Consumer Resistance to Green Innovations:
The Case of Natural Gas Vehicles

Klaus-Peter Wiedmann, Nadine Hennigs, Lars Pankalla,
Martin Kassubek, Barbara Seegebarth

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Marseille, France
June, 2010
It’s a pity

- Not being here yesterday.
- Not having decided for a conceptual paper.
- .................

However, maybe “piecemeal engineering” is indeed the best concept – following Sir Karl Popper
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Introduction/Background

Conceptualization

Methodology

Results

Conclusion
### Natural Gas Vehicles (NGVs)

- NGVs are regarded as a short call alternative for traditional combustion engines.
- Today, more than 1.1 million NGVs have been sold in Europe, therefrom 65,000 in Germany (IANGV 2009).
- Due to the novelty of the specific gaseous fuel, conventional petrol/diesel tank devices cannot be used by NGVs for refuelling.
- "chicken or egg causality dilemma"
- 800 refuelling stations in Germany.

### Perceived Risk

- Perceived risk concerns feelings of uncertainty and possible future adverse consequences coming from consumer actions.
- In the field of buyer behavior perceived risks include costs, especially performance and psychosocial ones, to achieve a particular set of buying goals.
- Studies in on-/offline contexts (e.g., Ram/Sheth, 1989; Ellen et al., 1991); only little (quantitative) research exploring the link between risk attitudes and consumer resistance in general and green innovations in particular.

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If and to what extent do consumers’ perceived risk influence the resistance of NGVs?
The Relevance of the Resistance to Buy Societal Important Products

- **Societal Impact**

- **Social influences**
  
  Perceived as anti-consumption

  Enforcement of consumer resistance – taking no consumption of others as a “good reason”

  Enforcing “dancing on the volcano”

- **Influences on technical development** – slow down of innovation, many alternative technologies were already invented many years ago ……

How much pollution could have been prevented over the last years early adapting NGV’s?
Research Tasks

- Find answers why people resist to buy NGVs
- Develop a framework for a better understanding of the influence of consumers’ risk attitudes and resistance behavior, focusing on:
  - Risk aspects that consumers perceive and associate with the purchase and usage of green technologies in general and in the context of NGV in special.
- Provide first empirical results for the identification of those individuals with the highest and lowest risk perception due to the resistance of NGVs
- Examine different types of potential NGV resistant consumers upon the risk perception dimensions
Conceptual Framework: Perceived Risk Dimensions as Major Determinants of NGV Resistance

Dimensions of Risk Perception:
- Financial Risk
- Social Risk
- Time Risk
- Performance Risk
- Physical Risk
- Psychological Risk

Innovation Resistance Concerning NGVs
- Car Involvement
- Ecological Awareness
In case of purchasing a NGV, the consumers' perceive a **financial risk**.

In case of purchasing a NGV, the consumers' perceive a **social risk**.

In case of purchasing a NGV, the consumers’ perceive a **time risk**.
In case of purchasing a NGV, the consumers' perceive a **performance risk**.

In case of purchasing a NGV, the consumers' perceive a **psychological risk**.

In case of purchasing a NGV, the consumers’ perceive a **physical risk**.
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Questionnaire, Sample, and Data Collection

- **Questionnaire:**
  - already existing and tested measures
  - further items resulting from exploratory interviews with marketing experts and consumers

- Items were rated on a five-point Likert scale
  \(1 = \text{strongly disagree}, \ 5 = \text{strongly agree}\)

- Male and female German and CIS (former Soviet Union) respondents, aged 18 years and older

- 480 interviews
# Item Scales

<table>
<thead>
<tr>
<th>Scale</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Risk</td>
<td>Stone and Grønhaug 1993</td>
</tr>
<tr>
<td>Social Risk</td>
<td>Stone and Grønhaug 1993</td>
</tr>
<tr>
<td>Time Risk</td>
<td>Stone and Grønhaug 1993</td>
</tr>
<tr>
<td>Performance Risk</td>
<td>Stone and Grønhaug 1993</td>
</tr>
<tr>
<td>Physical Risk</td>
<td>Stone and Grønhaug 1993</td>
</tr>
<tr>
<td>Psychological Risk</td>
<td>Stone and Grønhaug 1993</td>
</tr>
<tr>
<td>Car Involvement</td>
<td>Bloch 1981</td>
</tr>
<tr>
<td>Ecological Awareness</td>
<td>Nordlund and Garvill 2003</td>
</tr>
</tbody>
</table>
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The factor analysis produced a ten factor structure with medium (>0.5) up to high factor loadings (>0.8) and a Kaiser-Meyer-Olkin measure of .803; the factors’ Cronbach’s alpha were .601 up to .834.

The results of cluster analysis strongly suggested the presence of four clusters for useful classification of consumer subgroups.

A discriminant analysis validated the results of cluster analysis: 96.7% of the cases were assigned to their correct groups.

The four clusters were labeled as follows:
Cluster 1: The Status-Oriented Skeptics
Cluster 2: The Ecology-Minded Non-Drivers
Cluster 3: The Performance-Oriented Traditionalists
Cluster 4: The Risk-Averse Drivers
## Factor Structure and Cluster Means

<table>
<thead>
<tr>
<th>Factor</th>
<th>Cronbach’s Alpha</th>
<th>Cluster 1 Means</th>
<th>Cluster 2 Means</th>
<th>Cluster 3 Means</th>
<th>Cluster 4 Means</th>
<th>F-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factor 1: Financial Risk</td>
<td>(\alpha = .705)</td>
<td>2.89</td>
<td>2.23</td>
<td>2.88</td>
<td>3.59</td>
<td>118.62</td>
<td>.000</td>
</tr>
<tr>
<td>Factor 2a: Performance Risk (Technical)</td>
<td>(\alpha = .687)</td>
<td>3.57</td>
<td>2.57</td>
<td>3.64</td>
<td>4.11</td>
<td>156.26</td>
<td>.000</td>
</tr>
<tr>
<td>Factor 2b: Performance Risk (Structural)</td>
<td>(\alpha = .669)</td>
<td>3.15</td>
<td>3.24</td>
<td>4.08</td>
<td>4.42</td>
<td>82.10</td>
<td>.000</td>
</tr>
<tr>
<td>Factor 3: Physical Risk</td>
<td>(\alpha = .834)</td>
<td>3.29</td>
<td>1.70</td>
<td>2.45</td>
<td>3.63</td>
<td>137.80</td>
<td>.000</td>
</tr>
<tr>
<td>Factor 4: Time Risk</td>
<td>(\alpha = .601)</td>
<td>3.10</td>
<td>1.64</td>
<td>2.39</td>
<td>3.32</td>
<td>138.82</td>
<td>.000</td>
</tr>
<tr>
<td>Factor 5: Social Risk</td>
<td>(\alpha = .743)</td>
<td>2.62</td>
<td>1.24</td>
<td>1.26</td>
<td>2.31</td>
<td>153.01</td>
<td>.000</td>
</tr>
<tr>
<td>Factor 6: Psychological Risk</td>
<td>(\alpha = .780)</td>
<td>2.57</td>
<td>1.60</td>
<td>2.05</td>
<td>3.40</td>
<td>156.91</td>
<td>.000</td>
</tr>
<tr>
<td>Factor 7: Overall Risk</td>
<td>(\alpha = .721)</td>
<td>3.11</td>
<td>2.23</td>
<td>3.21</td>
<td>3.87</td>
<td>148.65</td>
<td>.000</td>
</tr>
<tr>
<td>Factor 8: Car Involvement</td>
<td>(\alpha = .812)</td>
<td>3.70</td>
<td>3.22</td>
<td>3.59</td>
<td>3.99</td>
<td>11.40</td>
<td>.000</td>
</tr>
<tr>
<td>Factor 9: Ecological Awareness</td>
<td>(\alpha = .737)</td>
<td>3.50</td>
<td>3.84</td>
<td>3.20</td>
<td>3.00</td>
<td>22.99</td>
<td>.000</td>
</tr>
</tbody>
</table>
Cluster Profile No. 1: “The Status-Oriented Skeptics”

- 16.5% of the sample
- 73.1% male, 26.9% female; mean age of 32.7

More than the members of other groups, typical consumers in this cluster associate the purchase of an NGV with F5 Social Risk as evidenced by the highest ratings for “The purchase of an NGV would cause me to be thought of as being foolish by some people whose opinion I value” and “My friends would think I was just being showy”.

With reference to the dimensions, this group strongly associates time and physical risk aspects with the possible purchase of an NGV: “My purchasing an NGV makes me concerned that I could lead to an inefficient use of my time understanding the characteristics of my new car” and “I would have security concerns in the case of an accident”.

In comparison to the other dimensions, the infrastructural risk factor is not perceived to be of high importance because members of this cluster state that they would be more likely than members of the other groups to know where to refuel the vehicle.
Cluster Profile No. 2: “The Ecology-Minded Non-Drivers”

- 28.1% of the sample
- 68.1% male, 31.9% female; mean age of 31.1

Overall, this segment does not seem to be greatly excited about cars; they exhibit the lowest mean scores for car involvement as evidenced by the lowest mean ratings of all groups for “I like to speak with others about cars”.

Significantly more than members of other clusters, they show a high ecological awareness and state that “I try to travel short distances without the car to spare the environment”. As they usually do not drive a car, but prefer to use public transport via bus and train, they possess little knowledge about cars in general and NGVs in particular.

With reference to a possible purchase of an NGV, they are less risk-averse than all other groups. Taken as a whole, their answers show the lowest mean scores on all risk-related statements of all clusters. To them, the most important aspect of buying a car is: “Cars should be as eco-friendly as possible.”
Cluster Profile No. 3: “The Performance-Oriented Traditionalists”

- Cluster Profile No. 3: “The Performance-Oriented Traditionalists”
- 29.6% of the sample
- 65.5% male, 34.5% female; mean age of 31.1

More than members of cluster 1 and 2, typical consumers in this cluster associate the purchase of an NGV with infrastructural and performance risk aspects, as evidenced by highest ratings for “I would have the anxiety that I do not comfortably reach the filling stations at which I can obtain natural gas on my journeys”, “The low number of available models would deter me from the purchase” and “As I consider the purchase of an NGV, I worry whether the car will really perform as well as it is supposed to”.

Additionally, members of this segment state that “In the near future, the purchase would be connected with too many uncertainties”.
Cluster Profile No. 4: “The Risk-Averse Drivers”

- Cluster Profile No. 4: “The Risk-Averse Drivers”
- 20.0% of the sample
- 66.7 % male, 33.3% female; mean age of 32.72

This group shows the highest mean ratings for F9 Car involvement and is, more so than other clusters, interested in cars and experienced with driving; ratings for ecological awareness are the lowest of all groups. They state that “Cars are important to me” and like to speak with others about cars. Even when travelling short distances, they are not likely to take public transport, but instead drive their cars.

Taken as a whole, this group associates the possible purchase of an NGV with the most risk aspects. Highest ratings are given to the psychological risk (“The thought of purchasing an NGV causes me to experience unnecessary tension”), financial risk (“I could spend my money in a better way.”), physical risk (“I would have security concerns in the case of an accident.”), and performance risk aspects, in terms of service as well as infrastructural arguments. Respondents in this group state that they would not know where to refuel the vehicle and are concerned that the car will really perform as well as it is supposed to. Overall, members of this segment share the opinion that: “I would make a mistake with the purchase of an NGV.”
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- The results demonstrated the existence of the multidimensional origins of potential NGV resistance based upon perceived financial, social, time, performance, physical and psychological risk aspects.

- These six dimensions of risk perception form a basis for a structured understanding and categorization of potential NGV resistance consumers characterized by a different underlying (positive or negative) attitude towards risk perception.

- In sum, referring to our conceptualization and exploratory results, marketers might be able to understand why different groups of consumers do or do not respectively might or might not purchase green innovations.

- Possible to base appropriate strategies (e.g., offer wider product portfolio, cooperation to improve station infrastructure), on our empirically verified principles to improve value for different segments of consumers, who differ in their risk perception and attitude towards green innovations.
Conclusion – Managerial Implications

- Targeting and Positioning in the context of Micro-level Marketing
  - Many attempts to activate consumers to accept NGVs failed because there was no segmentation strategy.
  - Companies did not find the right arguments to convince different consumer groups.

- Reducing factors which do have an impact on risk perception – objectively and/or subjectively – on the Macro-level Marketing
  - Also social marketing campaigns of political and social institutions should clearly address the “right arguments” in view of differing target groups.
  - It needs a joint effort of all to make sure that consumers do not find “good reason” to reduce their cognitive dissonances, and to excuse their resistance to green innovations.
Conclusion – Research Implications

- Anti-consumption & Consumer Resistance Research should also take the case of refusing to buy societal relevant products into account.

- Of course, besides analyzing the resistance to buy we might also have to analyze those factors which might have a positive impact – referring to the construct of “acceptance”.

- We also will have to take social influencing behaviors into account – anti-consumption (c.f., future internet business – hacker, open source movement).

- In a next step we will have to start qualitatively to better understand the behavioral drivers relevant in the different groups. The existing cluster analysis helps to structure focus group interviews.

- After having identified the relevant driver as well as moderators we will have to start with causal modeling.

- Taking inter-cultural differences into account via data collection in multiple countries.

- Adding the perspective of multiple “consumption animosities” – product, process, company, countries …

Integrating into a concept selective anti-consumption & consumer resistance.
Thank you for your attention!

Wiedmann, Hennigs, Pankalla, Kassubek, Seegebarth

Institute of Marketing and Management, Leibniz University of Hannover
http://www.marketing.uni-hannover.de