THE ADOPTION OF SUSTAINABLE SOLUTIONS IN THE AUTOMOTIVE SECTOR

Dipl.-Oek. Martin Kassubek
(kassubek@m2.uni-hannover.de)

Prof. Dr. Klaus-Peter Wiedmann
(wiedmann@m2.uni-hannover.de)

Dipl.-Oek. Lars Pankalla
(pankalla@m2.uni-hannover.de)

Dr. Nadine Hennigs
(hennigs@m2.uni-hannover.de)

Dipl.-Oek. Barbara Seegebarth
(seegebarth@m2.uni-hannover.de)

Leibniz University of Hannover
Institute of Marketing and Management
Koenigsworther Platz 1
D-30167 Hannover, Germany

SUMMARY

Objectives:
The aim of the present study is to examine uncertainty aspects that significantly influence an NGV-purchase decision in the end-consumer sector. More specifically, we analyze from a consumer point of view how the transition of NGV depends on the consumers' perceived risk. In this context, our paper basically applies to the German consumer market.
Methods:
Our paper is structured as follows: First, we describe the development of alternative fuels and engines, and then analyzing existing literature with regard to the perceived risk domain. Second, we develop a conceptual model of consumer perceived risk concerning the market penetration of NGVs. Second, based upon previous research and a German sample, perceived risk factors in case of purchasing an NGV are introduced and empirically verified to compare the consumer's perceptions. Third, the empirical results are discussed with regard to future research steps and managerial implications to handle identified risks in the different countries.
Results:
The analysis results might enable marketing researchers and managers to understand the multifaceted phenomenon of consumer hesitation and the gap between consumer pro-environmental attitudes and the intention to purchase an NGV.
Conclusions:
In sum, our study offers a basis for researchers, manufacturers and politicians to investigate how to best manage product characteristics, local incentives, and environmentalism sentiment in order to attract a larger number of consumers to green innovations like NGVs.

Key Words:
Automotive Industry, Customer Risk Perception, Technology Adoption, Natural Gas Vehicles

INTRODUCTION

Within the ongoing trend to economical passenger cars and the growing number of offered alternative engines and technologies by the worldwide leading car manufactures, compressed natural gas (CNG) is seen as a short call alternative for traditional combustion engines (IGU 2005). Understanding how firms can effectively manage the development of structural and technological challenges of alternatives technologies has become an important topic to academicians and practitioners in recent years. Part of this interest stems from the target of car manufactures and power suppliers to be participated in the development of sustainable traffic solutions (May 2004). Further research has mainly analyzed the performance of alternatives fuels and engines (EU 2001; German Federal Ministry of Transport, Building and Housing 2000; Dupont-Roc et al. 1994; Manning 1996).

In spite of the development of technologies with lower carbon dioxide emissions, the question why the registration numbers of natural gas vehicles (NGVs) are contemporary lower as petrol or diesel driven passenger cars has been largely neglected by academic research. All alternative drives have a share of only circa 1 percent based on German registrations in the year 2006 (Green Car Congress 2006; VDA 2007).

Part of the research of this paper stems from the recognition in the field of customer behavior that perceived risk influence the adoption of new technologies. Hence, this paper applies basically to the German market for passenger car and includes currently automotive trends in the consideration. The analysis accelerates the development of NGVs, whereas CNG, as a fuel, is regarded as an alternative technology for the combustion of petrol or diesel. In this context the following analysis focuses the private use of passenger cars. Also, the empirical study picks up this viewing angle. In the light of the exploration, we include serial manufactured NGVs from original equipment manufactures (OEMs). In this connection, NGVs are viewed as a possible substitute for classical petrol and diesel engines.

This paper is organized as follows: First, analyzing the development of alternative fuels and engines in Europe, especially in Germany, and on the literature on perceived risk, a conceptual model of consumer perceived risk concerning the market penetration of NGVs is developed. Second, based upon previous research, perceived risks factors in case of purchasing an NGV are introduced and empirically verified. Further, we specify and categorize different types of private drivers with reference to the various dimensions underlying the per-

ceived risks in case of purchasing an NGV. Third, the empirical results of our exploratory study are discussed with reference to future research steps and managerial implications to handle the identified risks.

BACKGROUND AND LITERATURE REVIEW

The structure of passenger transport and characteristics of NGVs

On European level, the long-termed target to disengage from fossil fuels and to employ more alternative fuels and technologies in passenger transport is declared. This vision is part of Europeans long-run traffic strategy. At this, regenerative-generated hydrogen is considered as the fuel with the highest prospects (EU 2001, Stromberger 2003). Among this technology, the focus is on the optimization of fossil fuel-driven engines, the usage of hybrid vehicles, bio-fuels as well as CNG which is mainly part of this paper. The development of natural gas propulsion systems continues to be dynamic. Currently, there are about 50,000 vehicles with gaseous systems in Germany, this number increases by over 35 percent each year (VDA 2007).

Due to the novelty of the gaseous fuel, conventional petrol/diesel tank devices can not be used by NGVs for refueling. The operation of NGVs requires a gas refueling technology which is special and being under pressure (Fulton 2005). Natural gas driven vehicles also benefit from the growing number of natural gas service stations. Up to the present, over 700 stations are installed across Germany. Consequently, CNG installations are available nationwide at approximately every twentieth filling station (IANGV 2006). Next to Germany, a positive development of the admittance numbers of NGVs connected to an expansion of available, compatible filling stations have primarily been established in Italy, Austria and Switzerland within the last few years (IGU 2005).

The attractiveness of NGVs is connected with one for the private driver comfortable accessibility of necessary supply points on public filling station locations (Flynn 2002). The local energy supply companies appear as an investor of setting up natural gas filling stations. The expansion of the national natural gas filling station network is connected with high investment costs (Stork 2000). One the one hand, the arising “the chicken or the egg causality dilemma" indicates that there is not the contingency for an increasing production and an expansion of the model variety of NGVs, if it is no full-coverage natural gas filling station structure available. Otherwise, the energy supply companies and mineral oil enterprises refrain from the development of petrol stations, if the promotion of NGVs can not be guaranteed (Yeh 2007; McTaggart 1915).

The process of innovation, including the stage of the market launch of NGVs not longer follows a separate economic logic (e.g., business profits, competition). Also, other stakeholders' (e.g., developers, sales representatives et cetera) interests as well as the politics and the public have to been integrated (Stromberger 2003). Hence, the development of alternative fuels and engines, especially the CNG technology, has technology push and also technology pull releases. Technological-push occurs when the introduction of new technologies precedes the development of a strategic focus by the adopting entity (e.g., car manufacturer, energy industry) (e.g., Morone 1993; Souder 1989). Technology-pull is divided into the types of internal demand-pull and external demand-pull. Internal demand-pull tendencies are derived from the major stakeholders, including management and customers. External demand-pull arises from three primary forces: institutional, political and innovative (e.g., determination of limit values for new cars' carbon dioxide emissions) (e.g., Drury and Farhoomand 1999; WBCSD 2008).

Perceived risk

Perceived risk was originally applied widely on psychology. In recent years, it is also considerably applied on the decision-making and explanation of consumers' behavior (Chaudhuri 1997; Dowling and Stealin 1994; Folks, 1998). Looking from the perspective of consumer behavior, the concept of risk was first presented in the 1960th (Cunningham 1967). The fundamental thoughts of perceived risk are traced back to Knight, whose work is influenced by different disciplines. The different view is of great importance, because they have numerous impacts on the essential definitions as well as the use of perceived risk so that there are various understandings of the risk construct depending on discipline focus (Knight 1948; Dholakia 2000; Mitchell 1999). The focus of this paper is on risk perception in the sense of consumer behavior that is strongly related to the psychology discipline (Dholakia 2000).

Mitchell (1999) proposed that the existence of objective risk in the theoretical literature is a necessity and he differentiates between objective and subjective risk. Rasmussen (1987) said that risk is only a feature of the "value perception underlying intuitive choice" that can not be considered separately. In this consideration it's important to mention the interrelationship between both - objective ("real world risk") and subjective risk ("perceived risk"). In contrast, Stone and Winter (1985) disbelieve the existence of objective risk, because of the human impossibility having a real world or objective risk. According to various authors, there are some limitations of perceived risk, because (the averaged) consumer has only limited information about historical data to reduce trials to consider and a semi-reliable memory (Erdem 1998). They are often confronted with completely new products and services which they

have never occurred before (Mitchell 1992, 1999), with the result that a risk-assessment is really difficult or actually impossible to realize.

Risk perception is believed to be an important factor in the decision making process of consumers and therefore an important impact for marketing strategies and technology management. On this account, it is necessary to delimitate perceived risk from other constructs existing in the literature. Some researchers refer to the important interrelationship between the construct of perceived risk and involvement (Engel and Light 1968; Bloch 1981; Bloch and Richins 1983; Gemunden 1985; Laurent and Kapferer 1985). Also, this understanding is indirectly supported by other authors (Cooper et al. 1988; Weber and Milliman 1997; Mellers et al. 1997; Weber and Hsee 1998) who stress the differentiation between risk perception and risk attitude. Therefore, risk attitude means the integration of more emotional responses into the cognitive process with information to get a more realistic risk perception.

However, regarding to their evaluations, alternative decision making and behaviors the risk perception of consumers is examined to be very important and central (Dowling 1999). Based on consumer behavior literature, the term perceived risk can be defined in different, multifaceted ways. For a better understanding table 1 lists the definitions and quasi-definitions.

----------*Insert Table 1 about here*----------

During the process of purchasing decision making of NGVs, the consumers might face the goals they can not accomplish and thus have to encounter the disadvantageous results of various material and psychological aspects.

CONCEPTUAL MODEL

Referring an integrated understanding of the perceived risk construct, all relevant actual and potential dimensions should be integrated into one single model. For the purposes of this paper, regarding all prospective and directly attributable risk dimensions, this research follows the statement of Stone and Grønhaug (1993) and segments perceived risk in case of purchasing an NGV into six highly interrelated components of perceived risk. The multidimensional model adds on the remarks of Jacoby and Kaplan (1972), but focuses the measurement of a theoretical construct of a technological innovation – the purchase of a personal computer (PC). The characteristics of this product are similar to the object tested in this paper: the technological acquisition, high-costs and the complexity operating mode. Also, the measurement is characterized by a high level of validity and reliability (Stone and Grønhaug 1993).

Against this background, figure 1 shows the proposed conceptual model to investigate specific perceived risk factors in case of purchasing a natural gas vehicle for private use.

----------*Insert Figure 1 about here*----------

The questions in risk dimension are as follows: as to the product purchased, the costumer actually can not experience the function (e.g., refueling mechanism). The customer has the loss of money since s/he can not actually experience the value of the product as in the advertisement, as to the NGV purchased. The customer might have the risk of being hurt physically, e.g., because of the damage of gas tanks in case of a crash. The NGV purchased can not satisfy her/his internal expectation and the loss is generated. As to the NGV purchased, s/he has the risk of being deceived, comparing with other alternative fuels or engines and might loses face because the customer can not face her/his relatives, friends and colleagues.

Financial risk: The consumer takes the risk of spending her/his money on it unsatisfactorily, since the product does not meet her/his expectations and needs as expected. Due to the limited NGV production, the purchase price of an NGV is higher than the price of a comparable conventionally fueled vehicle (American Gas Foundation 2000). Consequently, P_1: *The perceived financial risk may be conducive to customers' perceived risk in case of purchasing an NGV.*

Social risk: By the purchase of a certain product the consumer comes in the risk that buyers' reputation decreases within her/his social environment (e.g., family, teammates, and friends). Also, studies have just illustrated the expression of personality and individuality in the choice of cars (Train 1986; Golob et al. 1997) and the role of social influence (Algesheimer et al. 2005). Thus, P_2: *The higher degree of social risk results in higher degree of perceived risk in case of purchasing an NGV.*

Time risk: The time risk expresses the increased time expenditure and the amplified efforts at the purchase of an object. For example, the driver of an NGV has to ask about tank possibilities due to the not everywhere available filling stations prior to her/his journey (IANGV 2008). This leads us to, P_3: *Due to the new functions, the consumers' perceive a time risk in case of purchasing an NGV.*

Performance risk: The risk type pushes this one the deviation obtained out of this one in the reality of expectation to the performance and the consumer is running functionality of the product. The product-specific performance risk (Mitchell 1998) in case of new technologies arises because the equipment dependability may be not comparable with mature technologies. Thus, P_4: *The novelty of NGVs results in consumers' perceived performance risk.*

Physical risk: By the use of the product, there is a risk of the impairment of drivers' health or the risk of endangering others, e.g., the risk of being hurt physically in case of discharging gas (Nelson 2002). This reasoning leads us to, P_5: *The gaseous fueling systems affect the perceived physical risk.*

Psychological risk: The risk of limiting the self-esteem of one's own by the purchase of a "wrong" product. Taken as a whole, the psychological dimension is highly interrelated with the other perceived risk components. Psychological risk perception is viewed as the experience of anxiety or psychological discomfort from anticipated post behavioral affective reactions such as worry and regret (Perugini and Bagozzi 1999). Consequently, P_6: *In case of purchasing an NGV, the consumers' perceive a psychological risk.*

METHODOLOGY

The Questionnaire

All measures used in the study were adapted from existing scales, especially from the study by Stone and Grønhaug (1993). The wording of the items was adapted to reflect perceived risk in case of purchasing an NGV. Items were rated on five-point Likert scales because they are more commonly used in Germany than the seven-point scales.

As a first step, targeting the comprehensive ascertainment of the theoretical construct and the necessity for adapting the scales in case of natural gas vehicles, we posed a written, non-structured questioning to 20 potential passenger car buyers. The question, which focused the purchase intention, reads as follows: "Please imagine, you would purchase a brand new passenger car of your favorite manufacturer within the next 12 month. Alternatively, your dealer offers you a compressed natural gas engine of your favorite car model. If you would buy the natural gas vehicle, please write down the reasons of your choice. If you choose a petrol- or diesel vehicle, please describe why you favor these engines over a natural gas engine."

Second, the scales were pre-tested in a series of iterative personal interviews with 17 drivers. Each participant in the pre-test answered the questionnaire as s/he read the questions and verbalized any thoughts that came to mind (including ambiguities, inapplicable questions and interesting issues).

The Sample

In order to find out the perceived risk factors in case of purchasing an NGV, data from customers who had been able to acquire or drive a passenger car had been essential. To investigate the research model, an internet survey with a snowball sampling method was developed in Germany. It has been organized using an Internet form sent to addresses gathered by stu-

dents from a national university. We appealed private costumers via personalized emails with the invitation to actively contribute to the online survey. A total amount of 177 valid questionnaires was received. Table 2 describes the sample structure.

----------*Insert Table 2 about here*----------

Respondents mainly aged 25-44, those with higher education and those who have an own car were over-represented, which is indicative of the fact that many students and employees participated as they are particularly interested in automotives. The higher percentage of younger and male consumers in the sample may be also attributed to the greater internet usage of younger people.

RESULTS AND DISCUSSION

Within the data analysis, we first uncovered the various dimensions underlying the perceived risks in case of purchasing an NGV by a factor analysis using the principal component method with varimax rotation. The factor analysis produced a nine factor structure with a Kaiser-Meyer-Olkin measure of .800. All items had medium (>0.5) up to high factor loadings (>0.8) and the factors' Cronbach's alpha were .700 up to .860. Table 3 shows our proposed nine factor solution.

----------*Insert Table 3 about here*----------

Then, the factor scores for each respondent were saved and consequently used in stage two for clustering them into market segments. The focus of cluster analysis in this study was on the comparison of cases according to the natural relationships between the hypothesized risk perception dimensions and factors. We used both hierarchical and non-hierarchical clustering techniques: An initial hierarchical clustering procedure was employed to obtain a candidate number of clusters and seed points for a k-means cluster analysis. To identify the right number of clusters, the respondents were partitioned by the hierarchical procedure first. Because it produces tight minimum variance clusters and is regarded as one of the best of the hierarchical clustering techniques (Wishart 1987), Ward's method of minimum variance was chosen to check the cluster differences in each stage of combinations and to maximize homogeneity within and heterogeneity between clusters.

The results strongly suggested the presence of four clusters. This four-cluster solution was validated using non-hierarchical k-means clustering. Overall, following the typical criteria for effective segments that consist of consumers with homogeneous needs, attitudes, and responses to marketing variables (McCarthy 1982), are distinctive from one another (Weinstein 1987), are large enough to be managerial useful (McCarthy 1982), and provide operational data that are practical, usable, and readily translatable into strategy (Weinstein 1987) the

four-cluster solution most favorably met the above criteria and produced the most interpretable and stable result. With regard to classification accuracy once the clusters are identified, we also used discriminant analysis to check the cluster groupings (Hair et al. 1998). Using the categorical dependent variable a priori–defined four-cluster solution, the result of analysis revealed significant differences between the group characteristics. The classification results were used to determine how successfully the discriminant function could work. Overall, 98.9% of the cases were assigned to their correct groups, validating the results of cluster analysis for useful classification of consumer subgroups based on their risk perception.

----------*Insert Table 4 about here*----------

For market segmentation purposes, profiling the cluster solutions should lead toward a classification scheme through describing the characteristics of each cluster to explain how they might differ on relevant dimensions. To develop a profile of each market segment, more detailed information comes from looking at the questionnaire variables cross-tabulated by cluster segment. Comparisons among the four clusters were conducted on a variety of descriptive variables including demographic and socioeconomic characteristics. Based on the variables from which they derived, the four clusters were labeled as follows: Cluster 1 is referred to as the NGV-interested urbanites, members of Cluster 2 are referred to as the ecology-minded traditionalists, Cluster 3 is referred to as the service-oriented individualist, and members of Cluster 4 are called the security-oriented conventionalists:

Cluster 1: The NGV-interested urbanites

(n=57, 32.2% of the sample, 49.1% male, 50.9% female; mean age of 28.5)

Typical consumers in this cluster had the most positive attitude towards the functional value of NGVs (e.g., "*due to lower consumption costs", "an NGV is an interesting alternative"*). They perceive eco-friendly NGVs to be an interesting alternative due to lower consumption costs and state subsidies. Therefore, they do not associate the purchase of an NGV with financial or individual risks as evidenced by lowest ratings for "*I would make a mistake with the purchase"* and *"In the near future the purchase would be connected to too many uncertainties"*.

Cluster 2: The ecology-minded traditionalists

(n=36, 20.3% of the sample; 36.1% male, 63.9% female; mean age of 27.2)

This group shows highest mean ratings for ecological awareness and state that "*Cars should be as eco-friendly as possible"*. To spare the environment, members of this cluster try to put short distances back without a car and use buses or trains regularly. Overall, this segment does not seem to be greatly excited about cars what can be seen in lowest mean scores

for car involvement. With reference to a possible purchase of an NGV, they do not associate social risk aspects but are uncertain concerning the service aspects (e.g., "*I would not know where I shall refuel the vehicle"*).

Cluster 3: The service-oriented individualist

(n=42, 23.7% of the sample; 69.0% male, 31.0% female; mean age of 30.8)

Members of this group are more interested in cars than other groups as evidenced by highest ratings for car involvement *("Cars are important to me"* and *"I like to speak with others about cars").* When considering the purchase of an NGV they put emphasis on the number of available models ("*The low number of available models would stop me from the purchase"*) and state that *"I could spend my money on a better way"*. People in this group do strongly associate service risk aspects with the possible purchase of an NGV: "*I would have doubts that more costs come towards me than with my present vehicle"*. Ratings for ecological awareness are the smallest percentage of all groups.

Cluster 4: The security-oriented conventionalists

(n=42, 23.7% of the sample; 42.9% male, 57.1% female; mean age of 30.7)

Taken as a whole, this cluster associates the possible purchase of an NGV with the most risk aspects: Highest ratings for convenience risk, service risk, and social risk. They state that they would not know where to refuel the vehicle, think that the services would take problems, and for them, the purchase of an NGV would be connected to too many uncertainties. On the whole, more than the other clusters, they perceive that "*I would make a mistake with the purchase*".

Even though, we have just made a very first step to categorize different groups of private drivers along the dimensions of perceived risk associated with the possible purchase of NGVs, our exploratory results seem to be worth focusing in further research as well as in managerial practice.

FURTHER RESEARCH STEPS AND MANAGERIAL IMPLICATIONS

The purpose of this paper was to examine customers' perceived risk factors to gain a better understanding of the technology management of NGVs as a framework for a structured understanding and categorization of the different risk dimensions. Although, we have just made a very first step to categorize potential drivers in view of identifying different types along the dimensions of perceived risk, our integrative framework and the exploratory results seem to be worth focusing in further research as well as in managerial practice.

Of course, our study is only a first step and should be further developed in different ways. First, the different propositions sketched above will have to be elaborated more into

depth. Second, in the next step of developing hypotheses, we should as well emphasize the interplay between the different variables. As important the generation of such an extended model might be, we believe that first of all, it was important to empirically find out more about the relevancy of different variables underlying consumer attitudes towards NGVs based upon various risk dimensions. The cluster analysis results revealing four types of consumers based upon their risk perception might enable marketing researchers and managers to understand the multifaceted phenomenon of consumer hesitation and the gap between consumer pro-environmental attitudes and the intention to purchase an NGV. In line with a cross-national development of alternative fuels and engines, cultural differences in customer behavior have to be including into future research.

Further, there are wide-ranging managerial implications of our research. A central assertion is the development of natural gas fuelling stations. Cross-national cooperation could be suitable to promote the expansion of NGVs in Europe. Hence, the attractiveness of NGVs could be on the increase because customers would not have to expect any essential disadvantages compared with the refueling of petrol or diesel driven vehicles. By the amplified exchange of suppliers and OEMs, the targets to optimize technical characteristics of NGVs and to underline the economic and ecological advantages could be accomplished. Another strategic decision concerns the product-related segmentation of the market based on revealing different types of consumers. OEMs have to decide which models from the portfolio could be offered as natural gas types.

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TABLES AND FIGURES

TABLE 1: Definitions and Quasi-Definitions of Perceived Risk

Year	Author	Definition
1967	**Bauer**	Consumer behaviour involves risk in the sense that any action of a consumer will produce consequences which he cannot anticipate with anything approximating certainty, and some of which are likely to be unpleasant.
1967	**Cunningham**	"true" or "actual" probabilities of loss are not relevant to the consumer's reaction to risk except insofar as past experience is the basis for present perception. The consumer can only react to the amount of risk she actually perceived and only to her subjective interpretation of that risk.
1967, 1978	**Cox; Robert, Green and Saegert**	The *amount of perceived risk* involved in any behavioural act is assumed to be a function of two factors: (1) The amount that would be lost (i.e., that which is at stake) if the consequences of the act are not favorable. (2) The individual's subjective feeling or degree of certainty that the consequences will be unfavorable.
1992, 1998	**Mitchell**	Perceived risk influences every stage of the consumer decision-making process and the challenge is for the marketers to use this knowledge to gain a competitive advantage. (…) Since the outcome of a choice decision can only be known in the future, the consumer is forced to deal with uncertainty and to the extent that the consumer realizes he/she may not attain all of his/her buying goals, risk is perceived.
1993	**Stone and Grønhaug**	When studying perceived risk in consumer behaviour, however, the focus has primarily been on potentially outcomes only.
1994	**Dowling and Staelin**	The concept of perceived risk most often used by consumer researchers defines risk in terms of the consumer's perceptions of the *uncertainty* and adverse *consequences* of buying a product (or service). Their overall perceived risk model consists of two components: The first reflects the person's perception of risk inherent in purchasing any particular product in a specific product category (a person's category risk (PCR)). The second component (…) is associated with the particular product being considered in the product class (product specific risk (SR)).

FIGURE 1: The Conceptual Model

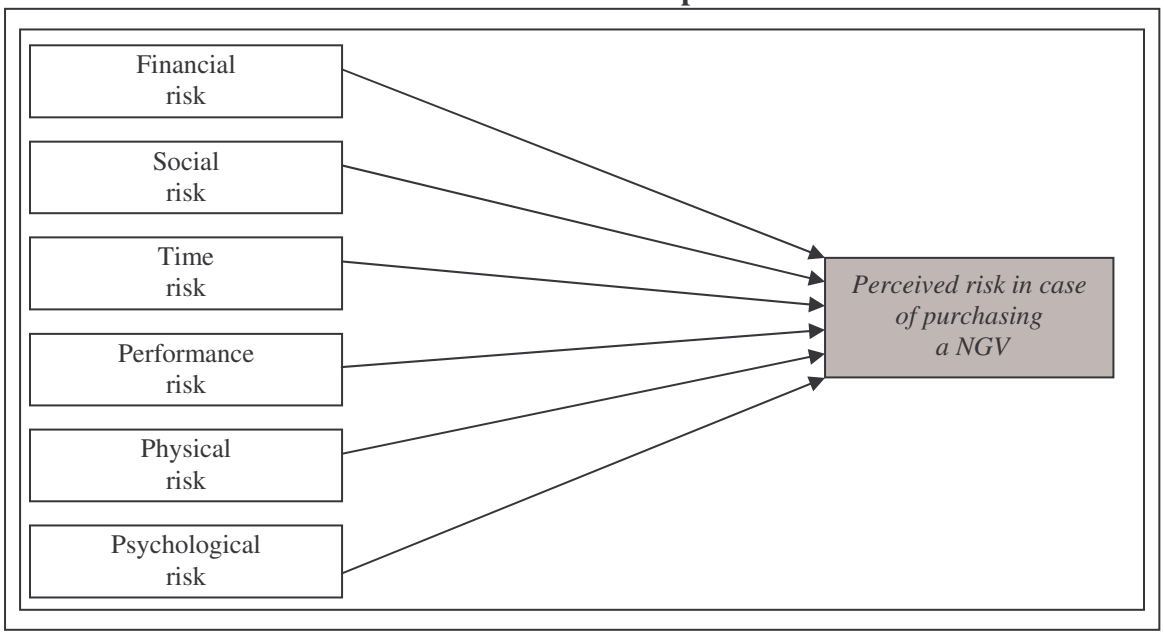

TABLE 2: Demographic Profile of the Sample			
Variable		**n**	**in %**
Age	17 – 24 years	42	23.7
	25 – 44 years	119	67.2
	45 – 59 years	13	7.3
	60+	3	1.7
Gender	Male	88	49.7
	Female	89	50.3
Occupation	Employee	62	35.0
	Worker	1	0.6
	Civil servant	9	5.1
	Self-employed	8	4.5
	Homemaker	2	1.1
	Pensioner	2	1.1
	Pupil	1	0.6
	Student	89	50.3
	Unemployed	3	1.7
Currently used engine	Petrol	90	60.8
	Diesel	52	35.1
	CNG (Compressed Natural Gas)	2	1.4
	LPG (Liquified Petroleum Gas)	3	2.0
	Other	1	0.7
Residential area	Rural area (less than 5.000 habitants)	22	12.4
	Small town (less than 20.000 habitants)	20	11.3
	Mid-size town (less than 100.000 habitants)	36	20.3
	Major city (more than 100.000 habitants)	99	55.9

TABLE 3: Factor Structure

KMO-Test: .800

Items	Factor Loadings	Means Cluster 1	Means Cluster 2	Means Cluster 3	Means Cluster 4	F	Sig
N		*57*	*36*	*42*	*42*		
F1 Social risk	**α =.860**	**1.39**	**1.06**	**1.21**	**1.63**	**7.290**	**0.002**
My friends would think I was just being showy.	0.877	1.30	1.00	1.10	1.48	5.444	0.001
I think I would be held in higher esteem by my associates at work.	0.874	1.42	1.00	1.12	1.45	5.270	0.002
The purchase of an NGV would cause me to be thought of as being foolish by some people whose opinion I value.	0.802	1.44	1.00	1.24	1.50	4.898	0.003
I become concerned about potential physical risks associated with an NGV.	0.619	1.40	1.22	1.38	2.10	13.549	0.000
F2 Physical-handling risk	**α =.798**	**3.50**	**2.99**	**3.20**	**2.91**	**12.932**	**0.000**
The thought of purchasing an NGV doesn't make me feel psychologically uncomfortable.	0.745	4.26	3.50	3.57	2.83	20.928	0.000
I think NGVs are safe and exclude endangering increasely.	0.740	4.12	3.17	4.00	3.31	9.586	0.000
I think the NGV would work reliably.	0.737	4.23	3.50	3.71	3.24	11.880	0.000
One concern I have about purchasing an NGV is that endangering my passengers, like e.g., family member, could be too high.	-0.507	1.40	1.78	1.50	2.26	9.334	0.000
F3 Financial risk	**α =.717**	**1.78**	**2.01**	**2.45**	**2.85**	**16.866**	**0.000**
I would be concerned that the financial investment would not be wise.	0.811	2.00	2.11	3.05	3.26	20.947	0.000
I could spend my money on a better way.	0.747	2.14	1.94	3.12	2.81	14.484	0.000
The thought of purchasing an NGV causes me to experience unnecessary tension.	0.522	1.56	2.42	1.95	2.76	13.510	0.000
The thought of purchasing an NGV makes me feel psychologically uncomfortable.	0.519	1.40	1.58	1.67	2.55	18.521	0.000
F4 Functional value	**α =.700**	**4.35**	**3.83**	**3.40**	**3.61**	**16.457**	**0.000**
Due to lower consumption costs, an NGV is an interesting alternative.	0.830	4.33	3.72	3.29	3.50	17.404	0.000
State subsidies (tank vouchers, tax exemption etc.) make the NGV attractive.	0.787	4.19	3.86	3.29	3.57	13.487	0.000
NGVs are eco-friendly.	0.749	4.53	3.92	3.62	3.76	18.480	0.000
F5 Convenience risk	**α =.723**	**2.89**	**3.56**	**2.86**	**4.10**	**16.498**	**0.000**
I would not know where I shall refuel the vehicle.	0.816	2.84	3.75	2.62	4.17	17.454	0.000
I would have the anxiety that I do not comfortably reach the filling stations at which I can tank natural gas on my journeys.	0.798	3.61	4.25	3.83	4.60	12.574	0.000
I would have security concerns in the case of an accident.	0.620	2.21	2.69	2.14	3.52	19.467	0.000
F6 Service risk	**α =.702**	**2.80**	**3.02**	**3.60**	**3.71**	**11.723**	**0.000**
I think that the services (repair, maintenance etc.) would take problems with itself.	0.818	2.70	2.86	3.50	3.69	14.164	0.000

I would have doubts that more costs come towards me than with my present vehicle.	0.716	2.86	3.03	3.45	3.74	9.811	0.000
The low number of available models would stop me from the purchase.	0.660	2.84	3.17	3.86	3.71	11.195	0.000
F7 Individual risk	**α =.799**	**2.18**	**2.83**	**3.19**	**3.46**	**25.290**	**0.000**
A possible purchase would causes problems which I cannot use.	0.871	1.91	2.69	2.95	3.36	31.078	0.000
I would make a mistake with the purchase.	0.811	1.79	2.25	2.95	3.00	26.957	0.000
With an NGV I would have to accept losses opposite my current vehicle.	0.742	2.54	2.92	3.36	3.67	19.446	0.000
In the near future the purchase would be connected to too many uncertainties.	0.737	2.46	3.47	3.50	3.81	23.678	0.000
F8 Car involvement	**α =.825**	**2.68**	**2.59**	**3.47**	**2.91**	**4.552**	**0.004**
I like to speak with others about cars.	0.873	2.21	2.28	3.10	2.57	4.282	0.006
Advertising for cars, e.g., on television or in magazines catch into my eye.	0.858	2.63	2.44	3.40	2.67	4.756	0.003
Cars are important to me.	0.781	3.21	3.06	3.90	3.48	4.618	0.004
F9 Ecological awareness	**α =.708**	**3.91**	**4.31**	**3.33**	**3.41**	**9.045**	**0.007**
I try to put short distances back without the car to spare the environment.	0.804	4.05	4.53	3.31	3.31	14.750	0.000
To spare the environment, I drive regularly with bus and train.	0.741	3.63	4.03	2.64	2.55	14.004	0.000
If I plan greater acquisitions, I calculate the costs of all alternatives exactly.	0.684	3.81	4.19	3.43	3.76	3.495	0.017
Cars should be as eco-friendly as possible.	0.623	4.16	4.50	3.95	4.00	3.931	0.010

Means were summated from scale items

TABLE 4: Discriminant Analysis

Discriminant Function	Eigenvalue	Canonical Correlation	Wilk's Lambda	χ^2	Significance
1	2.515	0.846	0.064	465,383	0.000
2	1.284	0.750	0.226	252,310	0.000
3	0.940	0.696	0.515	112,331	0.000
		Function 1	**Function 2**		**Function 3**
Centroids (group means)					
Cluster 1		-2.084	0.460		0.395
Cluster 2		-0.057	-2.075		-0.666
Cluster 3		1.034	1.144		-1.263
Cluster 4		1.843	0.010		1.298
Significant variable (structure matrix)					
F7 Individual Risk		0.627	0.001		-0.016
F4 Functional Value		-0.451	-0.017		0.298
F3 Financial Risk		0.393	0.245		0.016
F6 Service Risk		0.368	0.290		-0.051
F2 Physical-handling risk		-0.401	0.474		-0.177
F9 Ecological awareness		-0.190	-0.359		-0.195
F8 Car Involvement		0.101	0.175		-0.158
F1 Social Risk		-0.054	0.274		0.660
F5 Convenience Risk		0.231	-0.425		0.552

Classification matrix revealed that 98,9 % of the cases were classified correctly.