, and an interview. We presume the integration of sensors and IoT technology throughout the supply chain stages and present a methodology that facilitates real-time cost calculation based on standard costs. The integration of IoT makes it possible to keep track of average cost deviations and hold people accountable in real time, which makes things much more efficient. The ratio of making accounting reports and having fewer resources for managing other processes through this kind of supply chain segregation makes the process more sustainable and open, cutting costs, time, and waste while improving how resources are used. The goal is to make sure that this digital backbone can quickly add new technologies to current processes. It shows how the IOT could be combined with traditional costing methods. Organizations may see how resources are being used, how much output is going through, and how much variable cost there is in real time by linking physical assets, machines, and operating systems to a larger number of sensors and smart devices. This change lets businesses go from doing cost analysis only once in a while or looking back to doing it on a regular basis and using it to improve resource allocation and costs. The study also shows that staff has to be taught and trained in order to take use of these technological opportunities. Employees ought to comprehend this information, identify trends, and react to a developing trend instantaneously.
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INTRODUCTION:
In the fast-paced business scenario of today, with an ever-increasing trend towards sustainability and competition, technological innovations impacting different administrative, operational, and financial functions of organizations are already in sight. IoT is one of these technologies that significantly adds value by merging information systems with the physical world (machines, devices, warehouses…) to enable real-time data capturing and analytics to help enhance operational control and efficiency in the supply chain. Supply chain is one of the most wide beast type tough and everchanging evolving high volume low margins in the manufacturing ecosystem, and a variation in cost impacts worse on sustainability impact and financial performance for a critical and high margins outlier industry like pharmaceuticals. On the other hand, Traditional cost and its systems are not so great in Managerial decision making because it gives report after time lag and it is also not easy to predict variances, etc. Therefore, an IoT system needs to be developed which provides real-time costing information regarding actual and standard costs at the earliest time with a high rate of accuracy. This will help it in early identification and measurement of the deviances, and will help to reduce the negative effect of deviations, and help to construct adjustable but realistic cost reporting in conjunction with sustainability and efficiency targets. This applied research that we had previously made at the State Company for the Pharmaceutical Industry and Medical supplies, tries to apply and to explore the actual application of these theoretical digital methods to be applied at an actual industrial company. This technological transition allows research to measure how feasible and efficient such transition can be by emphasising the integration of IoT technology into the conventional costing style. It will evaluate how real-time data collection and analytics may assist in supervising production processes, raise precision and reduce costs of allocation processes, and allow more proactive governance of consumption deviations or variances to plan. The research will help in investigating how costing from IoT be able to improve the quality of cost information and whether better transparency and immediacy of information contributes to improved quality, timely and relevant financial information.

PART ONE: RESEARCH METHODOLOGY AND PREVIOUS STUDIES
1-1 Research Methodology
1-1-1 Research Problem:
The pain points of pharma institutions in supply chain cost visibility and control get magnified as it is becoming operationally more complex and the markets continue to be highly dynamic. Even as organizations use traditional accounting systems to track expenses and assess variances, those systems have age-old issues concerning the reporting cycle with a challenge of real-time monitoring of Variances facilitating poor decisions & optimal resource utilization. Instead, by these problems it will force IoT technology providing a real time channel for accounting and operations data collection — separately possibly it could become life based data assimilation with costing system to deliver reality based detail real time report. Although this technology has huge potential for implementation of real-time costing system, implementation of a real-time costing system in construction fields is not practiced uniformly. It is a metaphysical infringement in the sector of industry of Iraq. However, the IoT technology is a miracle which can actually offer a solution for the primary question of this study in the following manner: How IoT technology helps develop the design of a real-time costing system which is able to respond to the shifts of sustainability supply chain costs like sustainability elegance and expense regimen, then supply a more quick and precise charge report?.

1-1-2 Research Significance:
As evidenced in the significant areas of tech accounting and management, namely supply chain sustainability, cost concepts and digital transformation, this is an opportune study. This study contributes to the existing knowledge on the relationship between cost accounting and IOT, which is an unexplored area in the Arab context. The study offers a worldwide model that can ultimately be employed as a guide for future decision studies for implementing real-time costing. In that line, it also provides a practical prototype in regard to transfer of IoT technologies to functional application of machinery system in industrial field (and in this context it could be an industrial pharmacy complex as represented by State Company for the Pharmaceutical Industry and Medical Supplies); Continuous stream of data which is the relatively accurate and real-time which empower managers with the tools to make superior decisions within the context of waste reduction, deviation control, sustainability and efficiency improvement of systems. Lastly, it emphasizes the importance of IoT for evolving conventional accounting system to intelligent systems that also has interaction potentiality with real-time data engines developed for automating the pricing phenomenon is the most significant progress in accounting system advancements.

1-1-3 Research Objectives:

The purpose of this research is to demonstrate how IoT technology may be used to create a real-time costing system that corrects for variations in sustainable supply chain expenses and raises the standard of cost reporting in commercial organizations. Among the specific goals are:

1. Outlining the theoretical underpinnings of sustainable supply chains, real-time costing systems, cost variances, and the Internet of Things.
2. Examining the State Company's current pharmaceutical industry and medical supply cost system and determining the difficulties in monitoring cost variations.
3. Developing a suggested IoT-based real-time costing system model to gather accounting and operational data instantly.
4. Evaluating how well the suggested method improves the organization's capacity to identify and promptly address cost variances.
5. Assessing how IoT applications affect the precision and quality of cost reporting as well as how they contribute to supply chain sustainability by reducing waste and maximizing resource use.

1-1-4 Research Hypotheses:

Based on the research problem and objectives, the main hypothesis can be stated as: "There is a statistically significant impact of IoT technology application in building a real-time costing system that contributes to addressing Variances in sustainable supply chain costs and enhancing cost reporting**".** From this main hypothesis, the following sub-hypotheses emerge:

1. IoT device usage significantly improves the accuracy of real-time cost data.
2. Integrating IoT into costing systems reduces the time needed to detect and address deviations.
3. A real-time IoT-based costing system enhances the quality of accounting and managerial cost reports.
4. Applying IoT has a positive impact on supply chain sustainability by reducing waste and improving resource efficiency.
5. There is a significant relationship between the level of IoT adoption within the company and the effectiveness of the costing system in supporting decision-making.

1-1-5 Research Population and Sample:

The research sample consists of Iraqi manufacturing companies in various types of production sectors that are considered a must to conduct a field research sample for the purpose of utilizing for an IoT in cost accounting systems and elevate the process of supply chain performance levels. This target group is relevant given the need for affordable cost management and digital transformation in a fast-paced technical and economic landscape. The sample was deliberately included the sate company for the pharmaceutical industry and medical supplies, which is one of the serious industrial firms in Iraq due to the complexity of its production structure, as the company has the capacity to work in procurement, production, warehouses, and distribution of raw materials. This business represents an ideal opportunity to explore the feasibility of implementing IoT and embedded sensor technology in a real-world context and the impact that robotic manufacturing has on costing and cost reporting and variance monitoring in a daily, industrial context.

1-1-6 Research Approach:

This investigation conducts the required descriptive-analytical approach, in the view of the comprehensive analysis, and on the other hand, it studies most of the accounting and administrative phenomena associated with the new information technology in a practical environment of investigation regarding the feasibility of adoption of IoT as a modern real-time costing model in a practical environment of field investigation of the adoption of Internet of things as a modern costing model in the industrial environment of field investigation according to the environment of the research work. This approach aims to model the state of cost systems, analyze the deviations in the supply chain, and subsequently evaluate the IoT adoption versus system performance. This applied (practical) study part is for testing theory and measuring real effects of technology on cost reporting and the cost deviation management; this part also captures all potential real impacts of the designed IoT-based real-time costing system model and the way that (partially) the proposed model has been applied on the State Company for the Pharmaceutical Industries and Medical Suppliers.

1-2 Previous Studies and the Contribution of the Current Research:

1-2-1 Previous Studies:

1. This study report offers a comprehensive assessment of the current capabilities of Iraqi industrial enterprises regarding the integration of IoT technology into costing accounting systems, thereby providing a broad overview of the present stage of digital transformation in the industry. Like the recent education research mentioned above, it found several major obstacles to adoption, such as administrators not wanting to use new technology,

a lack of IT skills, and serious problems with the current digital environment, such as hardware and connectivity issues. To tackle these issues, we present a novel real-time costing model predicated on the Internet of Things (IRTC), which may be amalgamated with conventional accounting techniques to form a continuum of production costs. We... This gives businesses a way to deal with this problem by designing cost management systems that will get more complicated over time so that they can not only show what's going on, but also help people make the best decisions and/or respond to changes in costs depending on what they learn from data.

2. Sustainable Supply Chains: A Prima Facie in the Jungle of Efficiency that Cost Analytics Leverage with IoT Technology Challenges Fernandez & Kumar (2024) Using IoT devices and sensors in the supply chain lets companies get real-time data on things like production processes, inventory levels, and resource use. Making it easier to keep track of and analyze costs. The paper also says that IoT may greatly increase productivity by getting rid of bottlenecks and making procedures better. Then it can assist cut down on waste by keeping better track of supplies, energy, and logistics. It also finds anomalies and process deviations extremely early, such as sensitive level changes like equipment breakdowns, inventory changes, or unreported corporate spending. Question For several years, the study subject persisted in significance: how the Internet of Things (IoT) facilitates cost accounting while simultaneously fostering the development of a robust, intelligent, and sustainable supply chain.

3. Nguyen & Lee (2024) — The impact of the Internet of Things on the precision of cost data in Smart Factories — The authors stress the main point that the functions of cost management processes can be completely changed by combining traditional costing methods with the Internet of Things and cloud computing. With IoT, businesses can keep an eye on costs right away by collecting reliable data on how resources are being used, how well operations are running, and how well manufacturing is going. Then, cloud computing platforms use computational resources to process and store this data. It gives managers real-time, data-driven, technology-based insights that help them make better decisions. This leads to better cost control, forecasting, and budgeting, which is an improved way to manage finances. Because recording data by hand is no longer common and is now done automatically, there is less chance of human error, which is common in conventional accounting and manual record keeping. Together, they make a cost structure that is adaptable, accurate, and efficient. This lets businesses synchronize their operations, get rid of waste, and improve their financial governance.

4. Ali & Zhang (2025): "IoT for Real-Time Cost Measurement in Manufacturing — A Case Study, Asia-Pacific Region" — This case study illustrated an initial instance of how IoT gadgets and specific physical equipment might facilitate the consolidation of cost and financial data within an organization, aiming for substantial cost reduction. IoT sensors and devices built into the production and operation make it possible to automatically get real-time data on labor, materials, and resource use, which will then be analyzed. Constant tracking makes financial data available and fills the gap between what people expect and what actually happens. It also makes sure that cost calculations are correct and that the uncertainty produced by manual reporting is lessened. The technology also helps find cost differences or changes early on, so all managers are ready to immediately get rid of waste and make good decisions. The study's overall findings indicated that the integration of IoT technologies, such as RFID, can enhance operational accountability, necessitating the implementation of more stringent cost control measures within the enterprise, and facilitating a more agile and data-driven approach to financial administration processes.

5. Al-Khafaji & Hassan (2025) Abstract – A Suggested IoT-Based Cost Control System for the Iraqi Pharmaceutical Sector – The present study sought to establish a framework (A Cost Control System Based on IoT) for adoption and implementation within the pharmaceutical industry in Iraq, encompassing the processing of cost-related data; thereby underscoring the necessity of advancing the existing operating system grounded in cost control and management. This system connects IoT devices to production, inventory, and supply chain operations so that you can keep track of the time and cost of using materials and resources in real time. We assist management keep an eye on expense overruns and operational inefficiencies that are caused by more human error. The study said that the UP-EDMS helps people make judgments faster and smarter. Summary In conclusion, the work IoT based cost control system would pave the way to actualizing a strategic operation efficiency and finacial control to the Iraqi pharmaceutical industry as a whole.

6. Salim & Ahmed (2025): Internet of Things Sensors for Real-Time Cost Variance Accounting: An Accounting Strategic Model — This paper describes the proposal of an accounting strategic model that showed how the integration of IoT sensors could improve managerial decisions and propose a closer intertwined accounting

systems with the information technology. In this system, processes, resources, and activities can be watched, and if the cost changes, it can be found right away. It also means that if deviations are tracked in real time then managers can immediately curb inefficiencies and unnecessary costs, leading to the use of real time and correct data for making strategic financial decisions. In addition, this model ensures that the data collection, processing and reporting function is interlinked through which greater alignments of the accounting practices with the IT systems can be attained leading to an overall boost in operational transparency, reliability and agility.

1-2-2 Contribution and Distinction of the Current Research:

With an emphasis on increasing the precision and efficacy of cost reporting in the State Company for the Pharmaceutical Industry and Medical Supplies, this research aids in the development of an integrated real-time costing system based on IoT to manage variations in sustainable supply chain costs. Among its distinctive contributions are:

1. Actual country-specific implementation in Iraqi pharmaceutical enterprises—This research examines a particular Iraqi industry, however this is complicated by the previous research's focus on generic industries or regional locations.
2. Sustainability: The research looks for ways to include social and environmental sustainability concepts in the framework for reporting and cost analysis.
3. Real-time hotspot: It starts with accurate reporting and then goes on to find cost differences in real time and start taking steps to close the gap.
4. Combining modern IoT and accounting systems: This solved the problems of implementation and created a model that can be used in similar industrial situations..

These contributions are important for both academics and people who work in cost management and sustainable supply chains. It provides a solid base for creating new and useful costing methods for the pharmaceutical industry by suggesting the use of the Internet of Things (IoT) and real-time data integration to improve cost accuracy, boost efficiency, and make it easier to spot problems early on. The research advances the theoretical framework of digital cost management and offers empirical insights that may promote the adoption of more sophisticated, technology-driven methods among industry professionals. This study ultimately aids organizations in enhancing operational efficiency, financial transparency, and sustainability by offering a framework for developing a model that can be adapted and expanded across analogous industrial settings.

Part Two: The Theoretical Framework of the Research
2.1 The Concept and Importance of the Internet of Things (IoT):

The Internet of Things (IoT) lets things connect to the internet so they may gather information, talk to each other, and act on their own. This new technology links everything we usually think of as normal, including cars, industrial machines, and residential appliances, into one network. IoT is becoming necessary to boost operational efficiency since connected devices allow you to monitor and control processes from anywhere in real time. This connectivity is not only useful, but it also makes it easier to manage resources, do predictive maintenance, and make decisions more quickly in all areas. This makes life easier with IoT. (Atzori, et al. 2024: 15).

The Internet of Things (IoT) has the amazing capacity to build intelligent settings in which decisions are made quickly and intelligently based on real-time data. IoT improves accuracy and efficiency in a variety of industries by continuously gathering and evaluating data from linked devices. Better patient monitoring and quicker reactions to urgent circumstances are made possible in the healthcare industry. In agriculture, it facilitates accurate resource management, cutting waste and raising crop yields; in industry, it streamlines production procedures and reduces downtime. IoT is a vital tool for contemporary, data-driven enterprises because of its smooth integration of data and technology, which not only increases productivity but also encourages sustainable practices(Li & Xu, 2025: 37).

The gathering and analysis of large data using cutting-edge technology like artificial intelligence and machine learning is a key component of the Internet of Things. Strategic decision-making based on solid data is improved by these capabilities, which allow analysts and managers to comprehend operational patterns and anticipate failures or Variances (Zhang, et al. 2024: 102). In the realm of sustainable supply chains, IoT is becoming more and more significant since it can be used to track and evaluate production and distribution phases in real time. This enhances businesses' environmental efficiency while lowering energy and raw material usage (Singh & Kaur, 2025: 58).

The Internet of Things (IoT) improves operating procedures and promotes increased transparency and confidence among all supply chain actors by offering accurate and trustworthy real-time data. In sectors like pharmaceuticals and

medical supplies, where upholding stringent quality standards is crucial for safety and compliance, this skill is especially important. IoT enables prompt shipment tracking, ongoing condition monitoring, and early problem identification, guaranteeing that goods fulfill legal criteria. As a result, stakeholders may confidently make well-informed decisions, lowering risks, avoiding mistakes, and enhancing overall supply chain efficiency and accountability. (Brown & Taylor, 2024: 79).

Lastly, a critical first step toward complete digitization and digital transformation is the deployment of the Internet of Things (IoT) in commercial and industrial establishments. Organizations may promote more responsible and effective practices by incorporating IoT technologies to generate sustainable innovation that addresses urgent environmental and social issues. Additionally, IoT makes it easier to create new business models based on intelligent data analysis, which helps organizations predict trends, streamline processes, and provide consumers with more value. IoT is positioned as a critical enabler for future-ready companies dedicated to growth and sustainability because of its unique combination of real-time information, operational efficiency, and creative strategy (Martinez & Lopez, 2025: 45).

2.2 The Concept and Importance of Real-Time Costing Systems:

A real-time costing system is a sophisticated accounting framework that, instead of depending on past records or forecasts for the future, computes actual costs instantly using direct operational data. In fast-paced production settings, this method gives managers access to real-time financial facts, facilitating prompt and precise decision-making. Real-time costing assists in finding inefficiencies, managing spending, and allocating resources as efficiently as possible by capturing the actual costs of production as they happen. It is a vital tool for contemporary firms looking to improve operational performance, preserve competitiveness, and efficiently meet changing market needs because of its capacity to provide accurate, actionable information (Anderson & Patel, 2024: 22).

Real-time costing is crucial because it may identify Variances as they happen, giving management the chance to take prompt action and lessen adverse financial effects. This proactive management strategy reduces resource waste and provides more operational supervision (Lopez & Greene, 2025: 40). For real-time costing systems to give accurate and continuously updated data on the labor, materials, and machines utilized in production, they must be integrated with digital technologies like ERP software, smart sensors, and the Internet of Things (IoT) (Nguyen & Zhao, 2024: 77).

Businesses can increase price accuracy and profitability analysis in real-time by implementing real-time costing systems. This helps them make quick, data-driven choices about changes to their manufacturing, distribution, or marketing strategies (Chang & Miller, 2025: 91). By giving all pertinent parties—including suppliers and the financial and operational departments—up-to-date cost information, these systems help improve openness inside the company and among stakeholders, promoting coordination and minimizing duplication of effort (White & Schroeder, 2024: 33).

By reducing both fixed and variable costs, a real-time costing system can greatly improve an organization's financial performance. The system detects inefficiencies and waste causes instantly through ongoing operation monitoring, enabling prompt remedial action. In addition to streamlining procedures, this proactive strategy enhances resource efficiency and cuts down on wasteful spending. According to recent studies, businesses who use real-time costing have improved profitability, more precise budgeting, and increased cost management. This technology enables managers to make well-informed decisions that promote long-term growth and enhance financial stability by giving them rapid insights into actual operating costs (Kim & Hassan, 2025: 66).

Real-time costing systems give industrial businesses more flexibility in controlling expenses in the face of quickly shifting market conditions, according to field experiences. Businesses that deal with significant swings in the cost of energy and raw materials would particularly benefit from this flexibility. These technologies enable managers to maximize resource utilization, modify production plans, and react quickly to cost challenges by providing instant insights into actual operational expenses. In addition to reducing financial risks, real-time cost tracking and control facilitates more robust and flexible decision-making. As a result, businesses may remain stable and competitive even in erratic and fluctuating markets (Singh & Romero, 2024: 54).

Furthermore, a key component of the digital revolution of management accounting is the use of real-time costing tools. They are a first step in creating intelligent systems that improve cost forecasting and resource planning. These systems give managers access to real-time, precise financial data, which helps them predict trends, allocate resources effectively, and make more confident strategic decisions. In addition to improving operational transparency, incorporating real-time data into accounting procedures creates the framework for predictive modeling and advanced analytics. More informed, forward-looking financial planning is supported by this move toward intelligent, data-driven management, which also improves organizational agility (Garcia & Nolan, 2025: 103).

2.3 The Role of the Internet of Things (IoT) in Building a Real-Time Costing System:

Abstract: Amid the rapid digital revolution taking place, Accounting is undergoing a transformation, and Internet of Things (IoT) has surfaced as one of the vital tools to facilitate this transition of traditional accounting systems, particularly focusing on Industrial cost systems. Enabling smart infrastructure through sensors and built-in communication tools, this technology allows real-time monitoring of operational activities within supply chains and manufacturing lines. This takes us a long way forward from the existing real-time costing systems that captured and processed data with agility to provide decision-making inputs for improved accounting accuracy. Such systems enable managers to have real-time access to data on expenditure, which provides close monitoring of financial results and an early detection of anomalies. This capability enables quick corrective measures avoiding errors from compounding into inefficiencies. The fast feedback loop not only helps in enhancing the accuracy of cost calculation but enables proactive decision making and also ensures optimal utilization of resources. Ultimately, real-time data analysis facilitates accountability, better financial control and greater dynamic management styles. Below are listed the chief functions of IoT in this domain:

1. Real-Time Data Provision: By using sensors and networked equipment, IoT technology provides operational data in real-time, enabling cost accounting systems to instantly and continually update cost information. According to (Nguyen & Lee, 2024: 18), this serves as the practical cornerstone of an efficient real-time costing system.

2. Direct Production Data Capture: According to research, IoT can directly record production data from machines, such as run times, material usage, and energy levels. These data are essential for determining real-time prices (Ali & Zhang, 2025: 62).

3. ERP Integration: Field operations and accounting systems can be instantly aligned through the integration of IoT with ERP systems, which makes it possible to generate precise cost data as soon as production activity starts (Martinez & Lopez, 2025: 48).

4. Deviation Detection: By comparing actual data with predetermined criteria, IoT improves internal control and speeds up the time it takes to implement corrective actions, hence assisting in the early detection of cost Variances (Ahmed & Salim, 2025: 90).

5. Operational Transparency: Research indicates that IoT improves operational transparency and makes it possible to track costs at every point of the supply chain, from the receipt of raw materials to the delivery of the finished product. This helps to create more thorough and accurate costing systems (Fernandez & Kumar, 2024: 39).

6. Real-Time Cost Analysis: By combining operational and financial data, IoT not only increases data accuracy but also facilitates real-time cost analysis, enabling management to base choices on insights rather than reports that are delayed (Brown & Taylor, 2024: 71).

7. Changing the Management Accountant's Role: Applied research in smart industrial settings has demonstrated that the use of IoT in costing systems changes the management accountant's function from one of cost recording to one of real-time deviation analysis and active decision-making (Chang & Miller, 2025: 55).

2-4. The Role of the Real-Time Costing System in Addressing Cost Variances in the Sustainable Supply Chain:

Industrial businesses must create effective supply chains as strategic elements to integrate sustainability with social, environmental, and economic performance. As a business grows, it gets tougher to accurately figure out costs and keep an eye on changes that could threaten viability. In this case, a real-time costing system is necessary so that the business can keep track of actual costs as they happen. The system gives managers instant access to financial performance data so they can find problems right away and fix them swiftly. This makes sure that small problems don't turn into big ones. In addition to making it easier to manage costs and run operations more efficiently, this constant monitoring promotes sustainable practices by making sure that resources are used correctly. In the end, true real-time costing helps a business attain its long-term sustainability goals while still keeping an eye on the bottom line. This system works well because it can get accurate data from all levels of the supply chain right away. This lets you do a cost analysis right away and make the right decisions to fix the Variances and make sure resources are used in the best way possible. Here are the primary things this system does to help make the supply chain more sustainable:

1. The real-time costing system makes it possible to identify cost variations instantly, facilitating the early reporting of disparities that could affect the supply chain's financial and environmental sustainability objectives (Johnson & Rivera, 2024: 29).

2. By accurately and continuously monitoring the use of resources, including energy and raw materials, the system contributes to waste reduction, which is a key component of attaining sustainable environmental efficiency (Schmidt & Yang, 2025: 55).

3.   The system detects regions with recurrent Variances by precisely monitoring actual costs at each stage of the supply chain, enabling quick remedial measures to preserve operational and environmental performance (Lopez & Chen, 2024: 64).

4.   By providing rapid reports that highlight Variances and their causes, the real-time system encourages ongoing communication among supply chain stakeholders, improving teamwork and the accomplishment of common sustainability objectives (Ali & Jensen, 2025: 48).

5.   The system helps assess supplier viability from an economic and environmental standpoint by allowing a direct comparison of anticipated and actual costs associated with logistics, transportation, and the sourcing of raw materials (Kim & Gonzalez, 2024: 76).

6.   By directly connecting accounting data with operational operations, it enhances transparency by enabling organizations to track how each action affects actual costs and sustainability goals, especially in sectors with significant environmental effect (Brown & Lee, 2025: 92).

7.   By allowing management to track changes and Variances in real time and examine their reasons to stop recurrence, the system promotes the idea of "continuous improvement" in sustainable supply chains (Fernandez & Malik, 2024: 38).

8.   An organization's capacity to meet international standards and sustainability reporting requirements is enhanced by the real-time correlation between environmental performance and operating costs, which gives it a competitive edge (Garcia & Novak, 2025: 59).

2-5. The Role of the Real-Time Costing System in Addressing Variances to Improve Cost Reporting:

In a world where resource costs are constantly fluctuating, production methods are diverse, and regulations are stringent, industrial organizations face increasing obstacles. Traditional cost reports are no longer enough in this situation to assist in operational and strategic decision-making. As a result, companies need a real-time costing system that can quickly adjust to changes in production and finance procedures. For accurate deviation detection and analysis, such a system depends on the constant flow of operational data from logistics and production. Managers may spot cost variations as soon as they happen and take immediate corrective action by incorporating this data in real time. In addition to guaranteeing precise expense tracking, this dynamic method improves overall operational efficiency, facilitates well-informed decision-making, and fortifies the organization's capacity to react quickly to shifting production demands and market conditions. The accuracy, timeliness, and predictive power of cost reporting are improved by this temporal integration of financial and operational data. This system's main functions in enhancing cost reporting via deviation management are as follows:

1.   By offering immediate cost data that exactly reflect actual performance, the real-time costing system helps promptly and precisely identify Variances from standard costs or budgets, preventing the accumulation of financial errors (Nguyen & Carter, 2024: 41).

2.   The system increases report quality and facilitates prompt decision-making by decreasing the time lag between activity occurrence and cost analysis through continuous data updates (Kim & Patel, 2025: 88).

3.   The system makes it possible to track cost components (materials, labor, and time) in real-time, resulting in more thorough reports with improved analytical capabilities for comparison and explanation across projects and departments (Lopez & Freeman, 2024: 56).

4.   According to studies, the real-time system makes Variances more understandable for non-accounting experts and improves the usability of reports in daily management by presenting them in an interactive and visual way (Ali & Simmons, 2025: 73).

5.   The system's integration with IoT and AI-powered digital dashboards improves the dynamic of cost reports by showing real-time changes and automatically suggesting corrective actions (Brown & Han, 2024: 35).

6.   Reports utilized in financial statements, performance audits, and investment project assessments are more reliable due to the system's high accuracy of cost data (Zhang & Mikhailov, 2025: 102).

7.   The system makes it possible to record the reasons and frequency of deviations, establishing a knowledge base that facilitates the creation of future reports and more precise cost forecasts, which helps with strategic cost planning (Gonzalez & Rivera, 2024: 60).

8.   Lastly, by converting reports from tools for retrospective analysis into immediate diagnostic tools that directly support daily decision-making, the real-time costing system strengthens the idea of "continuous monitoring" within businesses (Singh & Oliveira, 2025: 49).

Part Three: The Applied Aspect of the Study

3-1. Overview of the Research Sample (The State Company for the Manufacturing of Drugs and Medical Supplies):

The State Company for the Manufacturing of Drugs and Medical Supplies is an Iraqi government-owned business that makes high-quality drugs that suit regional demand and help with public health research. It has a long history of making human medications and important medical supplies such intravenous solutions, sterilizing materials, and medical syringes. It is now one of the biggest companies in the Iraqi pharmaceutical business. It works in a multi-step, complicated supply chain that includes importing high-quality raw ingredients, chemical synthesis, pharmaceutical formulation, packaging, and distribution to hospitals and local markets. To make sure that these processes are economically efficient through good cost control and that they follow health and safety and quality requirements, they need to be regularly watched. Pharmaceutical firms have to deal with a lot of problems, like changing costs for raw materials, different ways of making things, and a lot of competition. To understand all the steps of its production at once, they need to use a real-time pricing system. This system will give you accurate, up-to-date information on expenses at every level. This way, you can easily and quickly find operational or financial problems that could hurt your profits or the quality of your products. The real-time system helps the environment and the economy by reducing waste and making better use of resources like energy and raw materials. This also makes things more open inside the company by giving management timely information that they can trust to help them make decisions based on accurate, current facts.

3-2. Developing a Real-Time Costing System Using Internet of Things (IoT) Technology in the State Company for Drugs and Medical Appliances:

The State Company for Drugs and Medical Appliances will be able to trace the value and cost of each item from the moment it is made until the time it is sold by connecting to the Internet of Things (IoT). There won't be any need for such estimates anymore once IoT devices and sensors are put in place in all manufacturing and logistics activities. This is because operational data will be collected and analyzed all the time, and costs will be available in real time with a high level of accuracy. In this method, managers track spending, in real-time, discover the deviation from the route chart and act promptly to redirect back. In the end, an IoT-based system is all about managing money, making the most use of resources, and establishing a strong business output. It has sophisticated sensors that keep track of the energy, things, and people that are used in real time. Sending this information to one place where it is looked at and analyzed in real time. Having real-time information about how resources are being used can help leaders keep track of costs accurately, show where things aren't working well, and make swift changes to operations. The constant flow of live values, along with increasing responsibility and openness, enables people make educated decisions that lead to higher throughput, less waste, and better financial and operational performance. This strategy actually makes things more efficient and sustainable since it makes it easy for management to see any cost differences and take the right steps when it comes to managing a building site. By showing how resources are used and what the operational expenses are, this helps managers cut down on waste and make processes more efficient before they become a problem in real time. A faster response time to Variances gives you more control over your money and makes your business more sustainable by cutting back on unnecessary materials and use Mattingly2023. In conclusion, these actions make it more likely that the organization will run more efficiently and responsibly. They also help find ways to use resources more sustainably and improve operational efficiency where it is needed. The next table illustrates an example of it:

Table 1: Stages of Building the Real-Time Costing System with Applied Technologies and Key Performance Indicators

Stage	Description	Technologies Used	Key Performance Indicators
1. Real-Time Data Collection	Installing sensors on production lines to record consumption of materials and energy	Weight sensors, energy sensors, RFID readers	Material consumption (kg/hour), energy consumption (kWh)
2. Data Transmission	Sending the collected data to a central database via wireless networks	Wi-Fi, LPWAN, MQTT protocols	Data transfer rate (messages/sec), latency (milliseconds)
3. Data Processing & Analysis	Comparing actual data with planned costs using advanced software	ERP, Big Data Analytics, AI	Cost deviation (%), waste rate (%)

4. Real-Time Reporting	Creating dashboards and mobile reports displaying real-time costs and deviations	Dashboards, mobile apps, alerts	Number of deviations, average response time (minutes)

The table shows the four key processes of a real-time pricing system. The first step is mostly about setting up different types of sensors, such as an energy sensor and a weight sensor, to get real-time information about how resources are being used. Phase Two: Focus on how the next-generation communication networks move the data to make sure that it flows quickly, has minimal latencies, and is delivered on time so that it can be examined. New technologies like AI and ERP systems are used to look at the data and find waste and outliers with great accuracy. These tools can find patterns, predict problems that will happen in the future, and suggest ways to improve operational efficiency, giving you a complete picture. Being able to analyze information in real time gives you a full and useful view of how resources are being used, how costs are changing, and how efficient they are. This also makes sure that organizations use proactive management methods that help them run their businesses better, get rid of waste, and keep peak performance at all levels all the time. This is another benefit of integrating AI and ERP to make decision-making easier. It is the penultimate step where management gets data on time through interactive dashboards and thorough reports so they can make smart choices. They show trends and differences from KPIs and turn a lot of complicated data into easy-to-understand pieces of information. Dashboards give managers a rapid glance at operations and costs so they can stop a situation from getting worse before it gets out of hand, see how things have changed over time, and use solutions right away. You can get the right data, and it's always up-to-date and part of the decision-making process. private sector solutions, thereby making sure that any decision-makers can get true full-factor data right now. The table below shows this:

Table 2: Example of Real-Time Cost Data Across Different Production Stages

Stage	Actual Material Used (kg)	Planned Material (kg)	Energy Consumption (kWh)	Actual Material Cost ($)	Actual Energy Cost ($)	Cost Deviation (%)
Packaging	500	480	120	5000	600	+4.17
Mixing	1500	1,600	350	15000	1750	-3.33
Filling	700	700	180	7000	900	0.00

This table compares the real and anticipated materials utilized at various stages of production, as well as the actual costs and energy usage. For instance, there was a cost overrun at the first packing stage when the company used 500 kg of materials instead of the 480 kg that was budgeted, resulting in a positive variance of 4.17%. On the other hand, a -3.33% divergence in material utilization during the mixing step was less than anticipated. In order to take prompt corrective action to stay within the budget and guarantee sustained efficiency, the table also keeps track of energy usage at each stage. The following table provides an illustration of this:

Table 3: Key Performance Indicators (KPIs) for Evaluating the Efficiency of the Real-Time Costing System

KPI	Description	Target	Current Value
Total Cost Deviation (%)	Difference between actual and planned costs	≤ 5%	2.5%
Material Waste Rate (%)	Ratio of wasted to used materials	≤ 3%	2.1%
Energy Consumption Efficiency (%)	Actual vs. planned energy use	≥ 95%	92%
Average Response Time (minutes)	Time taken to correct deviations	≤ 10 mints	8 mints
Availability of Real-Time Reports (%)	Data and report update frequency	100%	98%

The company's primary KPIs for tracking its real-time costing system are compiled in the table. With a current value of 2.5% falling inside the < 5% target, the "Total Cost Deviation" indicates how successfully the system regulates expenses within anticipated boundaries. At 2.1%, below the 3% criterion, the "Material Waste Rate" shows effective resource use. "Energy Consumption Efficiency" needs to be improved because it is only 92% of the target level. Excellent system

reliability is indicated by the 98% real-time report availability and the "Average Response Time" of 8 minutes, which guarantees timely response against deviations.

3-3. Addressing Sustainable Supply Chain Cost Variances Using the Real-Time Costing System in the State Company for Drugs and Medical Appliances:

One of the main issues facing the State Company for Drugs and Medical Appliances is addressing cost variations in the sustainable supply chain, particularly in light of the increased focus on sustainability and resource efficiency. Based on Internet of Things technology, the real-time costing system makes it possible to gather and analyze data in real-time throughout the supply chain. This allows for quick detection of Variances and close monitoring of both financial and environmental performance. With the help of this technology, the business may save environmental expenses and improve operational efficiency right away. The table below provides other examples of this:

Table 4: Stages of Managing Sustainable Supply Chain Cost Variances Using the Real-Time Costing System

Stage	Description	Technologies Used	Key Performance Indicators
1. Monitoring Environmental and Financial Data	Installing sensors to collect data on resource usage and environmental impact	IoT sensors, air and water quality sensors	Carbon emissions (kg/unit), energy consumption (kWh)
2. Deviation Analysis	Analyzing data to identify Variances from cost and environmental plans	ERP systems, Big Data analytics tools	Cost deviation (%), environmental performance index
3. Alerts and Corrective Action	Sending instant alerts to management for corrective action	Mobile apps, dashboard platforms	Response time (minutes), number of corrective actions
4. Continuous Evaluation and Improvement	Periodic review of action effectiveness and system updates	Periodic reports, AI technologies	Cost improvement rate (%), overall sustainability index

The key procedures for managing Variances with the real-time costing system are described in this table. IoT sensors that track energy use and carbon emissions are used to gather financial and environmental data at the beginning of the process, giving precise insights. In order to find Variances from benchmarks, this data is examined in the second phase utilizing ERP and Big Data techniques. In order to enable rapid corrective steps, the third stage places a strong emphasis on prompt response through immediate alerts to management. In order to promote sustainability, regular reports and AI technologies are used for continuous system review and development. The following table provides an illustration of this:

Table 5: Data on Sustainable Supply Chain Cost Variances Across Different Stages

Stage	Planned Cost ($)	Actual Cost ($)	Cost Deviation (%)	Planned Carbon Emissions (kg)	Actual Emissions (kg)	Emission Deviation (%)
Raw Material Purchase	50000	52,000	+4.00	1,200	1,350	+12.50
Transportation & Distribution	30000	28,500	-5.00	800	750	-6.25
Storage	10000	11,000	+10.00	400	450	+12.50

A thorough comparison of projected and actual expenses and emissions at different supply chain stages is given in this table. Carbon emissions increased by 12.5% and real costs were 4% more than planned during the raw materials stage, underscoring the need for efficiency gains. On the other hand, the transportation stage demonstrated excellent performance with a 6.25% decrease in emissions and a 5% cost reduction. Emissions and storage expenses, however, were 10% and 12.5% more than anticipated, respectively, indicating the need for a process review to lower expenses and improve sustainability. The following table provides an illustration of this:

Table 6: Key Performance Indicators for Managing Sustainable Supply Chain Cost Deviations

KPI	Description	Target	Current Value

Cost Deviation (%)	**Difference between actual and planned cost**	**≤ 5%**	**3.0%**
Carbon Emission Rate (%)	**Difference between actual and planned emissions**	**≤ 10%**	**8.5%**
Response Time (minutes)	**Time needed to take corrective actions**	**≤ 15 mints**	**12 mints**
Sustainability Improvement Rate (%)	**Annual improvement in sustainability metrics**	**≥ 5%**	**6.2%**

The organization uses the key performance indicators shown in the table to assess how well their deviation management system is working. Good financial control is shown by the present cost deviation of 3.0%, which is within the target limit of < 5%. In accordance with sustainability requirements, the carbon emission rate of 8.5% is likewise below the upper limit. Timely action against Variances is confirmed by a 12-minute reaction time. The company's sustainability improvement rate of 6.2% reflects its continuous efforts to improve environmental performance and lower long-term costs. This indicator shows observable advancements in adopting environmentally friendly procedures and maximizing the use of available resources. The company reduces operating costs and demonstrates its dedication to responsible environmental management by monitoring and enhancing sustainability. By showing a quantifiable effect on the business's overall performance and long-term resilience, the improvement rate shows that specific initiativesare successfully advancing both financial savings and sustainable development goals.

3-4- Improving Cost Reports Using the Real-Time Costing System at the General Company for Pharmaceuticals and Medical Supplies:

In the General Company for Pharmaceuticals and Medical Supplies, cost reports are regarded as essential instruments for administrative and strategic decision-making. The transition to real-time costing systems based on Internet of Things (IoT) technology, which permits direct and continuous data collection and analysis, has become imperative due to technological advancements. By enabling management spot Variances as soon as they happen and swiftly take corrective action, this system helps to increase the accuracy and transparency of cost reports. The following table serves as an example of this:

Table 7: Comparison Between Traditional Cost Reports and Real-Time Cost Reports Using IoT

Feature	Traditional Cost Reports	Real-Time Cost Reports Using IoT
Update Frequency	**Periodic (monthly or quarterly)**	**Continuous and instantaneous**
Data Accuracy	**Depends on manual aggregation and estimates**	**Accurate data from sensors and smart devices**
Decision-Making Speed	**Slow due to delayed data access**	**Fast thanks to instant data availability**
Detection of Deviations	**After a long time lag**	**Immediately upon deviation occurrence**
Transparency Level	**Limited due to delayed updates**	**Very high with continuously updated reports**

The table demonstrates the key distinction between real-time costing with IoT and the conventional system. Decision-making procedures are delayed by traditional reports' reliance on periodic data, which is frequently delayed and inaccurately reflects the actual situation. Real-time reporting greatly improves operational transparency by utilizing smart sensors to deliver accurate and continuous data updates. It ensures more precise tracking of spending and resource use by minimizing cost variances and reducing errors through the delivery of instant insights. Management is able to make quick, well-informed choices, react proactively to new problems, and maximize operational efficiency because to this steady stream of trustworthy information. Furthermore, by emphasizing trends and abnormalities as they happen, real-time reporting helps strategic planning by empowering firms to tighten process control, enhance accountability, and boost overall performance in fast-paced corporate contexts. This is further illustrated in the table that follows:

Table 8: Indicators of Improvement in Accuracy and Speed of Cost Reports Using the Real-Time Costing System

Indicator	Before Real-Time System Use	After Real-Time System Use	Improvement (%)

Average Report Preparation Time (hours)	48	1	97.9%
Error Rate in Cost Data (%)	5	1	80%
Number of Variances Detected Monthly	3	10	233%
Response Time to Correct Variances (hours)	72	6	91.7%

Following the implementation of the real-time costing system, the table clearly demonstrates an improvement in cost report performance KPIs. Faster information analysis was made possible by reducing the typical report preparation time from two days to just one hour. The data's error rate decreased from 5% to 1%, improving the information's accuracy. The efficiency of the method in early detection was demonstrated by the notable increase in the number of Variances detected each month. Furthermore, there was a significant drop in the average response time to rectify deviations, which improved control capacities and lowered potential damages. The following table helps to further clarify this:

Table 9: Impact of the Real-Time Costing System on Improving Financial Decision-Making in the Company

Aspect	Previous Result with Traditional System	Result After Applying Real-Time System	Notes
Accuracy of Recorded Costs	Medium	High	Reduced errors in data recording
Speed of Performance Reports	Slow	Instantaneous	Real-time reports support faster decisions
Flexibility in Handling Deviations	Limited	High	Immediate response to unexpected fluctuations
Financial Management Satisfaction Level	Medium	High	Availability of accurate data supports decision-making

Table illustrates benefits of real time costing technology in many aspects of a business financial decision making processes With the implementation of the new system, the tracking of costs improved significantly which resulted in the generation of more reliable financial reports. This improved accuracy helps management to now take decisions based on the right data instead of just a guess work or information that takes time. Reports were generated much faster too, enabling management to quickly respond to new trends. Access to real-time, accurate data strengthened financial control, underpinned strategic decision-making, and led to greater agility dealing with variances. Faster corrective actions would lead to stronger operational control, better resource allocation, and an overall boost to responsiveness and efficiency.

3-5- Testing the Research Hypotheses:

The impact of implementing Internet of Things (IoT) technology in creating a real-time costing system that helps to improve cost performance and sustainability in the supply chain at the General Company for Pharmaceuticals and Medical Supplies was investigated using main and sub-hypotheses developed in light of the research problem and objectives. Accurate field data was gathered utilizing a variety of research instruments in order to confirm the validity of these hypotheses. Subsequently, suitable statistical techniques were used to examine the impacts and correlations between the variables under investigation. The purpose of the hypothesis testing is to determine whether adopting IoT improves cost data accuracy, accelerates deviation detection, improves the quality of cost reporting, and supports supply chain sustainability in a statistically meaningful way. The outcomes of testing the sub-hypotheses are shown below, together with an analysis and interpretation of the data gathered and statistical tests that demonstrate the hypotheses' validity and influence on cost performance and decision support systems.

1- Testing the First Sub-Hypothesis:

This hypothesis states: There is a statistically significant effect of using IoT devices in increasing the accuracy of real-time cost data. One important factor influencing the effectiveness of the costing system and the capacity to make prompt and accurate judgments is the accuracy of real-time cost data. Data was gathered from samples inside the organization to assess the accuracy of cost reports both before and after the implementation of IoT devices in order to test this hypothesis. Since a T-test is suitable for examining differences between two related sample means, it was

employed to compare the data accuracy means between the two cases. The following table displays the findings of the T-test comparing the accuracy of cost data before and after IoT device application:

Table 10: T-test Results Comparing Cost Data Accuracy Before and After Applying IoT Devices

Case	Mean	Standard Deviation	Sample Size	T Value	p-value
Before Applying IoT	70.3	8.5	50	5.31	0.0001
After Applying IoT	85.6	6.2	50	8.45	0.0001

With the mean accuracy increasing from 70.3 to 85.6, the T-test results show a statistically significant difference between cost data accuracy before and after using IoT devices at the 0.05 significance level. The quality of the real-time cost information that is now available has significantly improved, as evidenced by this rise, which will help the business track and evaluate expenses more rapidly and precisely. Thus, our analysis demonstrates that utilizing IoT technology to increase the accuracy of cost data within the General Company for Pharmaceuticals and Medical Supplies has a favorable impact.

2- Testing the Second Sub-Hypothesis:

According to this hypothesis, including IoT into costing systems helps to cut down on the amount of time needed to identify and fix discrepancies. The average amount of time needed to identify variations in supply chain expenses was recorded both before and after the implementation of the IoT-based real-time costing system in order to assess this hypothesis. One key measure of the efficacy of a costing system is the amount of time required to identify deviations; the shorter the time required, the quicker the business may implement corrective measures, reducing the detrimental effect on overall performance. Using data gathered from process samples within the organization, the T-test findings comparing time before and after IoT installation are displayed in the following table:

Table 11: T-test Results for Average Time Required to Detect Variances Before and After Applying IoT System

Case	Mean (hours)	Standard Deviation	Sample Size	T Value	p-value
Before Applying IoT	24.5	4.8	40	8.42	0.00001
After Applying IoT	12.3	3.1	40	12.75	0.00001

According to the findings, the average time required to identify Variances dropped dramatically from 24.5 hours to 12.3 hours following the implementation of the IoT-based real-time costing system. The statistical significance of this difference is confirmed by the large T value and the extremely low p-value (0.00001). The idea that IoT improves costing system efficiency and shortens intervention time is supported by the fact that incorporating IoT technologies has successfully accelerated deviation detection.

3- Testing the Third Sub-Hypothesis:

According to this theory, the IoT-based real-time costing system helps to raise the caliber of managerial and accounting cost reports. When it comes to making the right administrative decisions, the quality of cost reports is crucial. The quality of cost reports was assessed using the perspectives of internal users, including managers and accountants, both before and after the real-time costing system based on IoT was put into place in order to test this hypothesis. Information clarity, correctness, and real-time availability were measured on a 100-point scale. The T-test results comparing the evaluations are displayed in the following table:

Table 12: Quality Assessment of Cost Reports Before and After Applying IoT System

Case	Mean	Standard Deviation	Sample Size	T Value	p-value
Before Applying IoT	65.2	7.3	45	6.12	0.00002
After Applying IoT	81.7	5.5	45	9.85	0.00002

With the average rating rising from 65.2 to 81.7, the results demonstrate a notable improvement in cost report quality following the implementation of the IoT system. The accuracy, transparency, and accessibility of vital cost data are improved by an Internet of Things-based real-time system, which fortifies administrative and accounting tasks. Operational data is continuously gathered and analyzed to give managers immediate and trustworthy insights that facilitate quicker and better decision-making. A high T value and a low p-value demonstrate the statistically significant evidence supporting the efficacy of this technique, suggesting that the improvements in operational responsiveness and data quality are not the result of chance. Thus, IoT-enabled real-time solutions are essential for improving overall organizational performance, expediting administrative procedures, and maximizing financial control..

4- Testing the Fourth Sub-Hypothesis:

According to this hypothesis, implementing IoT can improve supply chain sustainability by cutting waste and increasing resource usage effectiveness. The General Company for Pharmaceuticals has set a strategic aim to improve the

sustainability of its supply chain, which includes cutting waste and increasing energy and resource efficiency. Prior to and during the implementation of IoT technology in business operations, key sustainability indicators were compared. These metrics include total resource efficiency, energy efficiency, and the percentage of material waste. These metrics, together with the percentage change between the two periods, are displayed in following table:

Table 13: Comparison of Waste and Resource Efficiency Indicators Before and After Applying IoT

Indicator	Before IoT (%)	After IoT (%)	Change (%)
Material Waste	8.5	4.2	-50.6
Energy Efficiency	75.4	88.7	+17.6
Resource Efficiency	70.3	85.1	+21.0

According to the data, waste has significantly decreased by 50.6%, indicating an increase in supply chain loss reduction. Similarly, resource and energy efficiency rose by 21.0% and 17.6%, respectively. These advancements demonstrate how well IoT technology monitors and streamlines business operations, improving the organization's financial and environmental sustainability.

5- Testing the Fifth Sub-Hypothesis:

According to this hypothesis, the degree of IoT adoption inside the organization and how well the costing system supports decision-making are statistically correlated. A Pearson correlation test was performed on corporate data to assess the relationship between the degree of IoT technology adoption and the costing system's efficacy in decision support. The correlation coefficient and significance level are displayed in the following table:

Table 14: Correlation Test Between IoT Adoption and Costing System Effectiveness

Variables	Correlation Coefficient (r)	p-value
IoT Adoption and System Effectiveness	0.78	0.00001

The adoption of IoT and the efficiency of costing systems in aiding decision-making are strongly positively correlated, as indicated by the high correlation coefficient (0.78). The statistical significance of this link is confirmed by the extremely low p-value. According to the sample research, this indicates that a company's costing system's efficacy is directly improved by expanding its usage of IoT. Management may make well-informed decisions that appropriately represent the operational and financial conditions of the company today by utilizing more accurate and current data. Quicker responses to inefficiencies, better resource allocation, and enhanced cost monitoring are made possible by this real-time data, which eventually improves financial performance and operational efficiency. Thus, incorporating IoT into costing procedures is a strategic instrument for streamlining corporate operations and assisting with data-driven management choices.

PART FOUR: CONCLUSIONS AND RECOMMENDATIONS

4-1- Conclusions:

The research came to the following findings:

1.   The results showed that using IoT devices improved the accuracy of real-time cost data and increased the reliability of information utilized in operational and financial decision-making. This effect was positive and statistically significant.

2.   By integrating IoT technology, management was able to react quickly to issues and minimize possible losses by cutting down on the amount of time needed to identify and resolve supply chain abnormalities.

3.   Using an IoT-based real-time costing system enhanced the accuracy and clarity of managerial and accounting cost data, promoting openness and effective decision-making.

4.   IoT's importance in promoting sustainable behaviors and lowering environmental waste is demonstrated by the notable gains observed in sustainability metrics, such as waste reduction and improved resource and energy use efficiency.

5.   The degree of IoT implementation inside the organization and the costing system's ability to support decision-making were found to be strongly positively correlated, highlighting the significance of technology investment in improving institutional performance.

6.   Overall, the findings support the General Company for Pharmaceuticals and Medical Supplies' competitive and developmental goals by demonstrating that implementing IoT in the construction of a real-time costing system is a smart move to enhance cost performance and sustainability.

4-2- Recommendations:

The research suggests the following:

1.   Given its direct impact on boosting the accuracy of cost data and decreasing supply chain deviations, the research suggests that businesses increase their investments in IoT devices and technology to support the development of the real-time costing system.

2.   To improve cost management effectiveness and decision support, specialized staff should participate in ongoing training programs on IoT tools and technologies and real-time data analysis.

3.   To improve integration and boost the efficacy of performance and cost monitoring at different production and supply chain stages, it is better to link the Internet of Things-based real-time costing system with inventory, production, and product quality management systems.

4.   To continuously monitor and enhance supply chain sustainability, it is recommended to create sustainability performance indicators within the real-time costing system, such as measuring waste and resource consumption.

5.   To identify Variances and facilitate prompt responses, mechanisms for real-time monitoring and data analysis should be put in place. This will improve operational efficiency and minimize errors and unnecessary expenses.

6.   To make sure the business keeps up with technological developments, internal and external research and development projects should be encouraged to investigate fresh and creative uses of IoT technology in supply chains and cost accounting.

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