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Relative Advantage as a Determinant of Technology Adoption among Automobile Mechanics in Micro and Small Enterprises in Kenya

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Abstract: *Micro and Small Enterprises (MSEs) are facing tremendous challenges and threats to survive in a competitive environment. As a matter of fact, MSEs are faced with the threat of failure with past statistics indicating that three out five fail within the first few months. In spite of this fact, automobile mechanics in this informal sector have been slow in adopting modern technology despite the advantages that are attributed to new innovations. This study aimed to determine factors that influence technology adoption among automobile mechanics in micro and small enterprises in Nakuru town; Kenya. The one of the specific objective of the study was to establish the role of relative advantage, in the adoption of technology. The research used a descriptive cross sectional survey design and employed both probability and non-probability sampling techniques to collect quantitative and qualitative data. Applying the Binary logistic regression analysis and using SPSS to analyze, the study found that, adoption of various modern automobile technologies are influenced; among other factors, the perceived attitude of the mechanics relative advantage of a particular innovation. However, it was revealed that although a larger proportion of the mechanics appreciated the advantages of various auto innovations, adoption to the same was significantly quite low. The study recommended that the government should emphasize and create an innovation awareness system and invest in appropriate technology by way of developing relevant training curriculum for the mechanics based on industry and environmental needs. This study is significant as its findings, if implemented; can jump-start the informal mechanics towards achieving quality, competitiveness and both human and environmental safety.*

Key words: *Relative advantage, Micro and Small Enterprises, Appropriate technology, Technology adoption*

I. Introduction

1.1. Small and Micro Enterprises in Kenya

Small and micro enterprises in Kenya represent a vital part of the economy, being the source of various economic contributions through; the generation of income via exporting and importing, providing new job opportunities, introducing innovations, stimulating competition, and engine for employment. Intellectual capital appears as the most important and vital component of a knowledge-based economy. The role and importance of small and medium enterprises in a knowledge-based economy has been highly appreciated and acknowledged. Moreover, in the present economy, small and medium enterprises are facing tremendous challenges and threats to survive in a competitive environment. The impact of intellectual capital on the general performance of the Small and micro enterprises has become a very important issue now than ever, this is due to the level of globalization of whose outcomes are privatization and deregulation of markets, aggressive competition and the ever-rising expectations of customers. As a result of this, there is need for businesses to be at their best in order to be relevant in the environment (Karanja, Gakure, Were, Ngugi & Kibiru). The paper therefore examines the influence of perceived relative advantage of modern automobile technology among the mechanics operating in micro and small enterprises in Kenya and their rate of adoption to innovations.

1.2. Technology Adoption

Understanding the factors influencing technology adoption helps us predict and manage who adopts, when, and under what conditions. Armed with this information we can assess where people are in the adoption process and support them as they move from technology acceptance through to usage. The process of adopting new innovations has been studied for over 40 years, and one of the most popular adoption models is described by Rogers' foundational analysis and set of practices and categorizations that have informed innovation studies over the last several decades. Rogers (1995) described technology diffusion as 'the process through which an individual or other decision maker unit passes from first knowledge of an innovation, to a decision to adopt or reject, to implementation of the new idea'. He further asserted that diffusion involves two different actors: company or organization who will adopt the innovation or new technology and users or individual or organizations who will use the products or services regarded as new. Rogers (1995) conceived of the five

attributes that influence technology adoption in the following ways: "Relative advantage; the degree to which an innovation is perceived as being better than the idea it supersedes. The degree of relative advantage is often expressed as: economic profitability, social prestige, or other benefits, compatibility; the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. An idea that is more compatible is less uncertain to the potential adopter, and fits more closely with the individual's life situation. Such compatibility helps the individual give meaning to the new idea so that it is regarded as familiar. Complexity; the degree to which an innovation is perceived as relatively difficult to understand and use. The more simplistic and less complex the innovation is, the easier it is for someone to adopt. Trialability; the degree; to which an innovation may be experimented with on a limited basis. A trial is a way for a potential user to alleviate any hesitancy or doubt that they might have. The fifth attribute that can help explain the rate of adoption is observability. Observability is the degree to which the results of an innovation are visible to others (Rogers, 1995). Given the complexity of modern automobile innovations, the Rogers model is the most suitable in attempting to explain various factors that influence adoption of technology within the informal automobile mechanics. This paper sought to determine, specifically; the role of relative advantage in technology adoption.

Technology has been defined as "knowledge required to produce goods or services" and, alternatively, as "the application of practical or mechanical sciences to industry or commerce and the methods, theory and practices governing such applications." Whichever definition is applied, the advantages of technology are no longer a contentious issue, either in developed or in developing economies. What is at issue is the lack of policies that enhance access to it. (Russel, 1998). Technology is the means for adding value to goods, materials or resource in order to generate useful products or services. Thus industrial development is strongly related to the process of adding value to goods or materials and there from create a surplus (wealth creation). And technological capability is the key for doing this. A credible industrial development programme must be hinged on the availability of active indigenous technological capability. Technology has emerged in recent times as one of the key strategic variables in economic development. In Africa, technology as an instrument of change is now receiving special attention in national planning. However, there are still many issues requiring urgent attention before access to new technologies can diffuse and assimilate in Africa. Inventors, innovators, SMEs and R&D organizations constitute the pillars on which technological capability is constructed. And indeed it is through these bodies, often working in concert, that technology is nurtured, acquired, assimilated and fueled to power industrialization (Caryannis & Eric, 2006).

1.3 Statement of the Problem

New technologies come with various social and economic advantages. In the case of automobiles, Electronic Fuel Injection (EFI) systems have evolved significantly since the mid 1980s. These systems provide an accurate, reliable and cost-effective method of metering fuel and providing maximum engine efficiency with clean exhaust emissions, which is why EFI systems have replaced carburetors in the market place. EFI is becoming more reliable and less expensive through widespread usage. At the same time, carburetors are becoming less available, and more expensive. Virtually all internal combustion engines, including motorcycles, off-road vehicles, and outdoor power equipment, may eventually use some form of fuel injection (Wang, , Jin, , Wang, M. & Wei, 2010). Adoption of modern technology ensures accurate and reliable diagnoses, repair and or service of vehicles by use of on-board diagnostic scanners and thus lowering maintenance costs as in fuel consumption and less frequent repairs, maximum safety and a cleaner environment. Unfortunately, a significant proportion of motor vehicle mechanics in Kenya are yet to appreciate these relative advantages. It is critical for the informal mechanics to adopt and appreciate the advantages of modern automobile technology in order to alleviate the possible challenges.

1.4. Specific Objective

To establish the role of relative advantage in the adoption of technology within the informal automobile mechanics.

1.5 Hypotheses

H_0: Relative advantage does not influence the adoption of modern automobile technology among the informal mechanics.

II. Literature Review

2.1 Empirical Literature

Technology adoption is a complex, inherently social, developmental process; individuals construct unique yet malleable perceptions of technology that influence their adoption decisions. This decision of whether an individual will adopt a particular technology and the time frame involved with that decision has been a long

source of research across multiple disciplines, and it influences business, school, and everyday life. Therefore, it is essential to understand such aspects of the process such as the following: Why does one individual choose to adopt a technology while another resists? What is the influence of social context on the decision to adopt? These questions are addressed in the context of adoption and diffusion theories that suggest some attitudinal attributes that contribute to adoption.

2.2 Degree of Relative Advantage

The relative advantage of one technology over another is a key determinant of the adoption of new technology. The issue of relative advantage has been shown to have a positive relationship with adoption of innovation (Tornatzky & Klein, 2012). Users need to be shown that a new technology offers considerable benefit compared to traditional offering (Manfield, 1963a). A study by Saxena and Kehar (2011); "Innovation, Non-Expertise and Inabilities of Developing Countries E-Banking and E-Commerce" was carried out in India with a major objective to determine factors that influence the adoption of consumer oriented e-banking in various countries. Taking India and United States of America (USA) as case studies, the study used multivariate analysis of covariance (MANCOVA), correlation and multiple regression analysis to establish a relationship between adoption of modern banking technology and the Rogers innovation attributes. Findings were that relative advantage of a new technology had a positive relationship with adoption. This is corroborated by Tornatzky & Klein, (2012) who also found that relative advantage has a positive relationship with adoption of innovation. Other studies, for instance; Wanyoike (2013) found that the relative advantage of a new technology is positively related to adoption. Mechanics need to be shown that modern automobile technology offers considerable benefit compared to traditional offering. A large number of researchers have highlighted some of the key benefits that modern vehicles offer, these include: better combustion leading to fuel efficiency, less harmful emissions, less frequent tune-ups, smoother and more dependable engine response during quick throttle transitions, easier and more dependable engine starting, better operation at extremely high or low ambient temperatures, smoother engine idle and running, increased maintenance intervals among others (Growse, 2011). Overall modern motor vehicle technology does offer considerable advantages to mechanics and motor vehicle owners or users alike, however, the continued adoption needs to be encouraged for future uptake.

III. Methodology

3.1 Research Design and Sample Size

This study was a descriptive research specifically deploying cross-sectional survey to gather information from informal automobile mechanics. This type of design utilized different groups of people who differ in the variable of interest, but share other characteristics such as socio-economic status, educational background among others. This methodology was suitable for this study because informal mechanics tend to specialize in different areas like: auto-body, auto electrics, petrol and diesel powered engines though they have common socio-economic characteristics. A sample of 132 mechanics in Nakuru town, randomly drawn; from various areas of specialization as shown in Table 1 were used in this survey.

Table 3. 1: Distribution of the mechanics as per category and sample size

Mechanic category	Category Population (Nh)	Sample size for stratum
Auto body mechanics	73	49
Petrol vehicle mechanics	28	19
Diesel vehicle mechanics	21	14
Auto electricians	10	7
General vehicle mechanics	65	43
TOTAL	**N=197**	**S=132**

3.2 Data analysis

Binary logistic regression analysis was instrumental in testing of the hypotheses. This study hypothesized that adoption of automobile technology (Y) within the informal automobile mechanics is a function of the adoption perceived attributes, as presented in equation 1:

$$\textbf{Adoption (Y)} = f(X_1, X_2, X_3, X_4) \qquad (3.1)$$

In the equation, Y is a binary response adoption: Y_i is 1 if a technology has been adopted, Y_i is 0 if a technology has not been adopted, and; $X = (x_1, x_2, x_3 \text{and } x_4)$ are explanatory variables: complexity, relative advantage, compatibility, and observability respectively.

To establish the effect of the hypothesized independent variables on the dependent, the odds ratio (OR), which estimates the change in the odds of membership in the target group for a one unit increase in the predictor was generated. It was calculated using the regression coefficients of the predictors as exponents or exp. SPSS

calculated this value of the ln (odds ratio) and presents it as Exp(B) in the results printout in the 'Variables in the Equation.' In addition; to determine which particular independent variables had effects on the dependent variable, the wald statistics significant levels were also generated.

IV. Results And Discussion

Given their various levels of formal education, the mechanics were asked to respond whether modern automobile technology is relatively more advantageous than the traditional. The responses are shown in Table 4.1.

Table 4.1: Formal education in relation to relative advantage

Level of education	Relative advantage	
	No advantages	Advantageous
Primary	6.3%	31.5%
Secondary	11.8%	37.8%
Diploma	0.8%	11%
University	0%	1.6%
Total	18.9%	81.1%

Overall, 81.1% of the mechanics concurred that modern automobiles have more advantages than the older models. Of these, 37.8% were secondary school leavers, 31.5% primary school leavers, 11% diploma holders and 1.6% university graduates. The advantages they cited included: fuel efficiency in case of EFI systems, ease to drive in the case of automatic transmission systems, more user-friendly electronically operated accessories like power windows, power side mirrors, and central locking systems among others.

The study also related the training status of the mechanics and their perception on relative advantage as shown in Table 4.2.

Table 4.2: Relation between training status of the mechanics and relative advantage perception

Formal Technical Training Status	Relative advantage	
	No advantages	Advantageous
No formal training	8.7%	37 %
Formally trained	10.2%	44.1%
Total	**18.9%**	**81.1%**

A large proportion of the mechanics (81.1%) indicated that modern vehicles have more advantages over older models. A breakdown of the responses based on the technical qualifications of the mechanics is illustrated in Table 4.3.

Table 4.3: Technical training qualification of the mechanics and relative advantage perception

Technical Training Qualification	Relative advantage	
	No advantages	Advantageous
Craft certificate	1.5%	17.4%
Trade test III	2.8%	20.3%
Trade test II	5.8%	13.0%
Trade test I	5.8%	10.1%
Diploma	1.5%	11.6%
Higher National Diploma	1.5%	8.7%
Total	**18.9%**	**81.1%**

A significant number (20.3%) of mechanics with government trade test III agreed that modern vehicles have more relative advantages than older models. They were followed by those with craft certificate, 17.4%, trade test II holders 13%, diploma holders 11.6%, trade test I and higher national diploma graduates with 10.1% and 8.7% respectively.

When asked to make a technical comparison between modern and old model motor vehicles, mechanics drawn from the five areas of specialization responded as shown in Table 4.4.

Table 4.4: Area of specialization of the mechanics as related to relative advantage

Area of Specialization	Relative advantage	
	No advantages	Advantageous
Auto-body mechanics	5.5%	33.1%
Petrol vehicle mechanics	4.0%	11.0%
Diesel vehicle mechanics	3.1%	7.9%
Auto electricians	0.8%	4.7%
General vehicle mechanics	5.5%	24.4%
Total	**18.9%**	**81.1%**

As shown in Table 4.8, 33.1% of the auto-body mechanics, 24.4% of the general vehicle mechanics, 11.0% of the petrol vehicle mechanics 7.9% of the diesel vehicle mechanics and 4.7% of the auto electricians, indicated that modern vehicles have more relative advantages over older models. The mechanics cited several operational benefits, for instance; of a fuel-injected vehicle including: smoother and more dependable engine response during quick throttle transitions, easier and more dependable engine starting, better operation at extremely high or low ambient temperatures, smoother engine idle and running, increased maintenance intervals, and increased fuel efficiency.

The survey examined the influence of experience of the mechanics on their perception of modern versus old model automobiles in the context of relative advantage as revealed in Table 4.5.

Table 4.5: Experience of the mechanics and their relative advantage perception

Experience of the Mechanics	Relative advantage	
	No advantages	Advantageous
2-5 years	0.8%	11.8%
6-10 years	4.7%	17.3%
11-15 years	6.3%	26.8%
16-20 years	4.0%	18.1%
Over 20 years	3.1%	7.1%
Total	**18.9%**	**81.1%**

A good number of mechanics (26.8%) who had worked for a period of between 11-5 years indicated a favor of modern auto technologies. They were followed by those who had worked between 6-10 years at 17.3%. Notably, only 7.1%% of the mechanics with the longest experience, over 20 years, indicated in favor of new auto models. This may be attributed to the fact that new or modern vehicle technologies are radical innovations where prior experience may not be significantly useful.

A study by Straub (2009) found that 30% of successful entrepreneurs had no work experiences. This implies that although prior experience is important, it is not critical for business success. In the case of this study, emerging automobile inventions and innovations may not necessarily require prior experience as incompatibility and complexity issues may require the mechanics to re-train.

A logistic regression analysis using the 'enter' method was conducted to generate relevant statistical information and produced the following tables. A test of the full model is presented in Table 6.

Table 4. 6: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	35.634	4	.000
	Block	35.634	4	.000
	Model	35.634	4	.000

All variables against a constant only model were statistically significant (Chi-square = 35.634, $p < 0.000$ with df = 11) indicating that the predictors as a set reliably distinguished between adopters and non-adopters and there is adequate fit of data to the model. This means that at least one or all of the predictors is significantly related to the response variable. Results in Table 2 shows that the -2 log likelihood chi-square distribution for the logistic regression has a p value of .000. Hence the study concludes that the four variables are statistically significant. The -2 log likelihood is a measure of how well the model explains the variations in the outcome of interest thus the significance of the variables imply they collectively explain variations in technology adoption among automobile mechanics operating in micro and small enterprises. The Hosmer and Lemeshow test of goodness fit was also generated as shown in Table 4.7.

Table 4.7: Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.963	6	.682

A non-significance ($p = 0.682$) implies that the model adequately fits the data. Table 4.8 illustrates the summary of the model.

Table 4.8: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	105.527	.245	.765

Table 4.8: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	105.527	.245	.765

Nagelkerke's R^2 of 0.765 indicates that there exist a moderately strong relationship between prediction and grouping. Overall the success of prediction was 82.7% (93.8% for non-adopters and 48.4% for adopters) as illustrated in Table 4.9.

Table 4.9: Classification Table

			Predicted Adoption		
	Observed		0	1	Percentage Correct
Step 1	Adoption	0	90	6	93.8
		1	16	15	48.4
	Overall Percentage				82.7

To establish the effect of the hypothesized independent variables on the dependent, the odds ratio (OR), which estimates the change in the odds of membership in the target group for a one unit increase in the predictor was generated. It was calculated using the regression coefficients of the predictors as exponents or exp. SPSS calculated this value of the ln (odds ratio) and presents it as Exp (B) in the results printout in the 'Variables in the Equation' as shown in Table 4.10. In addition; to determine which particular independent variables had effects on the dependent variable, the wald statistics significant levels were also generated.

Table 4.10: Independent variables

Variables	B	S.E.	Wald	df	Sig.	Exp(B)
Relative advantage	-1.191	.528	5.091	1	.024	.304
Compatibility	2.555	.662	14.905	1	.000	12.868
Complexity	-2.080	.662	9.879	1	.002	.125
Observability	1.535	.621	6.108	1	.013	4.642
Constant	-1.846	.503	13.461	1	.000	.158

The odds ratio for the relative advantage independent variable '' was .306. This means that a one decrease in the variable decreases the chances of the mechanics to adopt a technology when all other variables are held constant. The wald statistics criterion demonstrated that relative advantage made a significant contribution to technology adoption at 0.01 level of significance (p=0.024).This leads to the conclusion that relative advantage influences technology adoption. Therefore, the null hypothesis that informal mechanics in Nakuru town do not perceive modern automobile technology as providing any relative advantage is rejected and the alternative accepted. The relative advantage of one technology over another is a key determinant of the adoption of new technology. The issue of relative advantage has been shown to have a positive relationship with adoption of innovation (Tornatzky & Klein, 2012; Venkatesh, Morris& Davis 2003; Lee, 2009). Mechanics need to be shown that modern automobile technology offers considerable benefit compared to traditional offering. A large number of researchers have highlighted some of the key benefits that modern vehicles offer, these include: better combustion leading to fuel efficiency, less harmful emissions, less frequent tune-ups among others.

V. Summary

The study sought to establish the role of relative advantage in the adoption of technology among mechanics operating in MSEs in Nakuru town. The relative advantage of one technology over another was found to be a key determinant of the adoption of new technology. Results indicated that this variable made was significant contribution (p=0.024) at 0.01 level of significance. This is the level of innovation perceived as better that a previous idea. Mechanics need to be shown that modern automobile technology offers considerable benefit compared to traditional offering. Taking the electronic fuel injection (EFI) system as an example, some of these advantages these include: Uniform air/fuel mixture distribution, highly accurate air/fuel ratio control throughout all engine operating conditions, superior throttle response and power, improved emissions control, Improved cold engine start ability and operation and simpler mechanics, reduced adjustment sensitivity.

5.1 Recommendations

The study recommends that through entrepreneurial orientation the owners/managers should be trained on the importance of being innovative, proactive and how to take calculated risks in the business operations that would go a long way in enhancing business success. The study further recommends that there should be a government policy on frequent training for businessmen in such areas as financial management, strategic management and human resource management that are paramount in the survival of any business.

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