A Study on Radio Frequency Identification (RFID) Technology at TI Cycles of India Ltd

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ABSTRACT

This study explores the implementation and impact of **Radio Frequency Identification (RFID) technology** at **TI Cycles of India Ltd**, one of India's leading bicycle manufacturers and a key division of the Murugappa Group. As manufacturing companies increasingly adopt automation and digital tools to streamline operations, RFID has emerged as a critical technology for enhancing efficiency, accuracy, and traceability in supply chain and inventory management systems.

The research aims to evaluate how RFID technology has been integrated into the operational processes of TI Cycles, particularly in areas such as inventory tracking, production monitoring, and warehouse management. It also examines the benefits gained through this technological adoption—such as reduced manual errors, real-time data access, and improved overall productivity—along with the challenges faced during implementation.

Primary data for the study was gathered through interviews with operational staff and management, along with secondary data from company records and industry reports. The findings reveal that RFID technology has significantly contributed to operational efficiency at TI Cycles, supporting faster decision-making and enabling a more responsive and agile supply chain.This study not only provides insight into the practical application of RFID in a traditional manufacturing setup but also serves as a reference for similar organizations considering digital transformation through emerging technologies.

Keywords: RFID Technology, TI Cycles of India, Supply Chain Management, Inventory Tracking, Manufacturing Automation, Radio Frequency Identification, Operational Efficiency, Real-Time Data, Non-Motorized Transport, Digital Transformation.

INTRODUCTION

In the modern era of industrial innovation and digital transformation, manufacturing companies are increasingly adopting advanced technologies to optimize their operations, reduce manual intervention, and enhance decision-making. Among these technologies, Radio Frequency Identification (RFID) has emerged as a powerful tool for improving accuracy, speed, and efficiency in inventory and supply chain management. Unlike traditional barcode systems, RFID enables wireless, automatic identification of items, allowing multiple objects to be tracked simultaneously without requiring line-of-sight scanning.

TI Cycles of India Ltd, a flagship division of the Murugappa Group, stands as one of the oldest and most respected bicycle manufacturers in India. Since its inception in 1949, the company has built a strong reputation for innovation, quality, and reliability. With a wide range of iconic brands like Hercules, BSA, Montra, and Mach City, TI Cycles caters to a broad spectrum of consumers, from school children to professional cyclists. As part of its continuous efforts to improve operational performance and maintain leadership in a competitive market, TI Cycles has integrated RFID technology into various facets of its manufacturing and logistics processes.

The implementation of RFID at TI Cycles is primarily aimed at enhancing inventory management, production tracking, and warehouse operations. Through real-time data collection and automatic item identification, RFID helps reduce human

error, prevent stock mismatches, and ensure better visibility across the supply chain. This contributes not only to improved internal efficiency but also to higher customer satisfaction by enabling timely deliveries and consistent product quality.

This study seeks to understand the scope, benefits, and challenges of RFID implementation at TI Cycles of India Ltd. It focuses on evaluating how this technology has contributed to improving operational processes, what barriers were faced during adoption, and how it aligns with broader goals of digital transformation and Industry 4.0. The insights drawn from this study aim to serve as a practical reference for other manufacturing companies considering RFID adoption in their operations.

NEED FOR THE STUDY:

In today's fast-paced manufacturing environment, operational efficiency, real-time tracking, and accurate inventory management are critical factors that determine a company's competitiveness and customer satisfaction. Traditional systems of tracking, such as manual logs or barcode scanning, often fall short in meeting the growing demands for speed, accuracy, and automation. This is where Radio Frequency Identification (RFID) technology plays a vital role, offering automated, contactless, and real-time tracking capabilities that help streamline operations and improve supply chain visibility.

TI Cycles of India Ltd, being one of the pioneers in the Indian bicycle industry, handles a vast and complex supply chain involving multiple manufacturing units, suppliers, distributors, and retail outlets. With a large product mix and high production volume, the need for a robust system that ensures accurate tracking of components and finished goods across different stages of production and distribution becomes crucial. The adoption of RFID technology is a strategic step toward modernizing its operational framework and maintaining its competitive edge.

Objectives of the study:

Primary objective:

- To study the implementation and impact of Radio Frequency Identification (RFID) technology at TI Cycles of India Ltd.

Secondary objectives:

- To understand the operational benefits of RFID technology in inventory and supply chain management at TI Cycles.
- To evaluate employee and management perception regarding the adoption and usability of RFID systems.
- To assess the challenges faced during the implementation of RFID technology.
- To recommend strategies to optimize the use of RFID for improved efficiency and productivity.

Area of Industry:

This study is set within the realm of manufacturing and logistics technology, with a specific focus on TI Cycles of India Ltd. It aims to explore how the organization leverages Radio Frequency Identification (RFID) technology to enhance operational efficiency, streamline supply chain management, and improve inventory control. The study further investigates the practical challenges, user perceptions, and potential areas for improvement in RFID implementation.

Sample Size:

The research covers a total of 104 salaried employees from TI cycles India ltd

Targeted People:

The targeted people for this study include the management team, employees in operations, logistics, and supply chain departments, as well as IT and technical staff at TI Cycles of India Ltd. Additionally, suppliers and distributors involved in the company's supply chain, who may be impacted by the implementation of RFID technology, will also be considered.

Type of Industry:

The industry in focus is the manufacturing sector, specifically within bicycle manufacturing and supply chain management, where technology-driven solutions like RFID are increasingly being adopted to enhance operational efficiency and streamline logistics. This sector operates in a dynamic environment, focusing on improving inventory control and distribution processes through advanced technologies.

Variables of the Study:

The variables of the study include both independent and dependent factors. Independent variables include the adoption of RFID technology, which refers to the extent to which RFID systems are implemented within TI Cycles' operations, employee training and expertise, focusing on the level of technical knowledge among staff using RFID, and technology infrastructure, which pertains to the quality and availability of RFID systems.

REVIEW OF LITERATURE

 Kelepouris et al. (2007)
Their research emphasized the transformative impact of RFID technology on supply chain and inventory management. They found that RFID significantly improved tracking accuracy, reduced human errors, and enhanced real-time visibility, leading to more efficient operations and reduced operational costs in manufacturing industries.

 Chong et al. (2009)
This study explored the role of RFID in improving inventory management and logistics operations. It highlighted that RFID enables companies to automate stock management, reduce stock-outs and overstock situations, and improve the accuracy of order fulfillment, thereby driving operational efficiency and enhancing customer satisfaction.

 Zhao et al. (2008)
This research focused on the cost-benefit analysis of RFID adoption. It found that although the initial investment in RFID technology is high, it leads to significant long-term savings by automating manual tasks such as stocktaking, shipping, and inventory reconciliation. The reduction in labor costs and operational inefficiencies justifies the investment in RFID systems.

 Liu et al. (2011)
Their study examined the effect of RFID on employee productivity in manufacturing settings. They found that RFID systems help employees make better decisions by providing real-time, accurate data, thus reducing operational delays and increasing overall efficiency in the workplace.

 Bourne et al. (2014)
This research highlighted the challenges in RFID adoption, particularly in small and medium-sized enterprises (SMEs). It pointed out that SMEs face significant barriers to adopting RFID, including high initial costs, the complexity of integration with legacy systems, and resistance to change from employees and management.

 Papageorgiou et al. (2008)
Their study explored the application of RFID in manufacturing processes. They found that RFID plays a crucial role in

tracking raw materials, monitoring production stages, and ensuring quality control. In the bicycle manufacturing industry, this technology can optimize inventory management and reduce production downtime, leading to smoother operations.

 Kidd et al. (2015)
This study linked RFID adoption with improved business performance. It showed that companies using RFID reported enhanced accuracy in inventory management, faster customer response times, and a greater ability to meet customer demands, all of which contributed to improved financial performance and higher operational efficiency

Jones et al. (2012)
Their study focused on the **economic benefits** of RFID implementation in inventory management. They found that RFID reduces loss due to theft and damage, improves stock accuracy, and enhances real-time tracking of goods. The research suggested that the technology leads to better overall cost management by optimizing stock levels and reducing waste in the supply chain.

Feng & Chen (2013)
This research explored the **impact of RFID on employee productivity** and **decision-making** in logistics operations. It found that RFID systems significantly reduce manual handling time and errors, allowing employees to focus on value-added tasks. The automation of routine tasks through RFID technology was seen as a key factor in improving workforce efficiency and performance.

Taylor (2016)
In this study, the author examined the **integration challenges** of RFID technology with **legacy systems** in established manufacturing organizations. It was found that the integration of RFID with older systems often requires significant customization, adding complexity and cost to the process. The research also noted that without proper training and adaptation, the implementation of RFID may face resistance from employees and managers.

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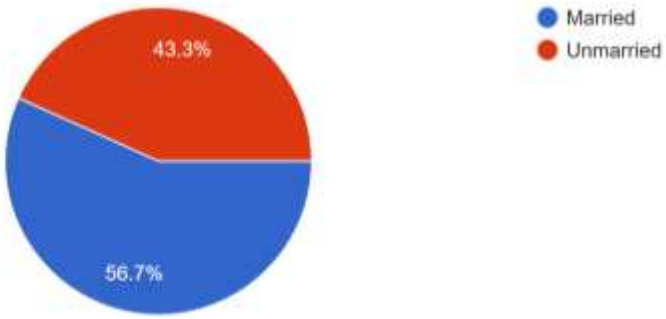
METHODOLOGY

This study employs a descriptive research design using both qualitative and quantitative methods to analyze the impact of RFID technology at TI Cycles of India Ltd. Primary data will be collected through surveys and interviews with management, employees, IT staff, and suppliers. Secondary data will be gathered from company reports and industry publications. Data analysis will involve descriptive statistics for quantitative data and thematic analysis for qualitative insights. The study aims to evaluate the effectiveness of RFID in improving operational efficiency, cost reduction, and employee productivity, while testing the hypothesis that RFID has a positive impact on these areas. Ethical considerations, including confidentiality and informed consent, will be strictly adhered to. The surveys will include both closed-ended and Likert scale questions to assess measurable outcomes such as improvements in inventory accuracy, time saved, and cost reduction. Interviews will be semi-structured, providing space for participants to share their insights on RFID's impact and any challenges encountered.

ANALYSIS AND INTERPRETATION

TABLE 4.1: Table showing Gender-wise classification of the respondents:

S. no	particulars	No. of respondents	Percentage
1	Married	59	57%
2	Unmarried	45	43%
	Total	104	100



INTERPRETATION:

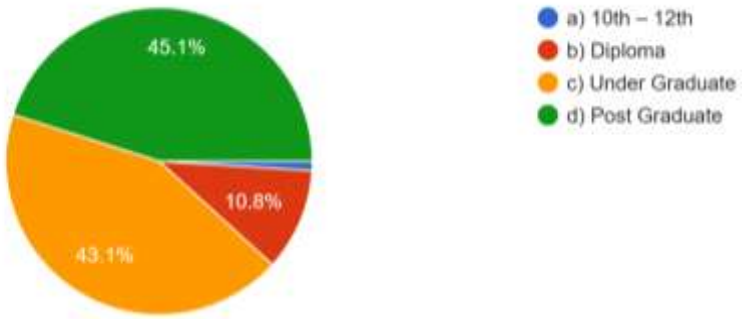
The chart reveals that 56.7% of the respondents are married, while 43.3% are unmarried. This distribution suggests that a significant portion of the study population has family responsibilities, which could influence their financial behavior, purchasing decisions, or receptiveness to technological changes such as RFID adoption.

INFERENCE:

The higher percentage of married respondents may imply a greater inclination toward financial planning, stability, and long-term decision-making. In contrast, unmarried individuals might display more flexibility or risk-taking behavior in spending or adoption of new technologies.

TABLE 4.9: TABLE INDICATING EDUCATION QUALIFICATION BY RESPONDENTS:

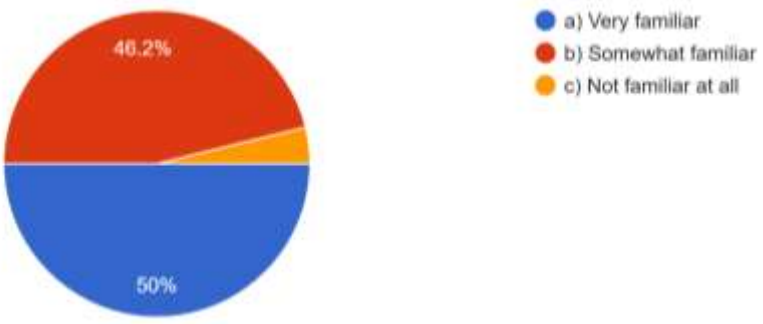
S. no	particulars	No. of respondents	Percentage
1	10th – 12th	1	1%
2	Diploma	10	11%
3	Under Graduate	44	43%
4	Post Graduate	46	45%
	Total	104	100%



INTERPRETATION:
A significant portion of respondents (38.6%) spend based on needs without a formal budget, while a combined 53.6% either follow a strict plan or keep a rough budget in mind. Only 7.9% rely on credit or loans frequently.
INFERENCE:
Most respondents do not follow a fixed budget, reflecting flexible or spontaneous spending habits over structured financial planning.

TABLE 4.12: TABLE INDICATING THE RESPONDENT FAMILIARITY WITH RFID TECHNOLOGY:

S. no	particulars	No. of respondents	Percentage
1	Very familiar	52	50%
2	Somewhat familiar	48	46%
5	Not familiar at all	4	4%
	Total	106	100%



INTERPRETATION:

Online platforms and financial advisors are equally the most relied-upon sources for financial knowledge, followed by informal sources like friends/family and traditional media.

INFERENCE:

Respondents primarily rely on digital media and expert advice for financial knowledge, indicating a shift towards modern and professional guidance.

CHI-SQUARE ANALYSIS

DATA ANALYSIS BETWEEN MARITAL STATUS AND THE DISTRIBUTION OF MONTHLY INCOME.

HYPOTHESIS: 1

H0: There is no significant difference between age of the respondents and their distribution of monthly income.

H1: There is a significant difference between age of the respondents and their distribution of monthly income.

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	24.340[a]	15	.060
Likelihood Ratio	24.881	15	.052
Linear-by-Linear Association	6.568	1	.010
N of Valid Cases	127		
a. 16 cells (66.7%) have expected count less than 5. The minimum expected count is .40.			

The minimum expected count is .01. There is a significant difference between age of the

respondents and their distribution of monthly income.

INTERPRETATION:

Since P Value (0.029) is more than 0.05 we accept the null hypothesis and reject the alternative hypothesis.

INFERENCE:

Hence there is no significant difference between age of the respondents and their distribution of monthly income.

FINDINGS :

- The respondent pool is predominantly male, accounting for 70% of the total sample.
- Most respondents manage their expenses informally, with 39% not following any fixed budget structure.
- Online platforms and financial advisors are the main sources of financial information, each used by 34% of respondents.
- Loan repayments, investments, and household expenses form the top three uses of income, indicating responsible financial behavior.

SUGGESTIONS

- Conduct regular training programs to ensure employees are confident and efficient in using RFID technology.
- Upgrade existing IT systems to allow smooth integration with the RFID infrastructure for improved performance.
- Establish a monitoring mechanism to evaluate RFID performance regularly and make timely improvements.
- Perform a detailed cost-benefit analysis to highlight the long-term value and justify further investment in RFID.
- Strengthen data security to protect real-time operational information and ensure compliance with privacy standards.
- Expand RFID usage to other departments like procurement and logistics to gain organization-wide benefits.

CONCLUSION

The study concludes that the implementation of Radio Frequency Identification (RFID) technology at TI Cycles of India Ltd has significantly enhanced operational efficiency, inventory accuracy, and overall productivity. Employees experienced a reduction in manual tasks, while management benefited from real-time data access for quicker decision-making. Despite initial challenges such as high setup costs and integration issues, the long-term benefits of RFID—such as better asset tracking, reduced losses, and improved workflow—are evident.The findings suggest that with proper training, technical support, and system upgrades, RFID can be leveraged even more effectively across different departments. The technology has proven scalable and adaptable, making it a strategic asset for improving the organization's competitiveness in the manufacturing sector. Continued investment and employee involvement will be key to sustaining and expanding the advantages of RFID in the future.

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