The Influence of Behavioral Factors on Alternative Choice

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Abstract
The transportation industry has become more competitive. The increased number of transport vehicles manufactured will increase the challenges. To overcome previous challenges and cope with any in the future, however, transport producers tried to adopt consolidation to offer a large range of options and services. This research studies the problem of how people select alternative The aim of the study is to determine the critical factors that control choice made by human when they select alternatives. The study used compressed natural gas vehicle (CNGV) choice as an alternative transportation fuel for fossil fuel (e.g. gasoline and diesel). The research carried out through a questionnaires sample, were analyzed by Statistical Package for Social Science (SPSS). In the meanwhile, the results determine influence of the independent variables on the human selection.

The Objectives

- To improve the forecasting
- To introduce different method of measurement relationship
- To enhance the choice model by incorporating the unknown variables into the choice model to estimate the effect of behaviors.

Introduction

In the current millennium, transport is considered the second largest source of energy-related CO_2 and contributing to greenhouse gases (GHG's) emissions such as methane (CH_4), carbon dioxide (CO_2), and sulphur dioxide (SO_2) etc. Improvement and mitigation of transportation patterns are essential to reduce the effect of global warming on our environment. Transportation fuels are playing a significant factor and critical role in maintaining healthy and safe environmental and economic systems for the human beings. Since the gasoline and diesel are transportation fuels that powered our vehicles, it is important to understand the human behaviours and demands towards these fuels and services. The environmental effects of current transportation fossil fuels are gradually fluctuated and becoming intense. The study goal is to evaluate the relationship between human behaviour factors and their selection of compressed natural gas vehicles (CNGV).

Compressed natural gas (CNG) has been known as one of the alternative vehicular fuels to fossil fuels. CNG has been used worldwide for its environmental benefits. Also it is used to minimize the emissions caused by current fossil fuels such as gasoline and diesel, but is CNG fulfilling the user's needs and desires or not? The liquid vehicular fossil fuels manage to attract consumers through a variety of strategies such as Infrastructure, acceptable pro-active operational, and fuel efficiency. These strategies were used to achieve specific earnings targets. Although the traditional vehicular fuels offer different services, the environmental concerns have become tangible and forced academia, industries, and researchers to search for choices. These alternative changes allow people to distinguish between their desires and needs. There is a need to define the critical factors that influence the human choice since the human is a core of the success or failure of any product.

There are several behavioural factors that influence human choice towards CNGV, including psychological factors and actual situational factors [Collins, C; Chambers, S.M. Psychological and situational influences on commuter-transport-mode choice. Environ. Behav. 2005, 37, 640–661, Choo, S.; Mokhtarian, P.L. The role of attitude and lifestyle in influencing vehicle type choice., T.M. The impact of social class and cultural variables on environmental behaviours: Municipal-level evidence from Massachusetts. Environment Behaviours. Although some empirical studies on the human selections were conducted, there is no research considering the perception of compressed natural gas vehicles (CNGV).

The research addresses the need for empirical studies to analyze the human factors that influence their behaviors towards. Discovering what factors that controlling human decision making for

adopting compressed natural gas vehicles and also mitigate these factors to an acceptance level are neccessary. Analyzing the factors disturbing the development of reliable alternative fuel vehicles and defined these factors help identifying a subsidy transportation policy, improving the alternative transportation markets, and limited local protectionism. Cheron and Zins were analyzed several factors that influence the human choices such as comfort, cost, safety, reliability, and price of the parts. Although previous studies found that social-economic and demographic factors are motivational factors, others indicated that human looking for the environmental benefits of the alternatives uses not the cost and social benefits.

However, Skippon indicated that the dynamic performance of alternative transportation vehicles in the future might offset the utility of small range, and extra cost. Navnm et al. found the relation between human behaviours and decision- making process in three stages: goal, behavioural, and implementation stages and confirmed that personal behaviours affect the human choice or their decisions of purchasing a vehicle. Also, Kang mentioned that experience, policy, people's needs are other important factors that attract consumers to accept and purchase the alternative vehicles. According to Zhang, the fluctuation of fuel price has made the consumers more cautious about the traditional transportation mode.

From the past experiences, the average price of conventional technologies such as regular transportation will increase but the income will not thus people might be unable to sustain their transportation expenses. Therefore human behaviour plays an important role when choosing a vehicle. Chiu and Tzeng have determined and analyzed (1999) the factor influencing human decision and satisfaction when choosing a vehicle. The study goal is to define an acceptable relationship model between independent variables and dependent variables (between transportation choice and meaningful variables (controlling factors)). First, the research has a significant contribution to academic, research and industrial fields, particularly contributing to improving technology knowledge. The focus of this research was to test human behavioural toward alternative CNGv choice and define unknown variables that controlling their decision. Thus, uncertainty associated with decision making has a risk which is defined as the consequences of their decisions and frequency. Many economic studies have been approved that price is the primary factor in selecting a product.

However, after testing the primary factors in the selection of CNGv, the study shows the controlling factors that play a significant role in human selection, particularly for CNGv. The first potential contribution to academia is the importance of examining other factors rather than only economic one. The second contribution is, thus, defining the significant factors will reduce the major risk associated with ambiguous choice. Thirdly, there is also industrial contribution which may help to identify the importance of sharing public as part of their product. It means that using the end consumers as a supplier to industrial to define all issues related to their choices. This will help industries for making appropriate strategy with minimal risk. Finally, this is not limited to transportation industries but might be favorable for policy makers.

Literature Review

Over past decades, there has been considerable development in the mathematical modeling of technology replacement decision. The relevant studies have focused on modeling the factors affecting the decision. In 2015, Garg declared that the harmful nanoparticles associated with the compressed natural gas (CNG) could change the perception that natural gas is a green fuel as it does not emit any visible smoke, which is in contrast to the smoke emitted by fossil fuels and perceived as harmful for human. The study presents a developed model that known as a choice model. Although there were such as, the pricing and economic models examine the factors affecting technology choice based on the marginal utility theorem and focus on commercial, this study present a model to assess the influence that structure of the people and risk related to a new choice or alternative technology perception has in the decision process. Previous studies demonstrated the correlation between human-induced and risk. These studies link between the physical risk and human –induced risk factor. A detailed review regarding this approach on modeling of choice was found in recent researches.

This led to the development of the choice and unknown variable models called latent variable models to analyze another decision. McFadden considered the model of the rational, utility, with a choice set of communities within a larger area. He suggested that this problem invalidates the application of the model of choice. Also noted that the utility of a user is a function of the attributes of choice, including accessibility, quality of public services, as well as a role of the decision maker's characteristics, such as type, cost, and risk factor.But in this research , the author focussed on social acceptance factors. The variations in preference of individuals in choosing their alternative method as well as socio-economic differences have to be taken into account as one of the choice modeling concepts. The modeling results can thus help formulate policies that effectively target specific groups. Proposed a mixed spatially correlated model for residential choice, capturing preference variations and space relationship in location choice analysis. Additionally, explored a different conceptual way to represent attributes in the site choice models and described different alternative ways for constructing operational units to represent attributes. They showed that prior distance and open space are all influential in people's new choices.

Modeling choice is considered as one of the social decision. However, usually for simplicity, the modeling selection of new technology is based on individual's (the household, and business) decision. Regarding the main factors affecting the decision, both the social and economic characteristics of the users (mainly people) which emphasized by their age, children, income, lifestyle and education of the members, and the characteristics of the alternative technology locations, such as: safety quality, technologies prices, technology accessibility measures and level of public services.

Additionally, the efficiency has been underlined as an impact factor in choice models. Another significant variable for the choosing a technology or making a decision has found to be the cost. The evaluation of the behavioral process by the choice model structure focuses on two issues: First, how the behaviors of different respondents will evolve into the future and changes in the assumptions lead to different predictions of choice. Secondly, how the results of the model can be interpreted regarding the application of choice and hidden variable models.

Behavioral analysis is widely used for factor analysis. The fundamental mathematical analysis was first described by Charles Spearman. Factor analysis is unique to test the correlation between observed variables and factors that affect the value of the indicators or observed variables. Compared to other statistical methods applied to industrial risk, applications of factor model to analyze and assess industrialism-related decisions are uncommon. Decision makers are very sensitive to two factors: (1) process, and (2) state of affair. They are not necessarily consistent and might be affected over a period. On the other hand, the discrete choice model which is, a standard technique for modeling individual choice behavior from the random utility, influenced by four factors: (1) choice, (2) state of affair, (3) knowledge, and (4) point of views. Lancer and McFadden assumed that the utility is the function of the attribute of the alternatives and the characteristics of the decision maker. A theoretical research written by Woodside and analyzed the awareness of the second choice that may cause by experience, lifestyle, and values, and economy-society factors. In 1977, the large gap between taking a management decision based on the behaviors and choice model encouraged McFadden to empirically demonstrate how behaviors influence decision-making due to the way information stored, and processed. The model based on that an individual derives the utility by choosing an alternative. The cumulative probabilities of individual selecting each alternative help to produce estimation for the population.

Also, other researchers found that the characteristics are essential regarding the perception of the type of risk. In 2009, Azim concluded that gender might play a major role in the perception of physical risk. He mentioned that the likelihood of alerting decision in a risky event influenced by the gender. Zhang and Gibson supported this argument by distinguishing between woman and men. The mentioned that men are more concerned about it than a woman. On the other hand, Lepp (2003) disagreed and found that women have more concerned than men especially in health risk.

Conceptual and Theoretical Framework
The research has adopted the decision hierarchy model for the selection of transportation. Decision hierarchy model is a tool to evaluate the complicated decision by measuring the rating scale which reflects the preference level of the end user towards the survey sample. This method has used in similar research in risk perception. The model designs the problem in a network structure to model a relationship between independent variables and dependent variables.

The Research Model
$$P = f(SO)$$
P = Probability as a function of several accident variables
$$TC = \beta_0 + \beta_1 SOT$$

Where,

TC = Transportation Choice

SOT = Social Acceptance

The following figure illustrated the determinants of transportation selection that involving social acceptance factors, safety, reliability and resilience, operation, environmental impacts, and cost as independent factors. There are forty-six questions include these six dimensions of assessment will be asked to the participants to rate the acceptance index. The rating scale is evaluated from 1 to 7 indicated the range from "strongly Low" to "strongly High" The rating scale helps to evaluate the participant's preference level towards each variable.

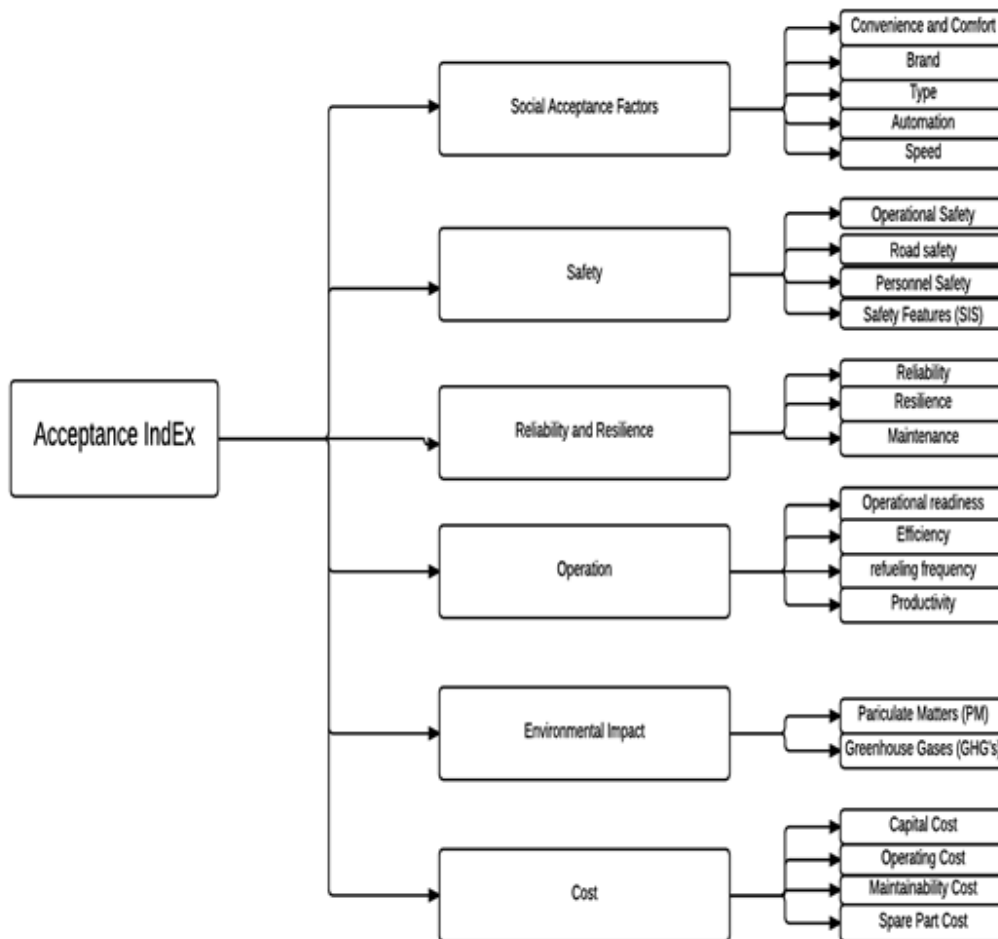### Relationship Development among Variables
The study determines priorities for the alternative CNGV with respect to each of the decision criteria. The results of the study instrument will be processed mathematically to derive the priorities for all the factors on the level. In the study, comparing based on the strength of selected criteria measured. The study developed a scale to measure the alternatives strength with respect to each selected criterion. Figure 2.1 shows the acceptance index of alternative CNG choice. This index divided into six factors but the research focus is social acceptance factor. The social Acceptance factors means the influential factors that are controlling people behaviors.

Transportation Mode Selection and Social Factors
Many researchers emphasize that the quality of the technology was an important factor when two technologies were compared. MacFadden has empirically demonstrated that human behaviors influenced decision making, he has conducted a survey by using more than 350 samples to analyze the factors influenced human selections. Other researchers also said that the quality of is one of the influential factors and plays an important role when selecting a particular product. Cheron and Zins studied the determinants factors such as comfort and its impact on the consumer's selections. The study concluded that the most important selection criteria are quality, reliability, and cost. Quality is considered one of the most important influential factors that affect the human behaviours choice. It indirectly influences the transportation mode selection; based on this study the impact of the quality of the transportation (social acceptance factors such as convenience, brand, type, automation, and speed) selection has positively identified [1-7].

Methodology
The methodology explained how the research carried out to easily understand by the reader. The study used questionnaire survey sample which describes the characteristics of respondents. The method of the research consists of research design, data collection method, sampling design, and measurement scales and data analysis method.

Acceptance IndEx

Social Acceptance Factors
- Convenience and Comfort
- Brand
- Type
- Automation
- Speed

Safety
- Operational Safety
- Road safety
- Personnel Safety
- Safety Features (SIS)

Reliability and Resilience
- Reliability
- Resilience
- Maintenance

Operation
- Operational readiness
- Efficiency
- refueling frequency
- Productivity

Environmental Impact
- Pariculate Matters (PM)
- Greenhouse Gases (GHG's)

Cost
- Capital Cost
- Operating Cost
- Maintainability Cost
- Spare Part Cost

Figure 2.1: Determinants of Transport Selection Criteria

Research Design

A related behaviour decision processes through the statistical model describing the relationship between transportation characteristics and the end-user decision for CNGV designed by a conceptual framework in the previous chapter. This theoretical framework research was quantitatively designed, and a suitable method was constructed for the research through reference to other similar studies, as well as the literature on research design. In this chapter, the method used for evaluating the theoretical framework is profoundly presented, and discussed. The chapter includes discussion of the research philosophy and approach, the research strategy, and specifics of the research including participants and sampling procedures, data collection, and data analysis. The chapter also discusses the ethical concerns of the study and its methodological limitations. This provides a comprehensive discussion of the reasons for specific methodological choices, as well as identifying potential weaknesses and problems in the methodology that could not be eliminated.

Research Approach

The deductive approach was the most appropriate choice for this research. In this study, the statistical analysis technique used to identify the Structural equation modeling (SEM). SEM was selected because it is ideal for designing the models which can determine the relationships between independent and dependent variables. SEM is a set of techniques (including factor analysis, path analysis, and other approaches) that are based on the general linear model. This statistical approach provided a more comprehensive analysis than the simpler analysis techniques by considering all the factors in combination [8-14].

Research Strategy

The research strategy of this study based on data collection and analysis. This research used a quantitative research design. The study selected to use a quantitative approach to identify the relationship between variables, and it is a better research design for hypothesis testing than other approaches The quantitative technique used data collection methods and established statistical analysis tools to create knowledge and draw conclusions. As Trochim confirmed that it is the only approach where findings can be generalized to some extent across populations. Although the quantitative approach has some issues, it also simplified and helped to ensure the research can be integrated on time. Therefore, the study aims to use this approach which consists of two sampling designs. The survey is the first and primary research design which effectively based on the collected data from participants using brief answers.

The main criteria of a valid survey depend on the response rate adequacy. A standard instrument is another important element to be used for data collection. The experimental design where the effect of the factors will be measured. This study used a survey research design, both for practical reasons and because there was no reasonable way to design an experiment for the research question [15-29].

Data Sampling

A sampling frame was placed on the sample to reduce the complexity of data collection. The data collection was limited to include limited number of participants from (Northern Border University, which serves mainly students). This limitation on the sample was placed for useful reasons since the Northern Border University considered the major point in Arar. The estimation of the sample size was based on estimation techniques for SEM, which is a sophisticated approach. The minimum sample size in SEM can be determined based on a relationship between minimum effect size, statistical power, and statistical significance, as a ratio of observed to latent variables. Also in 2011, Gravetter and Forzaqno presented the calculation of the minimum sample size in SEM. This results in a larger sample size than estimated using standard sampling techniques. The lack of knowledge about the demographics of the participants made it the best choice of a sampling method for this research. The selected participants have been chosen randomly from the campus of MUN to increase the randomness of the sample. Demographic characteristics were also collected for a clear description of the sample. To gather data from the respondents, the survey monkey was used. Using a survey monkey approach by sending the sample via valid and secured emails to request participation in the survey. This helped reduce researcher bias since participants were only selected based on their electronic emails

Data Collection

There are several methods for collecting data for a survey including online questionnaires, telephone surveys, self-administered questionnaires, and structured interviews. The survey is a vital part of data collection methodology which ultimately facilitates the analysis. Questionnaires can be collected online, by telephone, or on paper using self-administration, where the participant fills out the questionnaire. The questionnaire can also be filled in as part of a structured interview where the author reads the questions and, if necessary, defines terms. This approach is helpful for medical and health questionnaires. However, this research electronically used the online questionnaire choice for data collection, and there were no significant barriers or problems with understanding. The questionnaire printed in English in an easy-to-read format, and the respondents asked to answer multiple questions divided into four sections. In the case of the incomplete sample, if the respondent did not complete the survey in full, the questionnaire was discarded and was not counted in the sample. The survey was distributed electronically via emails. Every respondent was given a detailed questionnaire sample with the right to participate or not, he or she was contacted online and has their full freedom to respond to the survey sample questionnaire or not by explaining the objective of

this research. If Participants do not willing to answer or complete the survey, discard it, which was taken as an indication he or she did not wish to participate. When the team member received the questionnaire, he or she detached the information letter and sent it to our primary email, and then thanked them for his or her time in participating. No significant problems were reported in the data collection process from any of the volunteers.

Pilot Test. Because the research instrument was designed for this study, it had to be tested for reliability and validity before use. The reliability and validity tests were conducted using built-in SPSS tools. First, face validity and content validity were examined using expert review and pilot testing. The expert review process involved asking the experts from industries as well as other subject matter experts to review the instrument to make sure it reflected the intended constructs. This resulted in some suggested changes, which were incorporated into the questionnaire before the survey was conducted for a pilot test. A group of participants in the pilot test was asked to fill out a brief survey and identify any problems with the content, information, or wording. This resulted in some modifications to the language, which incorporated into the final survey [30-46].

Data Analysis

Data analysis was conducted in SPSS using three techniques. The first technique was descriptive statistics, which was used only as a descriptive profile of respondents and then compared to a general population. To describe characteristics of the sample.

Result and Discussion
Conclusion

The research describes the importance of alternatives in our daily life, where understanding the human behaviour and decision criteria might play a significant role towards rational decisions for the alternative options. This paper agreed with other researches that the introduction of risk into social decisions has the potential to change the process of making an industrial decision. This demonstrated the fact that the human behaviors towards the industrial and natural issues and pointing out how individuals perceive risk which affects their behaviors thus control their future decision. The correlation between the human behaviors and alternative choices discussed. Identification of the significant factors controlling human choice. Information is essential for all industrial sectors to make a decision. Thus, helping the industries decisions through a systematic and objective data collection is another platform of this research. Launching a new product without useful information could be a failure of any product. The research may supports policy-makers to design and promote the adoption of alternatives.

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