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IMPACT OF DIGITALIZATION IN INVENTORY MANAGEMENT: KEY TECHNOLOGIES AND THEIR INFLUENCE ON OPERATIONS

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ABSTRACT
In the recent years digitalization plays important role in operational efficiency, especially in inventory management. The use of digital tools transformed how companies manage and optimize inventory processes. This research paper explores the impact of digitalization in inventory management within Indian companies analyzing major technologies adopted and their resulting operational improvements through the series of case studies. This paper also discusses the implementation time of the digital tools. The findings underline that technological advancement in inventory management not only improves operational efficiency but also drives cost savings and efficiency gains, highlighting importance of technological innovation in modern supply chain.

INTRODUCTION
In today's competitive and fast paced business environment effective inventory management plays crucial role in determining success across the industries. Inventory is a stock of items such as materials, components, work-in progress and finished goods held at specific location at specific period of time for the purpose of production and supply in the market. Inventory management is a process of planning, organizing, directing and controlling the quality and quantity of inventory at appropriate level so that the production and distribution takes place effectively. Company needs to maintain adequate level of inventory. Overstocking of inventory blocks working capital and also increase overheads relating to warehousing. Understocking of inventory can affect the production cycle thus creates problem of losing customers. Effective inventory management helps prevent stockouts, reduce overstocking, and lower operational costs, contributing to improved profitability and customer satisfaction.

Earlier inventory management has been done by using traditional methods such as physical stock counts, periodic audits, paper records. When this system was in function its often led to difficulties like inaccuracies in stock levels, delayed delivery schedules, high cost of labour, time consuming and blocking of working capital due to over stocking. As consumer expects faster deliveries and customised and personalised services, companies are seeking innovative solutions to streamline inventory management processes. Inefficiencies of traditional methods have driven organisation to use advanced technologies to optimize their supply chain.

Digitalisation through technologies such as Artificial Intelligence (AI)**,** Radio Frequency Identification (RFID)**,** Internet of Things (IoT)**,** Cloud Computing**,** and Enterprise Resource Planning (ERP) systems has reform how companies track, manage and forecast their inventory. These tools help companies to get real time data, improve the visibility of supply chain, automation of processes, and informed decision making which leads to maximisation of efficiency and reduced operational cost.

Artificial Intelligence (AI):AI includes the simulation of human intelligence in to machines that are programmed to think, learn and make decisions like humans on the basis of past data. With regards to inventory management AI uses machine learning and algorithms to forecast demand, optimise stock level and to improve decision making.AI analyses historical data, trends seasonality and other relevant factors to forecast demand.AI helps in accurate demand forecasting, inventory optimization, automates reordering process and avoids stock outs and overstocking.

Radio Frequency Identification (RFID): RFID is a tool where electromagnetic fields are used to identify and track tags attached to objects. Microchip and antenna are included in RFID tags which can be read using scanner. RFID tags helps in real time tracking of inventory, it automates inventory counting, it prevents inventory from theft and loss of reduction and it also trigger alerts when stock level reach certain threshold.

Internet of Things (IoT): The Internet of Things (IoT) means the network of physical devices which are connected to the internet that can collect and exchange data. In inventory management, IoT devices like smart shelves, connected sensors, and RFID tags collect and transmit real-time data on stock levels and conditions. IoT helps in real time monitoring, supply chain visibility and automated replenishment.

Cloud Computing: Cloud computing means delivery of computing services over internet. Cloud computing provides services like storage, processing power, database over the internet. It allows business to store and

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access data on cloud rather than on local servers. This tool provides centralised access to data, easy scalability of inventory systems as per growth in business, it gives access to data from multiple locations and it also reduces the labour cost.

Enterprise Resource Planning (ERP): ERP systems are integrated software solutions that manage various business functions, including finance, procurement, sales, and inventory. ERP centralizes data across departments, providing a single platform for businesses to manage their resources efficiently. It helps in inventory tracking and control, optimise order management which leads to increase in operational efficiency.

LITERATURE REVIEW

(Praveen kumar, July 2024) This paper highlights how AI enhances the inventory visibility, demand forecasting accuracy and inventory turnover rates and discusses the future implications for supply chain management. Study explains the role of Ai in demand forecasting and explains how AI is not only improving demand forecasting but also improving operational efficiency through cost saving, meeting delivery schedules promptly and by optimizing delivery schedules. This study also examines the case studies of three leading companies: Walmart Amazon and Zara which states the key improvements in the operational efficiency due to use of AI. Along with the benefits this study also explains the challenges in adoption of AI in Inventory management.

(Mahendran deepika, December 2024) This research paper examines the importance of RFID technology in the inventory management systems. This is the comparative study has been made to examine EOQ investment assessment model with schedule shortage in absence and presence of RFID. The existing research has primarily focused on utilizing RFID technology investments in inventory systems to manually optimize total costs. However, effective stock management also requires optimizing key factors such as annual order frequency and cycle time to balance inventory expenses.

(Taas, March 2023) The study is especially done to know the impact of IoTs in inventory management and to understand its amalgamation in industry 4.0. the study shows that the use of new technology provides businesses with opportunities to generate value for themselves. These technologies have enabled them to get competitive advantage. Warehouses are the most important part of the 4.0 revolution in the supply chain. Due to IoT adoption, working practices of enterprises worldwide have changed significantly. The result is that organizations can develop more quickly and intelligently in a more responsive environment. The Internet of Things makes it possible to monitor warehouses, manufacturing plants, and distribution centres in real-time. IoT connections for inventory management continue to reduce inventory expenses and management errors.

OBJECTIVES OF THE STUDY

1. To understand the impact of digital tools like AI, RFID, IOT, ERP, Cloud computing on inventory management of Indian companies.
2. To examine the quantitative results achieved by the companies by adopting digital tools in inventory management.
3. To explore implementation timeline of digital tools across the industries.

LIMITATIONS OF STUDY

The limitation of study is that the primary data is not collected for the study. Secondary data is used which is derived from business articles, reports and business book. Study do not address the integration challenges faced by the business while adopting digital tools in inventory management. The study examines the quantitative results of 8 large scale companies ignoring the integration challenges of small scale and medium scale companies. Study relies on data from company reports, case studies which can introduce bias. Companies might overstate their success with digitalization, leading to inflated results that do not fully capture challenges or less favourable outcomes.

RESEARCH METHODOLOGY

1) Research approach

- **Qualitative approach:** This study adopts qualitative approach to understand the key technologies adopted by Indian companies in inventory management and their impact on operational efficiency through inventory visibility, cost reduction, demand forecasting accuracy and reduction in stockouts
- **Quantitative approach:** To examine the quantitative results achieved by the companies to quantify the impact of digital tools in inventory management and to analyse the implementation timeline for adoption.

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2) Hypothesis

H_0 (Null hypothesis): Implementation of digital tools in inventory management does not maximizes operational efficiency through increase in stock visibility, minimizing stock outs, reducing operational cost and by improving demand forecasting accuracy.

H_1 (**Alternative hypothesis):** Implementation of digital tools in inventory management maximizes operational efficiency through increase in stock visibility, minimizing stock outs, reducing operational cost and by improving demand forecasting accuracy.

3) Data collection

The secondary data is collected from industry reports, case studies and company publication. The study consists of case studies of 8 leading Indian companies, such as **Amazon India**, **Big Basket**, **Hindustan Unilever**, **Cipla Pharmaceuticals**, **Arvind Mills, ITC Foods, Tata Motors, Flipkart**.

Data analysis & Interpretation

Company	Technology Used	Impact Areas	Quantitative Results	Implementation Date	Source
Amazon India	AI, RFID, Cloud-based Solutions	Inventory visibility, Order fulfilment, Cost reduction	**30-40% improvement** in inventory visibility; **20-25% reduction** in warehousing costs; **15-20% increase** in fulfilment efficiency	2018-2020	**Report**: McKinsey & Company - "Transforming Supply Chains"
Big Basket	IoT, AI	Inventory turnover, Wastage reduction, Order fulfilment time	**20-30% reduction** in stockouts; **15% improvement** in inventory turnover; **10-15% reduction** in wastage	2019-2021	**Article**: Business Standard - "IoT in Supply Chain"
Hindustan Unilever (HUL)	IoT, Cloud-based Platforms	Inventory accuracy, Wastage reduction, Logistics cost savings	**15-20% reduction** in wastage; **20% improvement** in inventory accuracy; Savings of **₹200-300 crore** in logistics costs	2017-2019	**Report**: Deloitte - "The Future of Supply Chains"
Flipkart	AI, Cloud, Data Analytics	Demand forecasting, Inventory optimization, Order fulfilment	**30% improvement** in forecasting accuracy; **20-25% reduction** in warehousing costs; **10-15% improvement** in fulfilment times	2017-2020	**Article**: McKinsey & Company - "E-Commerce and Supply Chain"
Cipla Pharmaceuticals	RFID, Predictive Analytics	Stock visibility, Stockouts, Regulatory compliance	**100% visibility** in stock; **20-25% reduction** in stockouts; **12% reduction** in wastage	2016-2018	**Article**: Business Standard - "Digitalization in Pharma"
Tata Motors	ERP, IoT	Production delays, Spare parts management, Supply chain efficiency	**25% reduction** in production delays; **15-20% reduction** in inventory carrying costs; **15% improvement** in production cycles	2018-2021	**Report**: PwC - "The Future of Supply Chain in Auto Industry"
ITC Foods	Cloud Computing, ERP	Inventory optimization, Supplier coordination, Cost reduction	**20% reduction** in excess inventory; **15% reduction** in stockouts; Savings of **₹150-200 crore** annually	2019-2022	**Report**: KPMG - "Supply Chain Transformation in FMCG"
Arvind Mills	RFID, Cloud-based Solutions	Inventory accuracy, Stockouts, Lead time reduction	**95% accuracy** in inventory tracking; **25-30% reduction** in stockouts; **10-15% reduction** in lead times	2018-2020	**Report**: Gartner - "The Role of Technology in Manufacturing"

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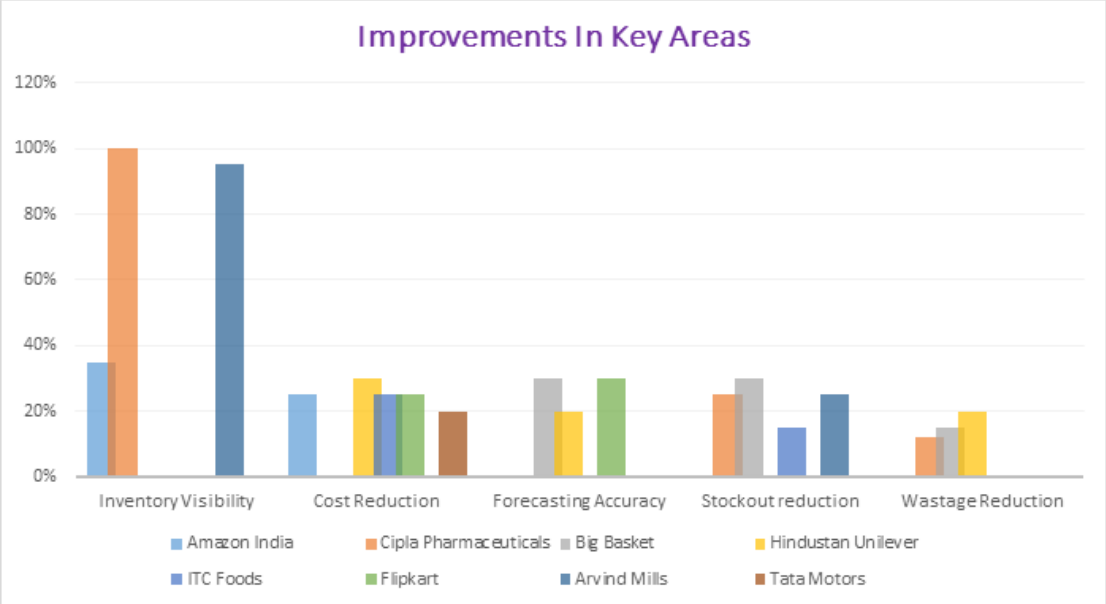

FINDINGS FROM THE DATA

- **Inventory Visibility**: Companies like Amazon India and Cipla Pharmaceuticals have claimed notable improvements in real-time inventory visibility, Cipla have reported 100% visibility in stock and amazon have reported 30-40% stock visibility. This becomes possible because of use of RFIDs and ERP systems in inventory management.
- **Cost Reduction**: Through the implementation of digital tools companies have reported reduction in Warehousing and logistic cost. Hindustan Unilever reported savings of ₹200-300 crore annually while ITC Foods saved ₹150-200 crore through inventory optimization.
- **Forecasting Accuracy**: With the use of AI, IoT, Data analytics tools Companies like Flipkart and Big Basket improved demand forecasting accuracy by up to 30%**,** leading to better operational efficiency and reduction in overstocking**.**
- **Stockouts and Wastage**: In companies like Arvind Mills and Big Basket the adoption of IoT and RFID helped in a reduction in stockouts by 25-30%. In several companies, including Big Basket and Cipla Pharmaceuticals Wastage was reduced by 10-15%.
- **Improved Efficiency**: Companies like Flipkart**,** Arvind Mills, and Big Basket noticed improvements in order fulfilment**,** lead time, and inventory turnover which leads to 10-30% improvements in operational efficiency.
- **Inventory Optimization**: There is significant improvements in inventory visibility and optimization of Cipla Pharmaceuticals, Amazon India, and Arvind Mills reducing stockouts and improving accuracy.
- **Implementation timelines** explains that the period between 2017 and 2020 was the most active phase for these digital transformations, with companies gradually scaling their adoption of these technologies. As digital tools continue to evolve, it is expected that even greater efficiency gains will be realized

Testing of Hypothesis

From the above findings it is concluded that H0 is rejected and H1 is accepted.

CONCLUSION

The research firmly established that Implementation of digital tools in inventory management maximizes operational efficiency through increase in stock visibility, minimizing stock outs, reducing operational cost and by improving demand forecasting accuracy. The advanced tools like RFID, ERP, AI, IoT cloud computing helped in transforming the systems of inventory management. Improvements in various metrics provides competitive advantage to the companies in a dynamic business environment.

By examining quantitative results of leading companies like **Amazon India**, **Big Basket**, **Hindustan Unilever**, and **Flipkart**, it is clear that digitalization has streamlined inventory processes and also delivered tangible financial benefits through reduction in warehousing and logistic cost. For instance, **ITC Foods** saved **₹150-200 crore** annually through cloud and ERP integrations.

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By rejecting the null hypothesis (H_0) and accepting the alternative hypothesis (H_1), the study confirms that digitalization plays an important role in improving inventory management in Indian businesses, especially in terms of optimizing supply chains and by improving operational efficiencies. through increase in stock visibility, minimizing stock outs, reducing operational cost and by improving demand forecasting accuracy.

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