Investigating and Weighing the Importance of Transport Mode Choice Factors: Dry-Cargo Shipping. A Case of Malawi

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ABSTRACT

Understanding the transport mode choice factors that are important to the commodity shippers is one of the important key aspects to consider when aiming for efficient and effective transport planning. Over the years, several studies have been conducted in other countries trying to establish the factors that influence commodity shippers' decisions when choosing transport modes. While these factors have been unearthed, little is known about how these factors are prioritized in shipping decisions. This study therefore aimed to investigate the factors that influence transport mode choices and also examine how shippers weigh and rank these factors with regard to their importance. A descriptive research design within quantitative methodology was employed. Using a simple random sampling technique, 84 participants were recruited for this study. The findings of the study revealed that shipment travel time, transport cost, transport mode availability, and transport service reliability have an influence on how shippers choose a transport mode for their shipments. The study further revealed that transportation cost was the ranking transport modal choice factor among the factors. It was therefore recommended that the government should consider revitalising low-cost rail transportation to make it more efficient and responsive to shippers' demands.

Key Words: Modal Choice, Transport, Cost, Theory of Planned Behaviour, Malawi

INTRODUCTION

This study is one key component of the principal researcher's Doctor of Philosophy thesis from the University of Zambia (UNZA) in the field of Supply Chain Management.

Over the years, a number of studies have been conducted in other countries trying to establish the factors that influence shippers' transport modal choices (Heljedal, 2013; Jing et al., 2020; Kim, 2014; Mels, 2020; Stinga & Olteanu, 2019). However, little has been researched and reported on how shippers rank and prioritize these transport mode choice factors. This knowledge gap is demonstrated in the dominance of road transportation in Malawi (Byiers et al., 2020; Zant, 2018). Almost 90 percent of international shipments are transported by road regardless of it being costlier than rail transport (*Malawi National Transport Master Plan 2017*). Despite shippers knowing that road transport is a costlier mode of transport than rail, they nevertheless predominantly use road transportation. This demonstrates that there are some factors that shippers consider, other than just transportation costs. For effective and efficient transport planning, the transport service provider should understand the factors that appeal to the shippers' transport mode choices and also how shippers prioritize these factors. Much as all the transport modal choice factors are important, knowing their priorities would enable transport planners to efficiently plan transportation, and policymakers in the transport sector may be able to better develop transport policies that complement a sustainable and efficient transport system. The government may also be well informed to better invest in transport sector areas that these transport mode choice factors lack. Therefore, the aim of this study was to establish the transport modal choice factors that influence the shippers' decisions and weigh the importance that these shippers place on these factors.

THEORETICAL FRAMEWORK

In this study, the Theory of Planned Behaviour was used. The model is a psychological theory that links beliefs to behavior (Ajzen, 1991) and is one of the most frequently used models in the literature to explore transport mode choice behavior (Lanzini & Khan, 2017; Mels, 2020; Rezaimoghadam et al., 2022). The theory assumes that the best prediction of behaviour is given by asking people if they are intending to behave in a certain way (Ajzen, 1991). The model further assumes that the consumers make decisions by calculating the costs and benefits of different courses of their actions and choosing the option that maximizes their expected net benefits. The theory focuses on theoretical constructs concerned with individual motivational factors as determinants of the likelihood of performing a specific behavior of making a specific choice.

The Theory of Planned Behaviour maintains that there are three core components, namely, attitude, subjective norms and perceived behaviour control that, together, shape an individual's behaviour intentions. It assumes that human behaviour is a function of these factors:
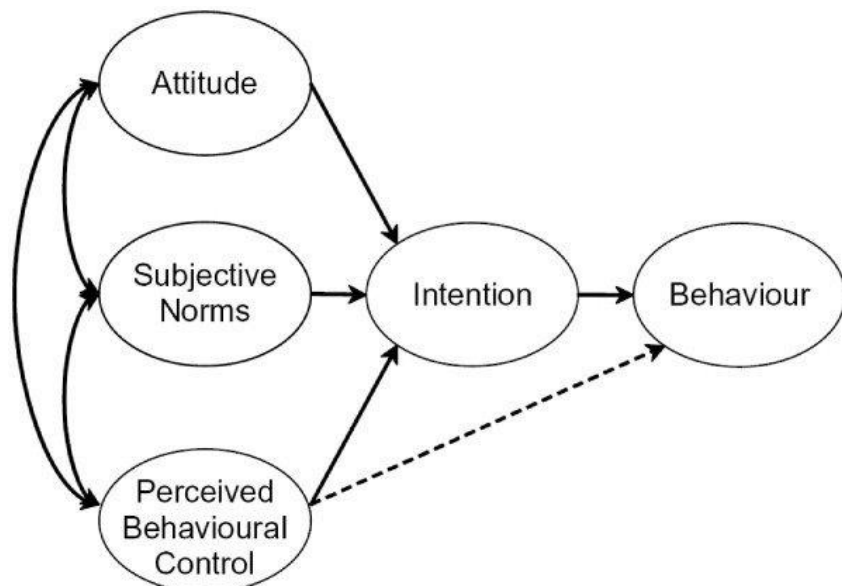

Figure 1: The Theory of Planned Behaviour (Ajzen, 1991).

Understanding the motivation behind transport mode choice is of utmost importance for interventions directed towards shipping behaviour change and the Theory of Planned Behaviour was developed to assist in predicting these variables that lead to some specific decisions. The factors of the theory are discussed:

Attitude

This refers to the person's judgement that performing the behaviour is good or bad (Ajzen & Fishbein, 2000). The theory postulates that a decision that one makes is dependent on the outcome, thus, whether it is positive or negative, and also depends on the benefits that would be gained as a result of the decision made. In this study, four beliefs regarding the transport modal choice were evaluated which were whether a particular mode of transport is able to provide timely shipment delivery, cost-effective transportation, availability and reliable service. It was expected that these beliefs had an influence on the intention to use a specific mode of transport.

Subjective norm

The subjective norm is a person's perception that most people who are important to him or her think he or she should or should not perform the behaviour in question (Ajzen, 1991). The subjective norm results in

perceived social or peer pressure where the person thinks about what other people expect him or her to do, how they are expected to behave and also whether they would be ridiculed should they make a particular decision. All these shape one's decisions or intentions. The subjective norm is therefore the reference of a perceived expectations multiplied by the motivation of this reference. It is therefore important to notice that the person performing the behaviour decides which referent persons are of importance to him or her. In this study, consignees and exporting firms' shareholders were taken as the referent persons and these were expected to have influence on the transport modal choice that a shipper makes. The consignee or the customer receiving the goods would want to have the goods delivered with speed and the shareholders would want to reduce transportation cost so that they increase their profits. These two stakeholders would support the use of a particular mode of transport that would deliver these two benefits. When a shipper perceives support from his or her stakeholders, it could feel as an approval of the usage of the mode of transport. This feeling of approval leads to a higher intention to use a particular mode of transport and it was therefore hypothesized that as the subjective norm of a shipper to use a mode of transport is positive, the intention to use the mode of transport increased as well.

Perceived behaviour control

Control beliefs produce a behaviour control by impacting performance of the behaviour. This requires whether one has the knowledge to make the decision and whether they have the necessary tools available to them to act. Perceived behaviour control, which is also known as self-efficacy, is an estimate of the skills needed for expressing the behaviour and possibility to overcome barriers. Beliefs, as with attitude and subjective norm form the basis for perceptions of behaviour control. These beliefs are control beliefs and concern the presence or absence of resources needed to perform the behaviour. Both beliefs regarding opportunity and resources as discussed were believed to have an influence on the intention to use a mode of transport. Opportunity comprised whether difficulty was experienced with the availability of transport mode. Therefore, two factors were taken into account which were the availability of transport mode and shipment travel time. When shippers perceive difficulty in finding transport mode, they had less opportunity that was needed to use the mode of transport, same way when the shippers did not have any control over the transport mode speed to deliver goods to a consignee. It was therefore hypothesized that as the opportunity of a shipper to find a mode of transport increased, the intention to use the mode of transport increased as well. It was also hypothesised that as the shipper had less control over transport mode speed, the intention to use that mode of transport decreased.

Conceptual Framework

A conceptual framework was adapted from the Theory of Planned Behaviour to explain the natural progression of a phenomenon of this study. Unlike a theoretical framework which was based on an existing theory, this conceptual framework was so specific to the study variables under investigation. A conceptual framework explained the relationship between the independent variables and dependent variable.
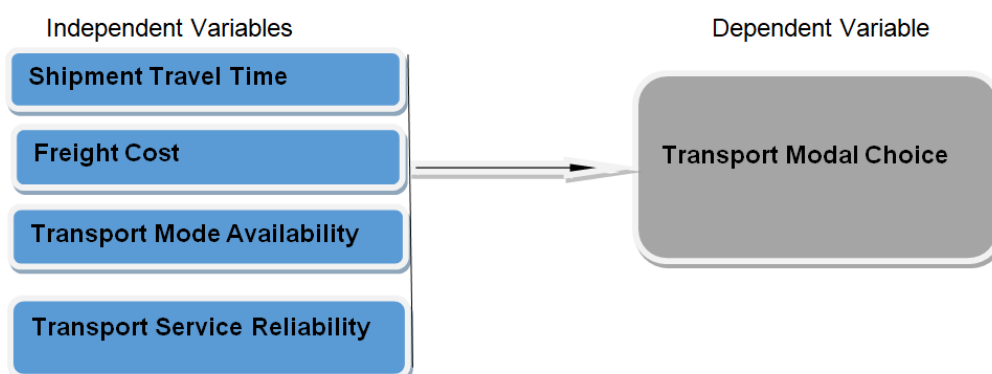

Figure 2: Conceptual Framework

LITERATURE REVIEW

Identifying the factors that influence the decisions that commodity shippers make is important. This importance has been highlighted in a large number of studies that have been carried out trying to understand what factors shippers consider when choosing a mode of transport for their commodities. Various factors have been identified depending on what type of commodities being shipped, the interest of a shipper or customers, the volume and also the value of the goods being transported. However, shipment travel time, freight cost, transport reliability, availability, distance and shipment size have been commonly identified as some of the factors influencing transport modal choice (Brooks et al., 2012; Li et al., 2020; Nugroho et al., 2016; Puteela et al., 2021; Tavasszy et al., 2020). Nonetheless, much as all these factors have a bearing on the decisions that shippers make, their priorities in modal choice vary depending on other factors which include type and value of goods being transported (Mayo & Taboada, 2020; Zeybek, 2019). Wet or perishable cargo shippers would choose a mode of transport with short delivery window capabilities. Similarly, shippers of bulk cargo with low-value to weight ratio would choose a low cost mode of transport (Stinga & Olteanu, 2019). Understanding these factors is one of the key important aspects to consider when developing transportation system.

In trying to rank the transport mode choice factors, Mustapha (2022) performed a study in Nigeria where determinants of mode of transport were analyzed and it was found that accessibility of a mode of transport was a ranking factor followed by safety and security, reliability of mode, frequency of mode and security of cargo. In another study that Zeybek (2019) conducted, the author found cost of transport to be a ranking transport mode choice factor. In 2019, Konstantinus and Zuidgeest (2019) took a study that was looking into the factors influencing inter-urban freight mode choice decisions in the Southern African Development Community (SADC) region. The study found that in terms of importance, reliability with reference to arrival time was the most important factor. It was also revealed that, transport cost was the second factor followed by risk of damage, frequency of service and transit time, in that order of importance.

Chang and Thai (2017) and Liu (2017) also conducted similar studies that tried to rank transport mode choice factors and they all came to a similar conclusion that cost was a ranking factor. Travel time of a shipment came second and transport reliability came third (Liu, 2017). The literature also revealed some interesting results of a study that was conducted in Europe in 2013 in which the authors were weighing the importance of mode of transport factors on intermodal transportation services. By using in-depth interviews with CEOs and executives in logistics sector, reliability of arrival time, transit time and freight rate were equally ranked as the most important factors in the selection of intermodal transportation (Lee et al., 2013).

It is clear from the literature that there are varying findings about the priority that shippers place on factors when selecting a mode of transport for their goods. Different goods require different shipping needs and these studies failed to define the type of goods that these shippers transport. Without knowing the type of goods transported, it would be hard to generalize the study results. It can therefore be concluded that, to date, there has been little agreement on what ranks first as a modal choice factor in transportation system. It was therefore imperative to conduct this study in Malawian context given the fact that the transport modal choice factors are ranked depending on where the study was conducted and also the economic status of the country of study. Malawi being a landlocked country that depends on neighboring countries for her export routing, would surely have different priorities when choosing transport modes (Lall et al., 2009; Vilakazi & Paelo, 2017; Zant, 2018). And, cognizant of the fact that different goods require different shipping requirements, this study targeted dry cargo shippers only.

METHODOLOGY

A) Research Design

A research design is a general framework that researchers use to answer research questions (Saunders et al.,

2007). When conducting a research project, it is important to first consider what one hopes to accomplish by conducting the research (Saunders et al., 2007). Is the aim of the study to gain a deeper understanding of a phenomenon or a researcher would rather just have a broad and less deep understanding? Is the aim of a research project about exploring inquisitiveness? If the aim is to gain a deeper understanding of a phenomenon, then qualitative research using exploratory research design could be used whereas if the aim is just to gain a broad and less understanding of a phenomenon, quantitative research using descriptive research design could be used. The answers to these questions will be the ones to inform the research design that the researcher adopts in the study.

There are three categories of research design that social researchers employ in search of knowledge and these are exploratory, descriptive and explanatory (Saunders et al., 2007). In this study, descriptive research design was used. The purpose of this study was to describe the transport mode choice factors and ranking them with reference to their importance and studies conducted with this purpose typically employ descriptive research design (Dwyer et al., 2012). Descriptive research can be quantitative as it gathers quantifiable data to statistically analyze a population sample. These numbers can show patterns, connections, and trends over time and can be discovered using surveys. In this study, a survey was used and employing this research design assisted the researcher to gather the required data. The design was therefore ideal because it provided a comprehensive description of how shippers choose and place importance on transport modal choice factors.

B) Study Site

This study was conducted in Blantyre City, Malawi. Being a commercial city, Blantyre has more manufacturing and shipping companies than other cities and it is also closer to the major seaports of Nacala and Beira. The city is also served by railway, road and air transportation (Byiers et al., 2020), making it the only city served by all modes of transport in Malawi. Thus, the shippers have more shipping options than those in other cities.

C) Sample Size

A sample size is a subset of the entire population from which inferences are made and the results generalized (Saunders et al., 2007). One of the challenges that researchers face is to find an optimum sample size that is representative of the population under study (Adam, 2020). The sample size is influenced by a number of factors which include the purpose of the study, size of the population, the allowable sampling error and risk of selecting a bad sample. Choosing the statistically significant sample size depends on a number of things namely the size of the population, how precise a researcher wants the estimates to be, how confident an investigator want to be in the results and how different the population of study is likely to be (Saunders et al., 2007). Yamane (1970), crafted a formula for determining sample size in respect to the population under study The method allows inferences and conclusions to be drawn from the survey to be applied to the complete population from which the sample was drawn. It was therefore important to use this formula to determine the sample size of this study. The formula was considered ideal because it considers levels of precision, confidence, and variability. This formula is also scientific and easy to use in cases of a large population and is presented below:

$$n = \frac{N}{1 + N(e)^2}$$

Where n= sample size required

N= number of people in a population

e= allowable error in percentage

To calculate the sample size from 141 dry commodity exporting firms in Blantyre, the study specified a 5 percent error as shown in the equation below:

N= 141/ (1 + 141 (0.05^2)) .... 104 (Yamane, 1970)

D) Sampling Technique

A sampling technique is a method of selecting individual members or cases of a population from which to make statistical inferences or estimate characteristics of the whole population. In general, sampling techniques can be divided into two categories namely probability sampling and non-probability sampling. In probability sampling, every item in a population has an equal chance of being selected and included in the study sample (Saunders et al, 2007). Using the probability sampling method reduces the selection bias in the sample derived from the population because the method gives each data point in the population an equal chance of being selected and also minimizing the likelihood of certain data points being overrepresented or underrepresented in the sample. This type of sampling leads to higher quality data collection as the sample approximately represents the entire population. In this study, simple random sampling technique was employed and it was ideal because using this method allows researchers to make generalizations about a specific population and this study being conducted in just one city, the findings would be generalized to the other cities in Malawi as well.

E) Data Collection

A questionnaire was used to collect primary data from the dry commodity shippers transporting dry maize, tobacco, rice, pigeon peas, cotton, and textiles. This tool was developed and had closed-ended questions to generate precise answers for the study. In designing the questionnaire, a five-point Likert-type scale was used to measure respondents' attitudes by asking the extent to which they agree or disagree with a particular question or statement. The Likert-type scale allowed the researcher to easily operationalize personality traits or perceptions. To collect data, the researcher presented participants with Likert-scale questions and a continuum of possible responses. The study selected dry commodity shippers only because different goods have different shipping requirements and combining these shippers of different types of goods in one study would provide misleading results.

FINDINGS AND DISCUSSION

The study sought to establish the transport mode choice factors that shippers consider when transporting their goods. This study being descriptive research that describes characteristics of a population, the collected data were first of all arranged in Microsoft Excel and then transferred to SPSS version 20.0 for analysis from which the mean and standard deviation of the study sample were calculated.

	N	Minimum	Maximum	Mean	Std. Deviation
Freight Cost	84	1	4	1.43	.854
Shipment Travel Time	84	1	4	1.57	1.009
Transport Mode Availability	84	1	4	1.79	.995
Transport Service Reliability	84	1	4	1.62	.956

Table 1: Descriptive Statistics for transport Modal Choice factors

Descriptive statistics for freight cost revealed a mean score of 1.43 (SD=.854). It also showed a mean score of 1.57 (SD=1.009) for shipment travel time. The study further showed descriptive statistics for transport mode availability where it had a mean score of 1.79 (SD=.995) and also a mean score of 1.62 (SD=.956) for

transport service reliability. These findings show a positive perception of these transport mode choice factors among the shippers. This suggests that all these factors are important to the commodity shippers when they are selecting transport mode.

The study went further to rank these transport mode choice factors to establish their importance in transport modal choice decisions. The collected data which showed frequencies of transport mode choice rankings were arranged in SPSS version 20.0 and descriptive statistics using frequency were run in the SPSS to generate the pie chart according to the data rate of recurrence.
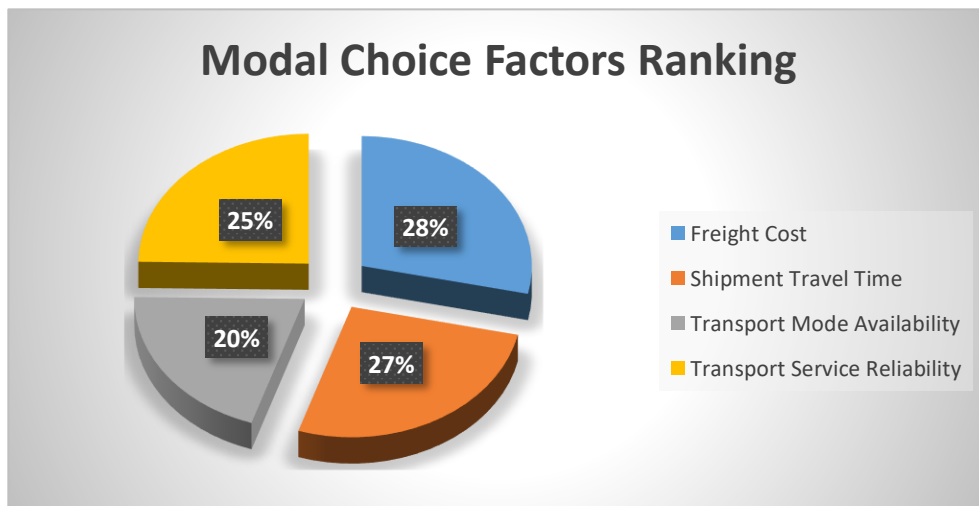

Figure 3: Transport Modal Choice Factors' Ranking

Much as all these factors are important to the shippers, the study found that freight cost is the ranking factor at 28 percent, closely followed by shipment travel time at 27 percent. Transport service reliability and transport mode availability come third and fourth at 25 percent and 20 percent respectively as shown in Table 2:

Variable	Percentage	Ranking
Freight Cost	28	1
Shipment Travel Time	27	2
Transport Service Reliability	25	3
Transport Modal Availability	20	4

Table 2: Modal Choice Factors' Ranking by Percentage

The study sought to investigate how these factors are ranked by the shippers and the findings highlighted that freight cost is the number one factor shippers consider when selecting a mode of transport. The results suggest that shippers would choose a mode of transport offering low freight rates. Ranked second was the travel time of a shipment followed by transport service reliability and then transport mode availability ranked least. A similar conclusion was reached by Liu (2017) where in the study, cost was ranked first, followed by travel time and then transport reliability. Also matching well with the study findings were results by Chang and Thai (2017) where cost of transport was found to be a ranking factor when choosing a mode of transport. Inconsistent with these results are the findings of Konstantinus and Zuidgeest (2019) and Lee et al. (2013). In their studies, the reliability of transport mode was found to be the most important factor that is considered when selecting transport mode. These differences could be attributed to varying types of goods being transported, geographical location, time and length of the study, and also economic factors of the countries in which these studies took place. It is therefore important to understand that this study targeted dry commodity shippers only and was conducted in Malawi.

As the theory of planned behaviour postulates, an attitude towards an outcome of a decision has a bearing on a decision one makes. One would consider whether the outcome of the decision is negative or positive and the theory states that it is more likely for one to make a decision which has a positive or beneficial outcome. According to the theory, a shipper is more likely to choose a transport mode which is faster in shipment delivery, available, cost effective and that provides reliable services. These transport mode factors would be beneficial to the shipper and also the consignee and this being the case, the shipper is more inclined to select that mode of transport which provides those benefits. Similarly, subjective norm as factor in the theory of planned behaviour has a bearing in the decisions that shippers make when selecting transport mode. Subjective norm, being a belief about whether most people approve or disapprove of the behaviour, stakeholders, which are shareholders of manufacturing and exporting firms and their customers would put a pressure on a shipper to choose mode of transport that is reliable, available, cost-effective and fast in shipment delivery. Choosing a transportation mode that provides these benefits would be considered a normative behaviour. The study findings therefore support the theory.

CONCLUSION

The study established that shipment travel time, freight cost, transport mode availability, and transport service reliability are perceived positively among the shippers. This implies that these transport modal choice factors have a bearing on the decisions that shippers make when procuring transport services. However, even though these factors matter, the shippers place dissimilar importance on them. The study revealed that freight cost is the ranking transport modal choice factor followed by shipment travel time, then transport service reliability, and least considered factor being transport mode availability. Appraising the literature, it was clear that studies found different results with regard to how shippers place importance on transport modal choice factors. The study therefore concludes that the importance that shippers place on the factors that they consider when making transport modal choices differ and this, therefore, is an ongoing debate. Also worth noting in these findings is that, although transportation costs rank number one in priority and also being found as one of the factors influencing transport mode choices, shippers still do not use the rail transport which is comparatively cheaper than road transport. This suggests that rail transport has inefficiencies that deter shippers from using it.

RECOMMENDATION

Based on the findings of this study, the researcher provides the following recommendation:

1.Transport cost being the most important factor that shippers consider when making transport modal choices, the government should pay more attention to low-cost rail transportation that provides this value than road transportation. A need for revitalisation of rail transport is of utmost importance and hopefully, the regeneration would make it more efficient.

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