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Effect of Product Prototyping on the Purchase Intention of BJ50 Among 3-Wheeler Tuk-Tuk Users in Laikipia County, Kenya.

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Abstract

This study examined the effect of product prototyping on the purchase intention of the BJ50 tuk-tuk among three-wheeler tuk-tuk users in Laikipia County, Kenya. Utilizing a descriptive research design, the study collected quantitative data through a structured questionnaire conducted with a census of 149 tuk-tuk operators. Guided by the Quality Function Deployment (QFD) model, the research investigated how customer feedback involvement, feature-based prototyping, and rapid prototyping influence purchase intention. Descriptive and inferential analyses reveal that active customer involvement in the prototyping process, including the integration of their feedback, significantly enhances purchase intention. A correlation coefficient (R) of 0.288 and regression model results ($p = 0.001$) confirm a statistically significant relationship, with product prototyping explaining 8.3% of the variance in purchase intention. The study concludes that prototyping fosters a customer-centered approach, aligning product features with user needs, building trust, and ultimately driving purchase decisions. It recommends investing in advanced prototyping technologies, iterative refinement based on customer feedback, and leveraging social media to create an engaged community around the product. These strategies can enhance product-market alignment and increase purchase intent.

Keywords: *Product prototyping, Purchase intention, BJ50 tuk-tuk, Customer engagement, Design thinking*

1.1 Introduction

The rapidly shifting landscape of global competition, technological advancement, and heightened market uncertainties compels manufacturers to prioritize competitive design practices that meet evolving consumer needs (Shuen, Feiler, & Teece, 2014). Prototyping is recognized as a crucial stage in product development, providing manufacturers with the tools to respond quickly to

consumer feedback and market changes. While several leading companies such as Xerox Parc and Apple have explored innovative prototyping techniques beyond traditional methods, there remains a gap in understanding the role of prototyping within smaller markets and industries (Lauff, Schwartz, & Rentschler, 2018). This development stage is invaluable, as rapid prototyping helps reveal unforeseen customer concerns and design flaws that can significantly affect product viability (Hiebeler, Kelly, & Ketteman, 2012).

In the design thinking framework, prototyping supports iterative development by producing tangible product models that allow users to interact with and test solutions directly, thereby improving the likelihood of meeting customer needs and preferences. This hands-on approach is particularly effective for capturing real-time feedback and allowing for immediate adjustments before a product launch (Beaudouin & Mackay, 2009). In manufacturing, successful companies tend to leverage prototyping to identify and resolve early-stage design challenges, making it a strong predictor of firm success (Zhang, Vonderembse & Cao, 2009). This suggests that prototyping can significantly impact customer acceptance and purchase intentions, especially within contexts where consumer needs are highly specific, such as the local transport industry in Kenya.

In Kenya's Laikipia County, the BJ50 tuk-tuk initiative highlights the role of prototyping in adapting to local transport demands. Initially launched in 2007 by Saagak Company as a low-cost, fuel-efficient vehicle for transporting passengers and goods, the BJ50 represents a unique innovation in Kenya's three-wheeler market (Venter, Mahendra, & Hidalgo, 2019). With the support of the Laikipia County government and Dedan Kimathi University of Technology, the BJ50 underwent prototyping and testing to meet engineering standards. Yet, despite efforts to refine the vehicle design and receive regulatory approval, the BJ50 has encountered challenges in sales, attributed in part to limited consumer involvement during the design and prototyping stages. This raises critical questions about the extent to which prototyping can improve user alignment with product features and encourage purchase intention.

Research underscores the crucial role of prototyping in refining products to better meet customer expectations, a process that minimizes development risks and enhances market readiness (Mat et al., 2018). However, despite advancements in prototyping for the BJ50, initial customer feedback highlighted unmet needs and raised concerns regarding practical usability. These critiques emphasize the importance of engaging customers throughout the prototyping process to align product development with user requirements and increase purchase intent (Mat et al., 2018). Limited user feedback during the BJ50's early development stages may have hindered its commercial success, despite achieving technical standards. This case exemplifies a broader trend in prototyping: it is not solely about perfecting the design but also about actively involving consumers to ensure the final product aligns with their needs. Prototyping, as part of a design-thinking approach, thus plays a vital role in continuous product improvement while fostering brand trust and purchase motivation (Dalton & Kahute, 2016). Understanding prototyping's impact on purchase intentions within Kenya's emerging automotive market can provide valuable insights for boosting product adoption and driving local innovation in transportation solutions.

1.2 Statement of the Problem

The manufacturing sector faces numerous obstacles, including outdated production methods, high raw material costs, and limited access to capital, all of which complicate efforts to create products that meet evolving market demands (Zahraee, 2016). In the context of product development, the lack of direct customer engagement during early stages like prototyping often leads to products that fail to fully address user needs, resulting in lower purchase intentions (Yang, Cheng, & Wang, 2019). Despite the essential role that prototyping plays in bridging design concepts and user expectations, many companies still overlook its potential for uncovering consumer insights that could guide product adjustments. Effective prototyping requires a hands-on, iterative approach that not only fine-tunes product quality but also aligns closely with consumer needs and preferences.

In Kenya, where manufacturing is a core pillar of the Vision 2030 development agenda, the push for high-quality, locally produced goods has gained significant policy backing. However, slow progress in developing products that appeal to local markets threatens the achievement of these goals, highlighting an urgent need for data-driven policies to address existing challenges in manufacturing. For niche products like the BJ50 tuk-tuk—a four-wheeled alternative to traditional three-wheeler models—the prototyping process is critical. Despite its enhanced passenger capacity and stability, the BJ50 has received mixed feedback, indicating a misalignment between consumer expectations and the unique selling points of the product. This disconnect suggests a lack of in-depth user engagement during the prototyping phase, which could have better informed product development to meet end-user requirements.

The negative reception of the BJ50 among target users highlights the critical need for a prototyping process that is both interactive and responsive to user feedback. Without meaningful consumer engagement during prototyping, essential product attributes such as functionality, comfort, and usability may fail to meet user preferences, ultimately reducing purchase intent. Research shows that prototyping can be a powerful tool for gathering consumer insights, refining product features, and ensuring quality standards—essential factors in a competitive market (Kaitila, 2019; Sugiarto & Octaviana, 2021). However, there is limited research in Kenya on the influence of design thinking and prototyping on consumer purchase behavior, signaling a gap in understanding how these methods can support local innovation and align with market needs. While design thinking frameworks are widely emphasized internationally, studies on their application within Kenya's manufacturing sector—especially concerning prototyping's impact on purchase intention—remain sparse. Addressing this gap, this study investigates how a robust prototyping process can enhance user satisfaction and drive purchase intention among three-wheeler tuk-tuk operators, focusing specifically on the BJ50. By examining prototyping within a design thinking approach, this research aims to illustrate how user-centered development can strengthen product-market fit and contribute to Kenya's broader manufacturing objectives.

1.3 Research Objective

i.) To assess the effect of product prototyping on the purchase intention of BJ50 among 3-wheeler tuk-tuk users in Laikipia County, Kenya.

1.4 Research Hypothesis

i.) $Ho4$: There is no statistically significant relationship between product prototyping and purchase intention of BJ50 among 3-wheeler tuk-tuk users in Laikipia County, Kenya.

1.5 Significance of the Study

This study is justified in its focus on design thinking—particularly prototyping—as a method for addressing unfulfilled customer needs through innovative processes. By examining prototyping's impact on purchase intention, this research provides essential insights for the Kenyan Ministry of Industrialization and Enterprise Development, enabling it to craft data-driven policies that prioritize urgent manufacturing challenges in line with Vision 2030's goals. For Saagak Company, the BJ50 tuk-tuk developer, the study offers user-centered recommendations to enhance product quality and better satisfy customer expectations, addressing specific market gaps that could increase product adoption. Dedan Kimathi University of Technology stands to benefit as well by deepening its understanding of effective prototyping and product development practices, potentially enhancing its contributions to the tuk-tuk production process and advancing Kenya's automotive industry. The study also serves as a practical guide for SMEs and larger businesses in Kenya, promoting the use of design thinking methodologies to develop products that meet localized customer needs, thus reducing the risk of product misalignment in the market. Finally, the research lays a foundation for future exploration into tuk-tuk manufacturing and design thinking, allowing other researchers to build upon its findings and further investigate customer-centered innovation within Kenya's evolving manufacturing sector.

1.6 Scope of the Study

This study focuses on the effect of design thinking—focusing on product prototyping—on the purchase intentions for the BJ50 tuk-tuk among 3-wheeler tuk-tuk users in Laikipia County, Kenya. Laikipia County serves as an ideal location for this research since it houses the production of the BJ50, and residents are more familiar with the product than those further afield. Targeting 3-wheeler tuk-tuk users as respondents provides critical insights, as these users not only represent a primary competitor market but also potential adopters of the BJ50. This focused scope aims to provide a nuanced understanding of how prototyping in product development can influence user preferences and purchasing behavior in a locally relevant context.

2.1 Theoretical Literature Review

The study was guided by the Quality Function Deployment (QFD) Model, a framework designed to translate customer requirements into product design attributes that meet those needs. Conceived in Japan in the late 1960s, QFD marked a shift in Japanese manufacturing from post-World War II imitation-based development to a focus on originality and quality (Akao, 1997). Originally implemented within Total Quality Control, the QFD model emphasized embedding quality assurance early in the product development process, allowing companies to ensure quality design

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Volume 8||Issue 7||Page 52-63||November |2024|
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throughout production. According to Shakhshir, Badran, Qasrawi, Radad, and Saadeh (2018), QFD was developed in 1966 to integrate the "voice of the customer" with engineering features, facilitating a customer-driven approach to design. The model became a foundation of Japan's quality systems, aiming to deliver products that satisfy consumer needs (Mazur, 1996). As the methodology spread to industries worldwide, including automotive sectors, it allowed for the conversion of user requirements into specific, actionable product characteristics (Akao, 1997.

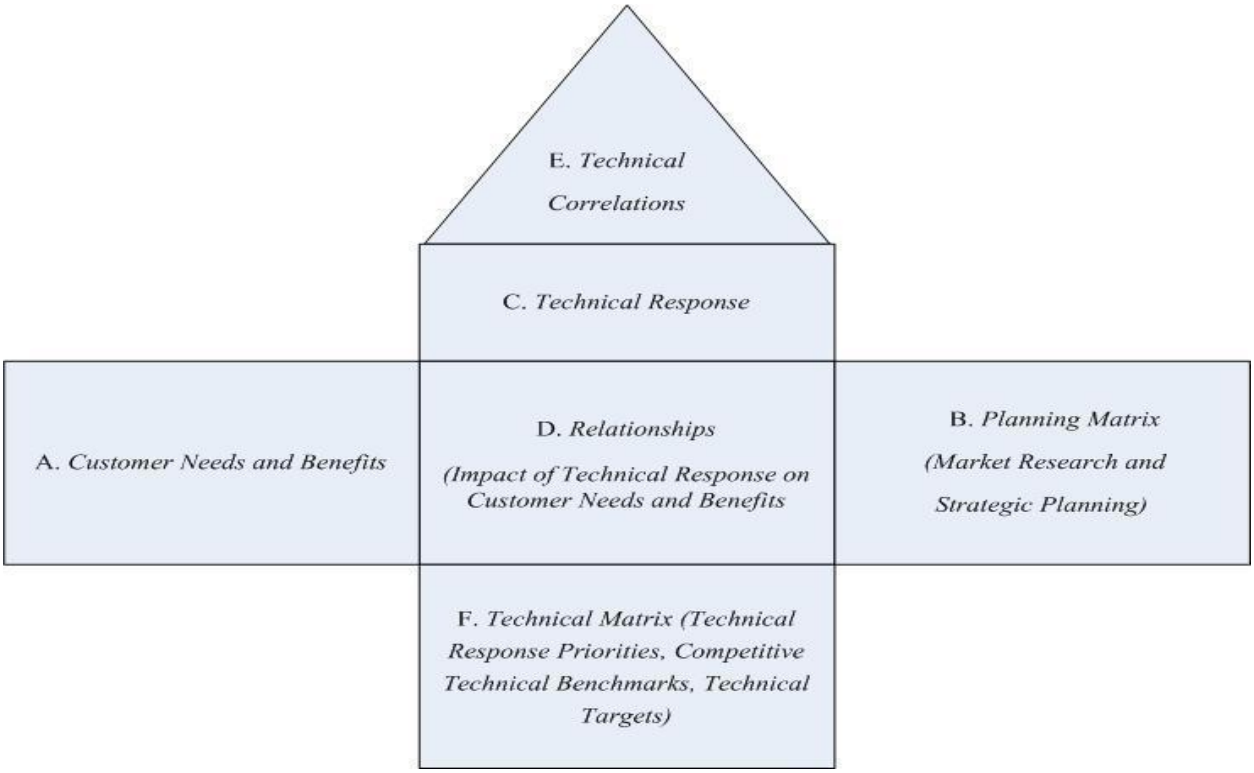

Figure 1: Quality Function Deployment (QFD) Model

Source: Akao and King (1990)

Besterfield, Besterfield-Michna, Besterfield and Besterfield-Sacre, (2004) argue that total Quality Function Deployment (QFD) integrates Total Quality Management (TQM) principles to continuously enhance customer satisfaction by converting customer needs into specific technical requirements (Akao, 1990; Devadasan, Kathiravan & Thirunavukkarasu, 2006). Using tools like the House of Quality, QFD provides a structured framework for prioritizing these technical requirements to ensure that products align with customer expectations (González, 2001). While widely adopted by firms in North America for cross-functional product improvement (Mazur, 1996), the model's effectiveness can be limited in solving innovative problems, often requiring hybrid methods like TRIZ to evaluate and generate new product alternatives (Yang et al., 2019). This model's focus on customer-driven design makes it highly relevant for studies on design thinking, particularly for aligning prototypes with consumer needs (Akao, 1997).

Stratford Peer Reviewed Journals and Book Publishing
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Volume 8||Issue 7||Page 52-63||November |2024|
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2.2 Empirical Literature Review

Product prototyping has emerged as a critical element in modern manufacturing, bridging the gap between design concepts and market readiness. Niaki, Nonino, Palombi, and Torabi (2019) explored the adoption of additive manufacturing and rapid prototyping across 105 companies worldwide, highlighting the economic benefits of this approach. Their findings reveal that companies using additive manufacturing for low-volume prototyping can reduce costs and enhance profitability by capitalizing on economies of scale. By lowering fixed costs per unit, these companies achieve financial sustainability. The study emphasizes the value of involving customers in the prototyping process to elevate satisfaction, suggesting that customer engagement with prototype versions of products can improve alignment between product attributes and user needs. This approach not only supports cost efficiency but also helps companies secure customer buy-in early in the product lifecycle.

Zhang, Vonderembse, and Cao (2009) also underscore the importance of flexibility within prototyping processes, especially in response to rapidly shifting customer expectations and competitive pressures. Their study of 273 manufacturing firms highlights that product prototype flexibility is a strong predictor of customer satisfaction, allowing firms to respond dynamically to user feedback and make iterative changes. Rapid prototyping enables companies to experiment with multiple product versions while staying closely connected to customers, providing them with tangible models to assess and refine their expectations. Given the inherent difficulty customers often face in articulating specific needs, prototyping offers a practical solution, allowing for a hands-on evaluation and adjustment to user preferences. The cumulative insights from these studies suggest that rapid prototyping significantly enhances customer satisfaction and purchase intention by reducing development uncertainty and incorporating customer feedback directly into product iterations.

2.3 Conceptual Framework

Figure 2 illustrates the conceptual framework for the study.

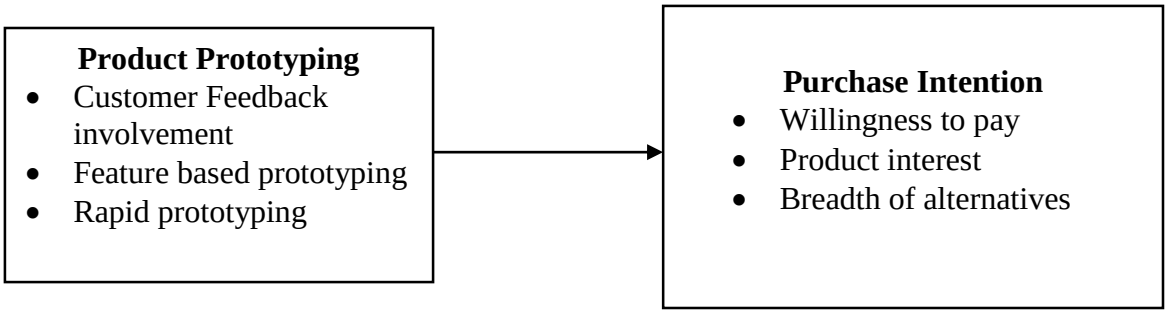

Figure 2: Conceptual Framework

The conceptual framework presented in figure 1 illustrates the relationship between Product Prototyping and Purchase Intention. Product prototyping, as shown, is comprised of three key elements: customer feedback involvement, feature-based prototyping, and rapid prototyping. Each of these aspects represents a crucial phase in the design and development process aimed at aligning the product closely with customer needs. Customer feedback involvement ensures that users' preferences and insights shape the prototype, creating a product that resonates more with the target market. Feature-based prototyping focuses on developing specific attributes that meet customer expectations, while rapid prototyping enables quick adjustments in response to market demands and user input. These components collectively influence Purchase Intention, which encompasses willingness to pay, product interest, and the consideration of alternative products. By fostering alignment between product design and customer preferences, prototyping directly enhances factors that drive purchase decisions. This framework suggests that an iterative, customer-centered approach to prototyping increases the likelihood of market acceptance and strengthens consumers' purchase intent.

3.0 Research Methodology

The research adopted a descriptive research design to examine the influence of product prototyping, along with other design thinking elements, on the purchase intention of the BJ50 among tuk-tuk users in Laikipia County. Through a structured questionnaire, quantitative data was gathered from a census of 149 members of registered tuk-tuk SACCOs. The use of closed-ended questions allowed the researcher to measure key variables, such as customer feedback involvement and rapid prototyping, which are vital aspects of product prototyping. Analysis was conducted using SPSS, where descriptive and inferential statistics provided insights into the impact of prototyping on purchase intention. Diagnostic tests for linearity, normality, multicollinearity, homoscedasticity, and autocorrelation were employed to validate the regression model's assumptions, ensuring accurate results. Ethical considerations, including participant consent, data privacy, and integrity, were maintained to uphold research standards. This approach provided a rigorous examination of how aligning the BJ50's features with customer needs through effective prototyping could influence user interest and willingness to purchase.

4.0 Findings

This section presents the findings of the study. They include the descriptive and inferential results. The sections below detail these findings.

4.1 Descriptive Statistics

The study sought to assess the effect of product prototyping on the purchase intention of BJ50 among 3-wheeler tuk-tuk users in Laikipia County, Kenya. The results are presented in this section.

Stratford Peer Reviewed Journals and Book Publishing
Journal of Entrepreneurship and Project Management
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Table 1: Descriptive statistics results for Product Prototyping

Characteristics	Agree	Neutral	Disagree	Mean	SD
My active involvement in providing insights (my thinking) during the prototyping stage increases my interest in the product	100	0.0	0.0	4.58	0.495
My interest in the product is boosted whenever my feedback on areas of improvement is reflected in the product's prototype	100	0.0	0.0	4.56	0.498
The general outlook of the product prototype influences my interest in the product	51.1	8.80	40.1	2.56	0.514
My knowledge of the product's key features of the prototype (sample) influences my purchase intention	83.7	3.20	13.1	3.83	0.517
Easy access to the company's product prototypes directly (image) will influence my purchase choice	100	0.0	0.0	4.62	0.487
My attention to the product is influenced whenever the virtual prototypes (image representations) are repeated several times to meet my needs	91.2	4.60	4.2	3.98	0.469
Overall Average				**4.02**	**0.302**

The study sought to establish respondents' opinions on product prototyping. All (100%) of the respondents in the study agreed that their active involvement in providing insights and the general outlook of the product prototype influences their interest in the product (4.58±0.495). Similarly, all the respondents agreed that their interest in the product is boosted whenever their feedback on areas of improvement is reflected in the product's prototype (4.56±0.498). Slightly above half agreed that their knowledge of the product's key features of the prototype as well as easy access to the company's product's prototypes directly (image) will influence their purchase choice (3.83±0.517). In addition, 91.2% agreed that their attention to the product is influenced whenever the virtual prototypes (image representations) are repeated several times to meet their needs (3.98±0.469). This lends support to Zhang et al. (2009) who indicated that rapid prototyping is an important issue in managing product development efforts. Since they are able to experiment with multiple products while closely communicating with the customers. This helps product inventors to take opportunities from customer feedback. The result also lends support to Niaki et al. (2019) where product designers need to share the final product prototype with the customers while developing the product to attain a high level of customer satisfaction.

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Volume 8||Issue 7||Page 52-63||November |2024|
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4.2 Inferential Analysis

To assess the effect of product prototyping on the purchase intention of BJ50 among 3-wheeler tuk-tuk users in Laikipia County, Kenya, regression analysis was conducted.

Table 2: Model Summary of Product Prototyping and Purchase Intention

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.288[a]	.083	.075	2.50885

a. Predictors: (Constant), Prototyping

The correlation coefficient (R) is 0.288 indicating that the correlation between product prototyping and purchase intention is positive. The R Square value is 0.083, suggesting that approximately 8.3% of the variability in purchase intention can be explained by product prototyping. This implies that product prototyping, as a single predictor, has a moderate influence on purchase intention.

Table 3: ANOVA of Product Prototyping and Purchase Intention

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	**Regression**	69.448	1	69.448	11.033	.001[b]
	Residual	767.907	122	6.294		
	Total	837.355	123			

a. Dependent Variable: Intention
b. Predictors: (Constant), Product Prototyping

The ANOVA table shows that the F-statistic is 11.033 with a p-value of 0.001, indicating that the regression model is statistically significant. In other words, product prototyping significantly contributes to explaining the variability in purchase intention.

The null hypothesis that product prototyping has no significant influence on the purchase intention of BJ50 Tuktuk among 3-wheeler tuktuk users in Laikipia County was rejected where the p-value was 0.001 which is less than 0.05. The null hypothesis $Ho4$ is rejected if the p-value is less than 0.05 and fails to reject if the p-value is greater than 0.05. The results agree with Zhang, Vonderembse and Cao (2009) results that prototyping influences firms' ability to act quickly to the users' changing needs resulting in the creation of innovative products.

Table 4: Coefficient of Regression

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	17.703	3.951		4.481	.000
	Prototyping	.476	.143	.288	3.322	.001

a. Dependent Variable: Intention

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The constant term (17.703) represents the estimated purchase intention when product prototyping is zero. The coefficient for Product Prototyping is 0.476, suggesting that for each one-unit increase in product prototyping, purchase intention is expected to increase by 0.476 units. The standardized coefficient (Beta) for Product Prototyping is 0.288, indicating the relative importance of product prototyping in predicting purchase intention. The results indicate a statistically significant relationship between product prototyping and purchase intention. Product prototyping explains a moderate portion of the variability in purchase intention.

$$Y= 17.703+ 0.476\ PP$$

The new model shows that without product prototyping, purchase intention would be 17.703. The model shows that prototyping plays a significant role in enhancing purchase intention where its inclusion causes the purchase intention to increase by 0.476 units

5.0 Summary

The study evaluated how product prototyping affects the purchase intention of the BJ50 among three-wheeler tuk-tuk users in Laikipia County, Kenya. All respondents agreed that their active involvement in providing feedback and reviewing prototypes significantly influenced their interest in the product, underscoring the value of customer engagement in the development process. Additionally, there was unanimous agreement on the positive impact of incorporating user feedback into the prototype to increase product appeal. While slightly over half of the respondents noted that understanding the prototype's features and having easy access to virtual representations influenced their purchase decisions, a substantial majority felt that repeated exposure to virtual prototypes tailored to their needs effectively captured their interest. These findings reinforce the importance of rapid prototyping and customer involvement as essential components in leveraging customer feedback and achieving satisfaction in product development. The study demonstrated that product prototyping played a meaningful role in shaping purchase intent, supporting previous research on its effectiveness in promoting innovation and responsiveness to user needs.

6.0 Conclusions

The study concludes that product prototyping plays a crucial role in shaping purchase intention for the BJ50 tuk-tuk among 3-wheeler tuk-tuk users in Laikipia County, Kenya. Active customer involvement in the prototyping process, including the integration of their feedback and exposure to evolving product representations, creates a stronger alignment between the product and user needs. This customer-centered approach not only enhances user engagement but also builds trust and confidence in the product, thereby increasing the likelihood of purchase. Although the effect size of prototyping on purchase intention is moderate, the significant relationship observed confirms that prototyping is a valuable strategy for influencing consumer decisions, especially in markets where product relevance and user satisfaction are critical to adoption.

7.0 Recommendations

The study recommends investing in advanced prototyping technologies to create realistic, interactive prototypes that actively engage customers, allowing them to provide valuable feedback and validate design concepts early in development. By iterating and refining prototypes based on this input, companies can ensure that products align with user expectations and effectively address

their needs. Utilizing social media and online platforms is also advised to foster a community around the prototype, keeping potential users engaged and invested in the development process. Additionally, conducting thorough market research is essential for understanding customer needs and preferences, helping to identify areas for improvement and innovation. These strategies collectively aim to enhance product appeal and increase purchase intention by aligning product development closely with customer insights.

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