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IMPACT OF IOT DEVICES IMPLEMENTATION IN SUPER MARKET AND RETAIL STORE IN TRICHY

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ABSTRACT :

The IoT devices brought about in supermarkets and retail stores changed traditional business operations by increasing efficiency, enhancing the experience of customers, and improving a retailer's decisions. IoT allows the seamless interconnectivity of devices to be readily available for real-time inventory tracking, automated checkout systems, personalized marketing, and energy management. Using IoT brings about minimized operational costs, excellent supply chain management, and enhanced security systems. It offers IoT-powered analytics, which generate rich insights into consumer behaviour, making it possible for data-driven strategies to enhance sales and customer loyalty. Data privacy issues, high setup costs, and need for heavy infrastructure would pose challenges for tapping into this.

With all this said, the transformative ability of IoT is making it possible for more intelligent and sustainable retail environments. Internet of Things (IoT) devices have revolutionized supermarkets and retail stores in order to introduce a new wave of operational efficiency, personalized customer experience, and decision-making backed by data.

IoT devices include smart shelves, RFID tags, and connected point-of-sale systems, which enable real-time inventory management, automated replenishment, and streamlined checkout processes significantly reducing labour cost and error.   In addition, IoT allows retailers to enhance in-store promotion and recommendation activities with the aid of proximity sensors and mobile applications, ensuring high customer satisfaction and loyalty.

Key points: IoT devices in supermarkets and retail stores enhance inventory management, improve customer experience, optimize energy use, boost security, and enable data-driven insights to operational efficiency and cost savings.

INTRODUCTION :

Through IoT devices in supermarkets and retail stores, the retail industry is made better through operational efficiency changes and customers' experience. Real-time collection of information and connectivity have allowed IoT to reduce shrinkages caused by stockouts and overstocks. Smart shelves, RFID tags, and sensors track products-ensuring accurate stock levels and automatic replenishment.

Improved customer experience through IoT- Personalized experiences are enhanced by IoT. Smart shopping carts with tailor-made recommendations and a navigation system to locate products quickly within the store are possible through IoT. Furthermore, IoT enhances security with smart surveillance systems and asset tracking. This minimizes theft and ensures store safety.

On the benefit side, energy management is in the spotlight with IoT-enabled systems managing lighting, heating, and cooling based on real-time conditions, thus saving millions. Supply chain efficiency is improved through streamlined communication between the stores, warehouses, and suppliers by ensuring timeliness and reduction of waste in deliveries.

Hence, in summary, IoT devices streamline operations, cut costs, and improve customer satisfaction and position retail stores for more profitability and long-run success..

LITERATURE REVIEW :

1. Inventory Management:

Studies have shown that applications of IoT technologies include RFID tags, smart shelves, and automated replenishment systems. Such technologies enable real-time tracking of inventories, increasing the chances that stockouts will not happen. For instance, a retailer can observe product levels remotely through such systems, avoiding potential restocking mistakes by humans (Santos et al., 2020).

2. Customer Experience:

Other research shows that IoT improves customer experience through personalization. For example, an IoT-enabled intelligent cart can suggest relevant products based on the customer's past purchases (Hernandez et al., 2021). In addition, a smart in-store navigation system allows the customer to navigate aisles more smoothly, thereby boosting overall shopping experiences and reducing frustration.

3.Energy Management:

IoT applications in energy management are famous for optimising power consumption. These systems have been shown in various studies to automatically adjust lighting, temperature and HVAC during occupancy patterns and time of day, with savings on energy (Zhao et al., 2019).

4. Security and Loss Prevention:

Some studies point out that IoT plays a crucial role in increasing the safety of the store. Smart surveillance cameras with motion detectors and facial recognition help analyze customers' behaviour to reduce theft (Morris, 2018). Furthermore, IoT helps track valuable assets and inventory, which increases the prevention of losses.

5. Supply Chain Optimization:

IoT-enabled devices improve the transparency and efficiency of supply chains. Research by Lee and Lee (2020) highlights how sensors can monitor the condition of perishable goods during transportation, reducing spoilage and ensuring product quality.

6.Data-Driven Insights:

IoT devices give retailers important information about consumer behavior, shopping habits, and consumer preferences. Data analytics from IoT systems help retailers make pertinent decisions on product placements, pricing strategy, and promotion (Patel & Gohil, 2021).

7. Staff Productivity and Cost Savings:

According to studies, IoT devices enhance employee productivity by automating tasks such as inventory checks and restocking, which saves retailers from spending excess hours on these tasks by merely a few employees or even reallocation of resources (Singh et al., 2020).

8. Sustainability:

Recent literature indicates that IoT can act as a critical means of driving sustainability in retail. IoT helps reduce waste, optimize energy consumption, and increase supply chain transparency for retailers, all of which allow them to achieve environmental targets while reducing operational costs (Wu et al., 2022).

OBJECTIVES:

- •Improve stock management: Real-time monitoring, tracking, and automatic restocking to minimize stockouts and inventory discrepancies
- •Enhance Customer Experience: Offer a unique in-store experience through IoT technologies such as smart carts, personalized recommendations, and in-store navigation.
- •Optimize Energy Consumption: Using IoT-enabled smart lights, thermostats, and HVAC systems based on factors such as store occupancy and environmental conditions.
- •Enhance security and loss prevention: Enhance the security of the retail store using IoT-enabled video surveillance cameras, asset tracking, as well as real-time monitoring to detect any theft activities.
- •Supply chain operations: Improve the transparency and efficiency of supply chain operations using IoT-based tracking of product conditions such as temperature during transportation as well as timely delivery.
- •Data-driven decision-making capabilities: Use data from IoT devices to analyze consumer behaviour, optimize product placements, as well as inform pricing, marketing, and operational strategies.

DATA ANALYSIS INTERPRETATION :

Age

Demographic		No. of Respondent	Percentage
Age	Under18	18	3.3
	18-24	85	15
	25-34	13	70.8
	Above 50	4	10.8

Age
120 responses

- under 18 years
- 18-24 years
- 25-34 years
- Above 35 years
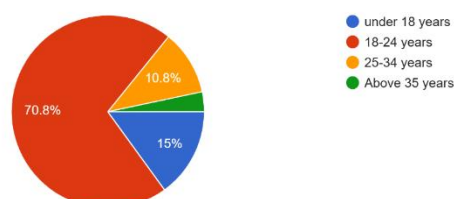
Interpretation:

Most of the respondents are in the 25-34 age group, which is the target group for most retail trends, especially the adoption of IoT technologies. The under-18 and over-50 groups are insufficiently represented, suggesting that younger adults and mature individuals will manifest different attitudes towards technology in retail environments. From the data, this survey might target the behaviours and preferences of young, tech-savvy adults..

Gender

| Demographic		No. of Respondent	Percentage
Gender	Male	51	42.9
	Female	67	56.3
	Prefer not to say	1	0.8

Gender
119 responses
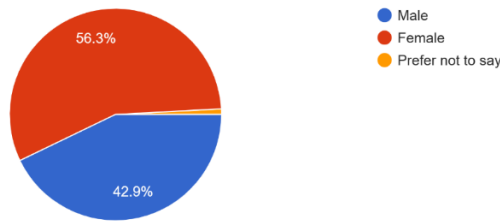
Interpretation:

The gender distribution was found to have females in 56.3%, followed by males at 42.9%. Perhaps a higher number of women might be interested in the topics that this survey is aimed at under particular demographic patterns or interests. With a meager 0.8% of respondents who chose not to disclose their gender, gender-based statistics can well be used with confidence for further analysis..

Income level

| Demographic		No. of Respondent	Percentage
Income level	0-20000	76	63.3
	20001-40000	22	18.3
	40001-60000	9	7.5
	60001andabove	13	10.8

Income level
120 responses
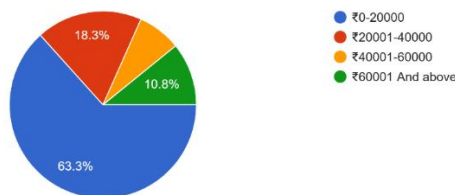
Interpretation:

The shape of the income distribution turned out to be skewed, with the large majority of respondents being classified in the lowest income bracket (63.3%). Altogether, the middle and high-income groups made up a much smaller percentage of the sample (36.7%). This might mean either an overwhelming majority of low-income people in the surveyed group or the prevalence of sampling bias. Further analysis would be required to examine the trends.

Education qualification

| Demographic		No. of Respondent	Percentage
Education qulification	HCC	11	9.2
	Undergraduate	63	52.5
	Postgraduate	37	30.8
	other	9	7.5

Education qualification
120 responses
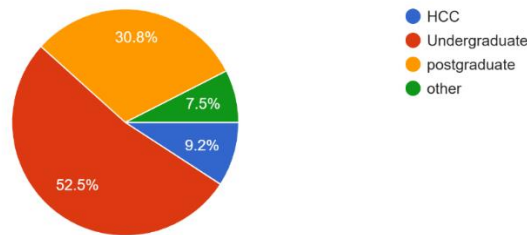
Interpretation:

A combined 83.3% of respondents have either an undergraduate or postgraduate qualification, highlighting a well-educated sample. The 16.7% with HCC or "Other" qualifications might represent a segment with more diverse or less formal educational paths. This distribution suggests that opinions or responses from the sample could be influenced by a predominantly higher-educated population. Efforts to target less-educated groups might require tailored communication strategies to ensure inclusivity.

How often do you shop at supermarket or retail market ?

S.NO	Particulars	No. of respondents	Percentage
1	Daily	17	14.2
2	Weekly	48	40
3	Monthly	32	26.7
4	rarely	23	19.2

How often do you shop at supermarket or retail market ?
120 responses
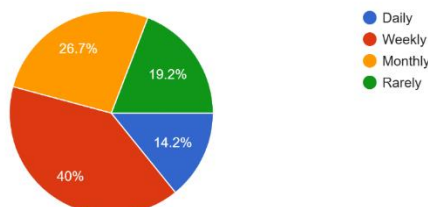
Interpretation:

   Most respondents engage in the activity either weekly (40%) or monthly (26.7%), indicating a preference for periodic involvement rather than daily engagement. .A smaller percentage (19.2%) participate rarely, while only a minority (14.2%) make it part of their daily routine .To encourage greater regularity or participation, strategies could focus on making the activity more accessible, relevant, or integrated into respondents' daily lives.

Have you noticed the use of smart devices in the stores you visit?

S.NO	Particulars	No. of respondents	Percentage
1	Smart card	34	28.3
2	Digital signage	20	16.7
3	Self checkout	21	17.5
4	Mobile app for shopping assistance	45	37.5

Have you noticed the use of smart devices in the stores you visit?
120 responses

- yes,frequently
- Occasionally
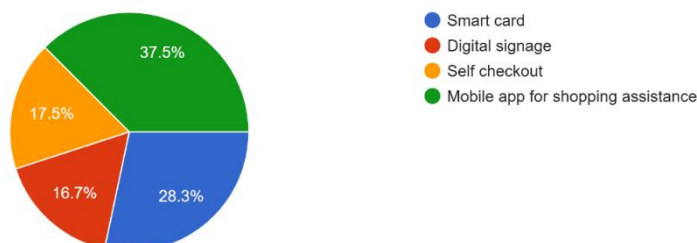- Rarely
- Not at all
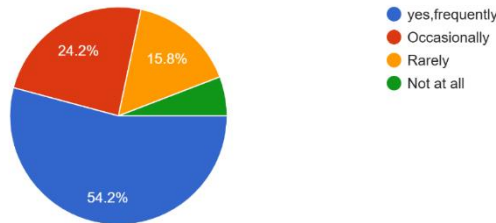
Interpretation:

   Mobile apps (37.5%) are the most popular tool, reflecting their versatility and integration into daily life. Smart cards (28.3%) also hold a significant share, showing their value in simplifying transactions. Self-checkout (17.5%) and digital signage (16.7%) are less popular, suggesting these technologies might not yet be as widely adopted or perceived as essential. Efforts to promote and enhance user experiences with digital signage and self-checkout could help improve their adoption rates. Additionally, investing in mobile app functionality and usability could further capitalize on its popularity.

Which smart technologies have you interacted with in store ?

S.NO	Particulars	No. of respondents	Percentage
1	Yes, frequently	65	54.2
2	Occasionally	29	24.2
3	Rarely	19	15.8
4	Not at all	17	5.8

Which smart technologies have you interacted with in store ?
120 responses

- Smart card
- Digital signage
- Self checkout
- Mobile app for shopping assistance

Interpretation:

A combined 78.4% of respondents engage with the feature either frequently occasionally, indicating its widespread presence and relevance. However, the 15.8% who engage rarely and the 5.8% who never engage suggest there is room to enhance accessibility, awareness, or perceived value for these groups .Strategies could focus on promoting the feature's benefits to convert occasional and rare users into frequent users while addressing barriers faced by those who don't engage at all.

Do you think IOT devices help reduce checkout waiting times?

S.NO	Particulars	No. of respondents	Percentage
1	Yes	53	44.2
2	Occasionally	29	24.2
3	Neutral	31	25.8
4	Rarely	7	5.8

Do you think IOT devices help reduce checkout waiting times?
120 responses

- Yes
- Occasionally
- Neutral
- Rarely
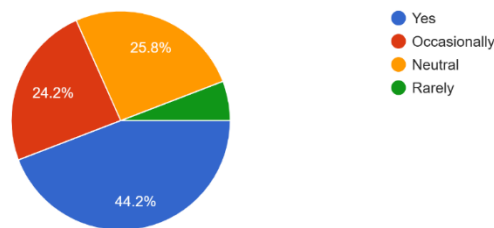
Interpretation:

Nearly half of the respondents (44.2%) show clear agreement or frequent involvement, and a combined 68.4% (Yes + Occasionally) indicate some level of positive response. However, the 25.8% neutral group suggests a considerable portion of the sample remains uncertain or indifferent. The 5.8% who engage rarely form a small minority, reflecting minimal concern about negativity .Strategies could focus on converting the neutral and occasional respondents into more engaged or affirmative participants by highlighting the subject's relevance and benefits.

How secure do you fell your personal data is when using smart devices in stores?

S.NO	Particulars	No. of respondents	Percentage
1	Yes	32	26.7
2	Occasionally	42	35
3	No issue	35	29.2
4	Not applicable	11	9.2

How secure do you fell your personal data is when using smart devices in stores?
120 responses

- Yes , frequently
- yes occasionally
- no issues
- not applicable
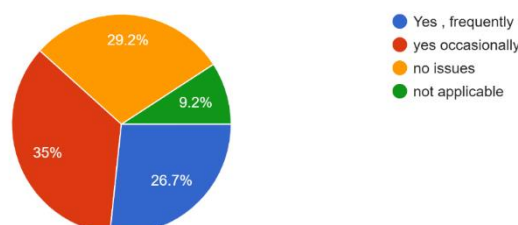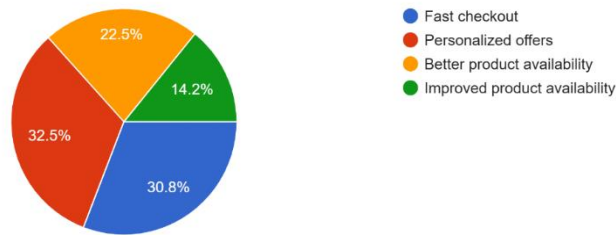
Interpretation:

A combined 61.7% (Yes + Occasionally) of respondents indicate they have encountered the issue to some degree, with the majority experiencing it occasionally.The 29.2% who report no issues and the 9.2% for whom the topic is not applicable suggest a substantial segment for whom the issue is irrelevant or resolved. Efforts to address occasional and frequent experiences of the issue could improve overall satisfaction, while maintaining the factors contributing to the positive experiences of those who reported "No Issue."

What do you consider the most significant benefit of IOT devices in store?

S.NO	Particulars	No. of respondents	Percentage
1	Fast checkout	37	30.8
2	Personalized	39	32.5
3	Better product offers	27	22.5
4	Improved customer service	17	14.2

what do you consider the most significant benefit of IOT devices in stores?
120 responses

- Fast checkout
- Personalized offers
- Better product availability
- Improved product availability

22.5% · 14.2% · 32.5% · 30.8%

Interpretation:

A combined 63.3% of respondents prioritize personalization or fast checkout, underscoring the importance of efficiency and customization in meeting customer expectations. Better product offers (22.5%) and improved customer service (14.2%) are secondary considerations but still represent valuable areas for enhancement.

would you like to see more smart devices implemented in store to improve you shopping experience

S.NO	Particulars	No. of respondents	Percentage
1	Definitely ,yes	48	40
2	Probably,yes	45	37.5
3	Neutral	22	18.3
4	Definitely no	5	4.2

would you like to see more smart devices implemented in store to improve you shopping experience
120 responses

- Definitely, yes
- Probably ,yes
- Neutral
- Definitely no

37.5% · 18.3% · 40%
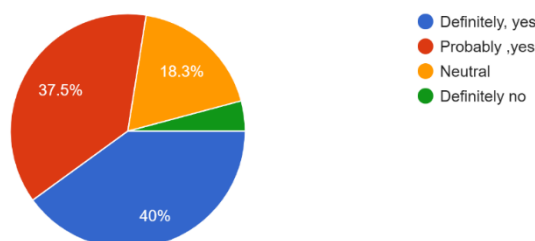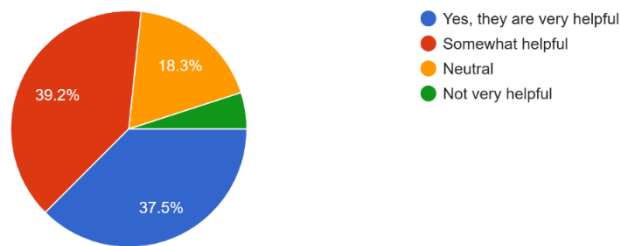
Interpretation:

the majority of respondents (77.5%) are in agreement to some degree ("Definitely Yes" or "Probably Yes"), indicating overall positive sentiment toward the topic. The 18.3% neutral responses suggest there is room to engage and persuade this group to lean more positively.The very small percentage (4.2%) of respondents with a "Definitely No" response shows minimal dissatisfaction or disagreement, making it less of a concern

have you noticed improvements in store navigation due to technologies like digital guides?

S.NO	Particulars	No. of respondents	Percentage
1	,yes	45	37.5
2	Somewhat helpful	47	39.2
3	Neutral	22	18.3
4	Not very helpful	6	5

have you noticed improvements in store navigation due to technologies like digital guides?
120 responses

- Yes, they are very helpful
- Somewhat helpful
- Neutral
- Not very helpful

Interpretation:

The majority of respondents (76.7%) find the aspect either "Very Helpful" or "Somewhat Helpful," reflecting an overall positive perception. However, the 18.3% neutral group and 5% "Not Very Helpful" group suggest there is room for improvement to address those who are less engaged or satisfied .Targeted efforts could enhance the helpfulness for individuals in the neutral or dissatisfied categories, further strengthening overall perception.

how would you rate the liability of IOT system during your shopping experience?

S.NO	Particulars	No. of respondents	Percentage
1	Very reliable	46	38.3
2	Somewhat reliable	35	29.2
3	Neutral	32	26.7
4	Very unreliable	7	5.8

how would you rate the liability of IOT system during your shopping experience?
120 responses

- Very reliable
- Somewhat reliable
- Neutral
- Very unreliable
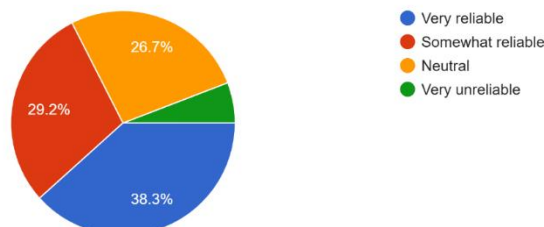
Interpretation:

  A majority (67.5%) of respondents find the subject reliable to some degree ("Very Reliable" or "Somewhat Reliable"). However, 26.7% remain neutral, indicating room for improvement in building stronger perceptions of reliability. The low percentage (5.8%) of those who consider it "Very Unreliable" suggests that negative opinions are relatively rare.

CHI-SQUARE ANALYSIS:

Table Name:

Age and IOT devices is more cost-effective in super market and retail store

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.54	9	.9978
Likelihood Ratio	16.273	5	.006
Linear-by-Linear Association	3.010	1	.083
N of Valid Cases	102		

7 cells (%) have expected count less than 5. The minimum expected count is .96.

Chi-square value= 30.54
Degree of freedom= 9
Significant level = 5%
Interpretation

        Thus the χ2 value is less than table value we accept the hypothesis. Therefore there is no
relationship between age and IOT devices is more cost-effective in super market and retail store

Table Name:

Gender and How often do you shop at supermarket or retail market ?

Chi-Square Tests			
	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	30.54	3	.006
Likelihood Ratio	16.273	5	.006
Linear-by-Linear Association	3.010	1	.083
N of Valid Cases	102		

7 cells (58.3%) have expected count less than 5. The minimum expected count is .96.

Chi-square value= 30.54
Degree of freedom=3
Significant level = 5%
Interpretation

        Thus the χ2 value is less than table value we accept the hypothesis. Therefore there is no
relationship between Gender and How often do you shop at supermarket or retail market

Findings from the study:

- The majority of respondents (63.3%) have an income level between 0 and 20,000

- A smaller proportion (18.3%) have an income level within the 20,001 to 40,000 range.

- The largest group of respondents are undergraduates (52.5%), followed by postgraduates (30.8%), showing that the majority have at least a bachelor's degree.

- A smaller segment (7.5%) has qualifications that do not fall into the standard categories listed

- The largest group of respondents (38.3%) considers the subject "Very Reliable."

- This indicates a strong positive perception of reliability among a significant portion of the population

- The majority of respondents (76.7%) find the aspect either "Very Helpful" or "Somewhat Helpful," reflecting an overall positive perception.

- The majority of respondents (77.5%) are in agreement to some degree ("Definitely Yes" or "Probably Yes"), indicating overall positive sentiment toward the topic.

- Most respondents engage in the activity either *weekly (40%)* or *monthly (26.7%)*, indicating a preference for periodic involvement rather than daily engagement

- Mobile apps (37.5%) are the most popular tool, reflecting their versatility and integration into daily life.

- The majority (*54.2%*) of respondents report encountering or using the feature *frequently.*

- he majority (*52.5%*) of respondents are *Undergraduates.*

- Nearly half of the respondents (*44.2%*) show clear agreement or frequent involvement, and a combined *68.4%* (Yes + Occasionally) indicate some level of positive response.

- The largest group (32.5%) values personalization the most. This indicates that a significant portion of respondents prefer tailored experiences, highlighting the importance of individualized service in enhancing customer satisfaction.

- The *29.2%* who report no issues and the *9.2%* for whom the topic is not applicable suggest a substantial segment for whom the issue is irrelevant or resolved.

Suggestion:

1. **Data Refinement:**

Address inconsistencies in column alignments to ensure accurate data interpretation .Group responses logically for cleaner analysis (e.g., categorize similar responses under one label like "Improved Efficiency" or "Faster Checkout").

2. **Key Insights to Highlight:**

Demographics Analysis Show how factors like age, income, and education influence attitudes toward IoT adoption .Shopping Habits .Identify the frequency of supermarket visits and how that correlates with the adoption of smart technologies.

faster checkout, and better product availability. Challenges and Concern: Explore data security issues and the reliability of smart systems as major concerns.

3. **Advanced Analytics:**

Perform a correlation analysis to find connections between demographic factors and satisfaction with IoT devices. Identify patterns in customer feedback, such as whether younger generations are more willing to adopt these systems compared to older ones.

4. **Visual Representations:**

Use pie charts for demographics and frequency of supermarket visits. Create bar graphs to illustrate satisfaction levels and most appreciated IoT benefits. Develop comparative charts showing differences in perceived benefits across various age or income groups.

5. **Recommendations for Retailers:**

Enhance customer trust by improving the security and transparency of IoT devices. Expand the implementation of smart devices in areas like navigation, product availability, and checkout to address frequent customer concerns. Provide clear instructions or assistance with using IoT devices to reduce challenges faced by less tech-savvy shoppers.

6. **Future Scope:**

Include qualitative feedback from customers to gain deeper insights into their experiences .Explore how emerging technologies like AI, AR, and VR could enhance shopping further. Suggest periodic surveys to track evolving customer perceptions over time.

Conclusion:

The survey highlights growing awareness and interaction with IoT-enabled technologies among retail customers. Most participants recognize the benefits of smart devices in improving shopping efficiency, such as faster checkouts and better product availability. However, concerns about data security and occasional system reliability issues remain significant barriers to broader acceptance.

Demographic trends indicate that younger shoppers are more adaptable to these technologies, and frequent shoppers are likelier to notice their benefits. While satisfaction levels with systems like self-checkouts are mixed, there is a clear demand for more smart devices in stores, provided they address usability and reliability concerns.

Retailers can capitalize on these insights by focusing on enhancing the reliability of IoT systems, ensuring data security, and increasing customer awareness about the technology's benefits. Overall, IoT technologies present a promising avenue to transform shopping experiences, provided challenges are systematically addressed.

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