

Effects of Innovation of Transport Technology on freight transport firms' performance in Mombasa County, Kenya

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ABSTRACT

The study sought to evaluate the effects of innovation of transport technology (SGR) on freight transport firms' performance in Mombasa County. The study established that performance in Mombasa County was affected by haulage capacity, speed and risk of the innovated transport technology. The analysis was done using Statistical Package for Social sciences (version 21). The findings 25.5% of the variation in freight firms' performance was explained by changes in haulage capacity, speed and risk. Ceteris paribus haulage capacity affected performance by $\beta=0.140$ ($\alpha<0.05$), speed $\beta= -0.017$ ($\alpha<0.05$), and risk $\beta= -0.347$ ($\alpha<0.05$). F- Significance $p=0.039^b$ implies a probability of 3.9% occurrence of false information. Haulage capacity positively affected performance with a small margin whereas speed and risk negatively affected performance. Therefore technology negatively affected performance. The management should formulate structures, operations, policies and strategies to align their business operations with the current dynamics in order to enhance their performance.

Keywords: Haulage capacity, Haulage speed, Haulage risk, freight firms' performance

1. Introduction

The Kenya government (GoK) implemented the vision 2030 by investing heavily in infrastructure development so as to achieve interconnectedness and World Class infrastructure. Mombasa County being the gateway was a beneficiary of the development agenda taking place in the country. It was designed to strengthen the country's position as a regional leader in transport and logistics centre for the Eastern Africa region. The key milestones to realize the global vision 2030 agenda for sustainable development goals (SDGs) was sustainable transportation systems and people's mobility. In Kenya road transport accounted for about 93% of all freight and passenger traffic. The mass public transit system in Kenya was chaotic, exploitative and inefficient. Kenya's road network is the gateway through which neighbouring landlocked countries used to transport their goods from and to the Mombasa sea port. Urban areas experienced heavy traffic jams compared with other areas. The country's roads were severely overstretched (Okeyo M. , 2016). Kenya was entirely served by Mombasa-Uganda railway which was developed in the early 1890s by the colonial government. For several years the railway network in Kenya had undergone much dilapidation due to poor maintenance, lack of technological development hence becoming almost obsolete in transportation within urban areas and the country at large. Roads were used as the major mode of transport in Kenya due to the ineffective rail transport (Mairura, 2010). In Eastern Africa, Kenya, Uganda, Rwanda and South Sudan governments committed themselves to increase capacity and provided less costly rail transport through the construction of a Standard gauge railway whose first phase was implemented (Waweru, 2016).

The government of Kenya through implementation of vision 2030 invested in innovation of Standard Gauge Railway transport technology in order to facilitate cargo transportation. The innovated transport technology has a large haulage capacity. A single train handles 108; twenty foot containers in a single trip from Mombasa to Nairobi compared to 54 trucks with capacity of

two twenty foot containers on the road. At this haulage capacity, many trucks each truck having a crew of two were replaced. This technology also operates with high operational speed therefore saves transportation time from 24 to 8 hours to ferry containers from Mombasa to Nairobi by road (Mwakio, 2018). This resulted into mass job losses and businesses in Mombasa County. The innovated transport technology also lowered risk of container damage and theft since SGR trains are less prone to accidents. As a result it saves lives and damage to cargo as opposed to road freight and the narrow gauge railway transport. This transport technology and freight technologies and intelligent transport systems transformed transportation globally. Intelligent transport systems increased system performance, minimized travel time, improved safety and enhanced the customer experience. Rapid technological advancement changed the way businesses were operated in an economy (Jincheng, 2018).

Truckers, Container Freight Stations (CFSs), and clearing agents continued to count losses, with some logistics companies reported to have resorted to restructuring the activities that ended up with thousands of job losses and businesses (Standard N. , 2018). The extended innovated transport technology into the port of Mombasa enabled off-loading of cargo to be done directly from vessels at Mombasa Sea Port onto the innovated transport technology. Container Freight Stations and trucks do not have enough cargo to store and transport. A move which edged freight transporters, clearing and forwarding agents and Container Freight Stations out of their lucrative container business (Business, 2018)

Development was referred to as a process of structural change. The innovated transport technology in Mombasa County affected the static economic system in the transport industry. The economic dynamics affected the data of the static economic system that destroyed the circular flow of the economic system, carried out new combinations that resulted into gainers and losers in the transport industry. This was referred to as ‘creative destruction’ (Ciborowski, 2016).

2. Research Objectives

The objectives that guided the study include: to examine the effects of haulage capacity of innovated transport technology on freight transport firms’ performance, to evaluate the influence of haulage speed of innovated transport technology on freight transport firms’ performance, and to assess the influence of haulage speed of innovated transport technology on freight transport firms’ performance.

3. Literature Review

Technology transfer involves a range of strategies that promote the transfer of new innovations, knowledge, technologies, practices, and skills from one setting to another. It is the movement of skills, knowledge, organization values and capital from the source of technology to the recipient for it to be adapted and applied (Jasinski, 2009). The main purpose of technology transfer is to improve the human resource and manufacturing capacity of the recipient country, firm, or project for long-term economic development. Technology Transfer bridges the gap between developed nations in the process of achieving technological and managerial competences to developing countries with a long-term plan for technology and skills development (Bernard M.H, 2004). Competition from

road transport being the main competitor followed by minor competitors; air transport, pipelines and water transport, lack of finance, lack of morale of human resource and clients corruption, inhibited the performance of Rift Valley Railways in Kenya; Finally, competition being the key challenge had negatively affected the volume of cargo hauled. The rolling stock of Rift Valley Railway was outdated technology that could not cope up with current customer requirements (Nyalwal, 2013).

Railways Corporation is the largest transport infrastructure project in Kenya that leads to a positive impact on the Kenyan economy. Standard Gauge Railway led to major economic benefits: transportation cost reductions, accelerated GDP growth of at least 1.5%, growth of new industries, direct job creation, congestion reduction, accidents reduction, and low carbon emissions (Nduire, 2018).

The innovated transport technology has a large haulage capacity. A single train handles 108; twenty foot containers in a single trip from Mombasa to Nairobi (Mwakio, 2018). This is translated into 54 trucks with capacity of two twenty foot containers on the road. At this haulage capacity, many trucks each truck having a crew of two were replaced. And again truck drivers could make up to 14 trips in a month whereas these days they get one or two trips. Mombasa County has lost kshs. 17.4 billions and 2,987 jobs since SGR was implemented (Standard N. , 2019). It also operates with high operational speed therefore saving transportation time from 24 to 8 hours to ferry containers from Mombasa to Nairobi by road. Time and funds were also saved since cargo is shifted from vessels directly onto the innovated transport technology. This resulted into mass job losses and businesses in Mombasa County. The innovated transport technology also lowered risk of container damage and theft since SGR trains are less prone to accidents. It also assured security and safety of cargo (Railways K. , 2019). As a result it saves lives and damage to cargo as opposed to road freight and the narrow gauge railway transport. These transport systems increased system performance, reduced transportation time, increased safety and improved customer satisfaction. This transport technology, coupled with freight technologies and intelligent transport systems have transformed transportation globally. Technological advancement changed businesses processes and structures in the economies (Jincheng, 2018).

Methodology

The research adopted survey research design. Survey research is defined as the collection of data attained by asking individuals questions either in person, on paper, by phone or online. A survey design is appropriate for this study since data can be collected from members of a population within the various set ups of similar characteristics in terms of their attitudes, perception, opinions, behaviours, or values (Saunders, 2012). The study used quantitative and qualitative approaches in collecting and analyzing data. According to (Babbie, 2010) quantitative methods emphasized objective measurements and numerical analysis of data collected through polls, questionnaires or surveys. The study universe was 105 chief executive officers of freight transport firms located in Mombasa County. Stratified sampling technique was used to select the freight transport firms. They were segregated into several mutually exclusive sub-populations or strata. A sample size of 32 respondents formed 30% of the population of freight transport firms represented the freight

transport firms in Mombasa County was selected. This was determined in line with the arguments advanced by (Mugenda, 2003) that a sample of 30% was favorable and adequately represented the entire population. Amongst other scholars who supported Mugenda was (Kathori, 2004), who stated that a sample size of 10% to 30% was appropriate. A sample size of 30% that was well selected enabled a very careful attention and measurements to be made with a high degree of accuracy than carrying out an investigation on a large sample of freight transport firms. Structured closed-ended questionnaires that limited the respondents' responses to the subject for easier analysis were administered (Mugenda, 2003); (Kathori, 2004) and collected within two weeks. Items were randomly chosen from this content that accurately represented the information of the content of the trait or property to be measured (Saunders, 2012). All 32 Chief Executive Officers of freight transport firms forming 30% of the population participated. This showed the importance of the subject under study to the respondents. It also affirmed that the content was representative of the population measured.

Quantitative approach was used for data analysis. Quantitative data were entered into Statistical Package for Social Sciences version 21 (SPSS) so as to run descriptive statistics and inferential statistics such as frequency and percentages for the purposes of presenting it in tables and graphs. It also provided a range of statistical procedures suitable for many problems, including regression analysis, correlation coefficient and ANOVA.

4.0 Findings

The sample size consisted of 32 chief executive officers representing the freight transport firms in Mombasa County. The researcher collected information from 32 respondents. $N = 32$. All 32 questionnaires administered were completed by the respondents and were all found fit for data analysis. This gave a response rate of 100% which was as a result of the effort and commitment of the researcher to meet his target of 100% response rate coupled with the willingness of the respondents to participate in this course. The willingness of the respondents to participate in the study was an indication that the research findings were important to their organizations. This response rate was viewed to be excellent since a response rate of above 70% is believed to be very appropriate (Kathori, 2004)

Reliability of the instrument was determined by the use Cronbach's Alpha reliability test. The results drawn from the study were therefore reliable.

As shown in table 4.1 Cronbach alpha values for all the variables; was 0.710 meeting the requirements. From these findings it was concluded that the constructs measured had the adequate reliability for the subsequent stages of analysis since the Cronbach Alpha value was greater than 0.7. This indicated a very high level of consistency for the scale used to measure the innovation of transport technology on the performance of freight transport firms in Mombasa County.

4.1 Demographic Profile

4.1.1 Position Held

The study sought to establish the position held by each respondent. According to table 4.2, the study found that 9.4% of the respondents, were managing directors, 12.5% were departmental heads, 50% were clerks and 28.1% represented other positions. This showed that the respondents had the ability to give the necessary information for the research signifying that the information given was valid for the study.

4.1.2 Level of Education

The results on table 4.2 reveal that 31.3% of the respondents attained school certificate level of education, 46.9 % attained Diploma level, whereas 15.6% were graduates and 6.2% were post graduates. This is an indication that all 32 respondents read and understood the questions asked and the purpose of the study and therefore gave accurate and reliable information for the research.

4.1.3 Length of Service

The respondents were asked to indicate their length of service with the firms they worked for. According table 4.2 the results were, 65.6% had worked for the organization for a period of between 1-10 years, 25% had worked for the organization for a period of between 10-20 years, 9.4% had worked for the organization for a period of between 20-30 years and over 30 years there was none. This indicated that most of them had acquired enough working experiences in their respective working fields and therefore could participate well in giving the required information desired by the study.

4.2. Effects of haulage capacity on freight transport firms performance

The study was to determine the effect of haulage capacity on freight transport firms' performance. The findings in table 4.3 reveal that haulage capacity of innovated transport technology influenced the operations of freight transport firms' performance at a mean rate of 3.0625 and a standard deviation of 0, 94826, income was affected at a mean rate of 4.0313 and a standard deviation of 0.86077 and profitability was influenced at a mean rate of 4.5625 and a standard deviation of 0.66901. The results indicated that haulage capacity has an effect on freight transport firms' performance.

4.3 Effects of haulage speed on freight transport firms' performance

The study was to determine the effect of haulage speed on freight transport firms' performance. The findings in table 4.4 showed that haulage speed of innovated transport technology influenced the operations of freight transport firms' performance at a mean rate of 2.3750 and a standard deviation of 0.90696, income was affected at a mean rate of 2.3750 and a standard deviation of 0.87067 and profitability was influenced at a mean rate of 2.2188 and a standard deviation of 0.87009. The results indicated that haulage speed had a significant effect on freight transport firms' performance.

4.4 Effects of haulage risk on freight transport firms' performance

The study was to determine the effect of haulage risk on freight transport firms' performance. The findings in table 4.5 reveal that haulage risk of innovated transport technology influenced the operations of freight transport firms' performance at a mean rate of 2.0938 and a standard deviation of 0, 89296, income was affected at a mean rate of 2.0938 and a standard deviation of 0.96250 and profitability was influenced at a mean rate of 2.0625 and a standard deviation of 0.87759. The results indicated that haulage risk has a significant effect on freight transport firms' performance.

4.5 Regression Analysis

The study applied inferential analysis to facilitate the relationship between innovated transport technology and freight transport firms' performance using the regression model below:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon$$

Y = Freight transport firms' performance

α = Constant Variables

$\beta_1 - \beta_3$ = Regression coefficient of predictor variables

X1 = Haulage capacity

X2 = Haulage speed

X3 = Haulage risk

ϵ = Error Term

Table 4.6 shows the regression model summarized. R indicates the correlation between observed and predicted values of the independent and dependent variables. The analytical model in table 4.6 showed an overall negative relationship between independent variables (Haulage capacity, haulage speed and haulage risk) and the dependent variable (Freight transport firms' performance) shown by the value $R = (-0.505)$. R^2 is the coefficient of determination that explains how freight transport firms' performance (dependent variable) varied due to changes in the independent variable (Haulage capacity, haulage speed and haulage risk). The R^2 (0.255) value shows the correlation between the dependent and independent variables by an implication that 25.5% of change in dependent variable (Freight transport firms' performance) was caused by changes in the independent variables (Haulage capacity, haulage speed and haulage risk). The remaining 74.5% represent changes brought by other factors not under study where further study is recommended.

The Analysis of Variance (ANOVA) in table 4.7 was applied to test the suitability of the regression model by comparing the magnitudes of the coefficients of the independent variables to determine their effects (significance on dependent variable). The significance F value of 3.192 ($p = 0.039$) obtained at 0.05 level of significance shown in table 4.7 implies that (Haulage capacity, haulage speed and haulage risk) strongly affect freight firms' performance. The regression model was statistically significant at ($p = 0.039$) and fit to predict outcomes. F-significance value ($p = 0.039$) indicates that there was a probability of 3.9% of the regression model presenting false results not explained under this study. The model is therefore highly suitable for the study.

A regression model was established:-

$$\text{Freight firms' performance} = 3.834 + (0.140)X_1 + (-0.017)X_2 + (-0.347)X_3 + (0.879)\square$$

Where X_1 = Haulage capacity, X_2 Haulage Speed and X_3 Haulage risk

$$\beta_0=3.834, \beta_1=(0.140), \beta_2=(-0.017), \beta_3=(-0.347)$$

The regression constant in table 4.8 shows that when the independent variables (Haulage capacity, haulage speed and haulage risk) are constant at Zero, freight transport firms' performance value would be 3.834, meaning that without the three factors, there would still be some performance at the freight transport firms' performance due to other factors not under this study hence ($p=000$).

These results showed that with every positive unit change in haulage capacity, the freight transport firms' performance would rise by a small margin of 0.140 (14%). Similarly, a positive unit increase in haulage speed would decrease freight transport firms' performance by -0.017 (1.7%), and a positive unit increase in haulage risk would decrease freight transport firms' performance by -0.347 (34.7%) other factors held constant. This indicated that haulage speed and haulage risk have severe destructive effect on freight transport firms' performance whereas haulage capacity has a small positive influence on freight transport firms' performance.

4.7 Discussion of the findings

On the effect of haulage capacity on the freight transport firms' performance, table 4.3 indicated that haulage capacity reduced profits of other freight transport firms by scoring the highest mean of 4.5625, lowered the income by attaining a mean of 4.0313 and reduced operations since it attained a mean of 3.0625.

Operational speed of innovated transport technology reduced operations and income of other transport firms by scoring means of 2.3750 respectively and profitability decreased by scoring a mean of 2.2188. Operational risk of innovated transport technology reduced operations and income by scoring means of 2.0938 respectively, and profitability was decreased by scoring a mean of 2.0625.

The government of Kenya invested in innovation of transport technology i.e. the Standard Gauge Railway in order to facilitate cargo transportation. The innovated transport technology has a large haulage capacity. A single train handles 108; twenty foot containers in a single trip from Mombasa to Nairobi compared to 54 trucks on the road (Mwakio, 2018). This is translated into 54 trucks on the road. At this haulage capacity, many trucks each truck having a crew of two were replaced. And again truck drivers could make up to 14 trips in a month whereas these days they get one or two trips. Mombasa County has lost kshs. 17.4 billion and 2,987 jobs since this was implemented (Standard N. , 2019). The technology also operates with high operational speed. It saves transportation time from 24 to 8 hours to ferry containers from Mombasa to Nairobi by road. Time and funds were also saved since cargo was shifted from vessels directly to the innovated transport technology. This has resulted into mass job losses and businesses in Mombasa County.

As a result it saved lives and damage to cargo as opposed to road freight and the narrow gauge railway transport. This transport technology, coupled with freight technologies and intelligent transport systems transformed transportation globally. These transport systems increased system performance, reduced transportation time, increased safety and improved customer satisfaction. Technological advancement changed businesses processes and structures in the economies (Jincheng, 2018).

At this haulage capacity, it meant replacement of many trucks with each truck having a crew of two that resulted into loss of jobs and business as a result of shifting cargo freight from trucks to the innovated transport technology. Innovation of transport technology changed how businesses are operated in Mombasa County. It also decreased risk of container damage and theft since SGR trains are less prone to accidents. As a result it saved lives and damage to cargo as opposed to road transport and the narrow gauge railway transport. It also assured security and safety of cargo. This supported by modern technology at the ICD in Nairobi brought efficiency in cargo clearance (Railways K. , 2019). Previously, road and narrow gauge trains were prone to cargo theft and damage due to frequent accidents and both delayed cargo delivery.

The innovated transport technology evacuates slightly above 800 containers daily to the Inland Container Depot (ICD) (Manduku, 2019). Currently cargo is evacuated direct from the vessels onto the innovated transport technology to be ferried to the inland container depot (ICD) in Nairobi for clearing and forwarding, and then for onward transmission to their respective various destinations. This impacted on the Container Freight Stations' operations. Truckers, Container Freight Stations (CFSS), and clearing agents continued to count losses. Some companies were reported to have resorted to restructuring the activities that saw thousands of job losses and businesses (Standard N. , 2018). Previously, cargo was offloaded from vessels onto trucks either for storage at the port or for onward transmission to Container Freight Stations for storage. Clearing and forwarding was done at the port. These economic dynamics affected the static economic system. It destroyed the circular flow by bringing in new combinations and processes that resulted into gainers and losers. Most clearing and forwarding and storage activities were taken away from Mombasa County to the inland container depot (ICD) in Nairobi (Otieno, 2018). In response to the above there has been constant series of demonstrations by Mombasa residents and businessmen to protest the government directive (Standard N. , 2019).

The research findings were in line with Schumpeter's (1949) theory of economic development. Innovation of transport technology in Mombasa County deliberately dismantled the established long-standing processes and made way for improved methods of production for adoption by other freight transport firms. This was termed as "creative destruction" (Ciborowski, 2016). Creative destruction was referred to as the purposeful process of destroying old industrial processes and structures in order to align them with current ones. Innovation of transport technology in Mombasa County resulted into destruction of the old industrial processes and structures in the freight transport industry in order to align them with current ones. This affected the other freight transport firms' structures and processes. Innovation of transport technology revolutionized the current economic structure in Mombasa County. This resulted into gainers and losers within the freight transport industry in Mombasa County. Schumpeter described development as a historical process

of structural changes, which was driven by innovation (Sledzik, 2017). The entrepreneur's main function was to allocate existing resources to "new uses and new combinations" (Sledzik, 2017). The factors under study destroyed the old operational systems and negatively affected the flow of activities in the other freight transport firms in Mombasa County. Innovation was the driving force of economic development since it was involved in the process of structural change which was caused by these factors under study and thereby negatively affecting freight transport firms' performance.

The study results also deviated from a study done by (Chege S. W., 2019) to find out the influence of technology transfer on sustainability and performance of standard gauge railway in developing countries, specifically in Kenya. The findings showed that effective technology transfer contributed positively to the performance and sustainability of standard gauge railway. The results further showed areas of improvement that guaranteed efficient rail technology transfer and were useful to advance the knowledge of technology transfer and offered a theoretical foundation of technology innovation transfer mechanisms.

5.1. Conclusions

The study was to determine the effects of innovation of transport technology on the performance of freight transport firms' in Mombasa County. The researcher established that haulage capacity at a small margin positively affected the freight transport firms' performance. However, operational speed and operational risk of innovated transport technology had a negative effect on freight firms' Performance. The regression analysis also confirms that there was a significant relationship that exists between the dimensions of innovation of transport technology; haulage capacity, haulage speed and haulage risk on freight transport firms' performance. However, it should be understood that there were other factors that account for 74.5% effect on freight transport firms' performance that were not studied. This indicated that haulage speed and haulage risk had severe destructive effect on freight transport firms' performance whereas haulage capacity had marginal positive influence on the other freight transport firms' performance.

5.2 Recommendations

Based on the findings, the management of freight transport firms should develop good mechanisms to align their business operations with the current dynamics i.e. adoption of innovation so as to apply new technologies, new techniques and new processes in order to enhance their performance. The management of freight transport firms should formulate structures, operations, policies and strategies that would enhance their operations, income and profitability in order to increase their performance.

The ministry of transport should conduct seminars and workshops to enlighten the management of freight transport firms on new and modern ways of business practices so as to keep abreast with changing times.

The remaining factors of 74.5% have not been explained by the study leaving room for further research to be conducted.

7. Tables and Figures

Table 4.1 Reliability Statistics

Cronbach's Alpha	Number of Items
0.710	9

Source: Researcher, (2020)

Table 4.2 Demographic Profile

Position Held	No.	%
Managing Directors	3	9.40
Departmental heads	4	12.50
Clerks	16	50.00
Others	9	28.10
TOTAL	32	100.00
Level of Education		
School Certificate	10	31.30
Diploma	15	46.90
Degree	5	15.60
Post Graduate	2	6.20
TOTAL	32	100.00
Length of Service		
1-10 Years	21	65.60
10-20 Years	8	25.00
20-30 Years	3	9.40
Over 30 Years	0	0.00
TOATL	32	100.00

Source: (Researcher, 2020)

4.3 Effects of haulage capacity on freight transport firms performance

Statements	N	Mean	Std. Deviation
Influence of haulage capacity on your firm’s operations.	32	3.0625	0.94826
Influence of haulage capacity on your firm’s income.	32	4.0313	0.86077
Influence of haulage capacity on your firm’s profitability.	32	4.5625	0.66901

Source Researcher (2020)

4.4 Effects of haulage speed on freight transport firms’ performance

Statements	N	Mean	Std. Deviation
Influence of operational speed on your firm’s operations.	32	2.3750	0.90696
Influence of operational speed on your firm’s income.	32	2.3750	0.87067
Influence of operational speed on your firm’s profitability.	32	2.2188	0.87009

Source Researcher (2020)

4.5 Effects of haulage risk on freight transport firms performance

Statements	N	Mean	Std. Deviation
Influence of reduced risk on your firm’s operation.	32	2.0938	0.89296
Influence of reduced risk on your firm’s income.	32	2.0938	0.96250
Influence of reduced risk on your firm’s profitability.	32	2.0625	0.87759

Source Researcher (2020)

4.6 Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.505 ^a	.255	.175	.52338

a. Predictors: (Constant), Haulage_Risk, Haulage_capacity, Haulage_Speed

4.7 ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	2.623	3	.874	3.192	.039 ^b
	Residual	7.670	28	.274		
	Total	10.293	31			

a. Dependent Variable: Firms' performance

b. Predictors: (Constant), Haulage_Risk, Haulage_capacity, Haulage_Speed

Table 4.8 Coefficients

Model		Un standardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.834	.879		4.363	.000
	Haul_cap	.140	.213	.108	.657	.516
	Haul_Speed	-.017	.132	-.023	-.125	.902
	Haul_Risk	-.347	.134	-.478	-2.591	.015

a. Dependent Variable: Firms performance

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