

Hydrogen Fuel Cell Vehicles (HFCV) Adoption in the Environmental Dimension Perspectives: A Study at Middle Zone State in Malaysia

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Abstract: The aim of the study is to identify the perceptions of respondents on environmental dimensions perspectives that affected in adoption hydrogen fuel cell vehicles in Malaysia. The study was conducted at Middle Zone state in Malaysia that include Selangor State, Kuala Lumpur and Perak State with the number of respondents are 641 respondents in the various job positions that related with engineering and automobiles industries. The findings of the research shows that the environmental dimensions perspectives that consists of HFCV Internal Environmental overall total score of Selangor state, Kuala Lumpur and Perak state are 47 percent of agreement in implementation. The findings on HFCV Eco Design shows that the overall total score of items statement for Selangor state, Kuala Lumpur and Perak state are 29 percent. The findings on HFCV Environmental Organizational Culture shows that the overall total score of the items statement for Selangor state, Kuala Lumpur and Perak state are 39 percent. The overall total score for HFCV Environmental Leadership at Selangor state, Kuala Lumpur and Perak state are 41 percent of agreement and the findings on the perceptions of HFCV Environmental Performance shows that the overall total score of the items statement for Selangor state, Kuala Lumpur and Perak state are with the percentage of agreement are 35 percent.

Key words: HFCV Internal Environmental Management, HFCV Eco Design, HFCV Environmental Leadership

1. Introduction

A hydrogen fuel cell vehicle is a type of electric vehicle that uses a fuel cell instead of a battery to power the car. Hydrogen cars are basically electric cars that drive the wheels just like an electric car but the difference lies in the battery. A hydrogen fuel cell creates a chemical reaction with the hydrogen that generates electricity, water and heat. Just like an electric car, there are no harmful exhaust emissions that can affect environment. But the continuous improvement on the management and behavioural dimensions of the HFCV manufacturers and users are needed to safe and secure the environment for the long term. The initiatives of HFCV in the perspectives of

environmental dimensions that consists of HFCV internal environmental management, HFCV eco-design, HFCV environmental organizational culture, HFCV environmental leadership and HFCV environmental performance is in need to continuously care and cautions on the impact of environmental dimensions in an adoption of HFCV.

2. Literature Review

In the perspective of the environmental dimensions of the study were determined as in Table 1.

3. Methodology

3.1 The Research Objective

The research objective of the study is to identify the perceptions of the respondents on environmental

dimensions perspectives on adoption of the hydrogen fuel cell vehicles in Malaysia.

3.2 The Research Instrument and Measurement

The instrument and measurement of the questionnaire items use of “five-point Likert scale from 1 to 5” which can be seen in Table 2.

3.3 The Reliability of Environmental Dimensions

The reliability for each of the environmental dimensions is presented in Table 3.

The highest correlation coefficient of Alpha Cronbach value is HFCV environmental organizational culture with 0.902 and the lowest correlation coefficient is HFCV eco-design with 0.670 Alpha Cronbach Value.

3.4 Research Methods and Data

This study is base don data generated from a questionnaire survey. The unit of analysis in this study was the individual level at various sectors that mainly focused on the employees at the middle level of management.

3.5 Data Collection

Data was collected at middle zone state in Malaysia namely as Selangor state, Kuala Lumpur Federal Territory and Perak State and purposely selected only at the state city centre áreas of the state. Data was collected within six months from September 2015 to February 2016 as stated in Table 4.

Table 1 Literature review.

Dimensions	Description	Author
1. HFCV Internal Environmental Management	Is the practice of developing green supply chain management as a strategic organizational imperative through commitment and support of the imperative from senior and mid-level managers	Zhu Q., Sarkis J., and Lai K. H. (2007)
2. HFCV Eco Design	Manufacturers design products that minimize consumption of materials and energy that facilitate the reuse, recycle, and recovery of component materials and parts, and that avoid or reduce the use of hazardous products within the manufacturing proces	Zhu Q., Sarkis J., and Lai K. H. (2007)
3. HFCV Environmental Organizational Culture	As a symbolic context about environmental management and protection within which interpretations guide behaviors and processes of members’ sensemaking.	Chen (2011) and Chen et al. (2012)
4. HFCV Environmental Leadership	A dynamic process in which one individual influences others to contribute to the achievement of HFCV environmental management and HFCV environmental innovations	Chen (2011) and Chen et al. (2012)
5. HFCV Environmental Performance	The ability of manufacturing plants to reduce air emissions, effluent waste, and solid wastes and the ability to decrease consumption of hazardous and toxic materials.	Zhu Q., Sarkis J., and Lai K. H. (2007)

Table 2 The rating constructs in this study.

Measurement	Scales
1. HFCV Internal Environmental Management Adopted (Source: Zhu Q., Sarkis J., and Lai K. H. (2007) and revised the items to suit with the study requirement.	Five-point scale (1. not considering it; 2. planning to consider it; 3. considering it currently; 4. initiating implementation; 5. implementing successfully)
2. HFCV Eco Design Adopted (Source: Zhu Q., Sarkis J., and Lai K. H. (2007) and revised the items to suit with the study requirement.	Five-point scale (1. not considering it; 2. planning to consider it; 3. considering it currently; 4. initiating implementation; 5. implementing successfully)
3. HFCV Environmental Organizational Culture Adopted (Source: Chen, 2011, Chen et al., 2012) and revised the items to suit with the study requirement.	Five point Likert scale (1 – strongly disagree to 5 – Strongly agree)
4. HFCV Environmental Leadership Adopted (Source: Chen, 2011, Chen et al. 2012) and revised the items to suit with the study requirement.	Five point Likert scale (1 – strongly disagree to 5 – Strongly agree)
5. HFCV Environmental Performance Adopted (Source: Zhu Q., Sarkis J., and Lai K. H. (2007) and revised the items to suit with the study requirement.	Five point scale (1. not at all; 2. a little bit; 3. to some degree; 4. relatively significant; 5. Significant)

Table 3 Internal coefficient alphas for environmental dimensions.

Environmental Dimensions	No of Items	Alpha Cronbach Value
1. HFCV Internal Environmental Management	4	0.765
2. HFCV Eco Design	3	0.670
3. HFCV Environmental Organizational Culture	4	0.902
4. HFCV Environmental Leadership	4	0.790
5. HFCV Environmental Performance	9	0.677

Table 4 Data collected.

Middle zone state	City Centre	Duration
Selangor	Shah Alam	1.5 month
Kuala Lumpur Federal Territory	Kuala Lumpur City Centre	2.5 month
Perak	Ipoh	2 month

4. Research Findings

The result findings were presented accordingly based on the following:

4.1 Demographic Profile

The demographic profile of the respondents were total up 641 respondents with various job title as in Table 5.

The majority of the demographic profile of respondents in middle zone state in Malaysia as presented in Table 6. It shows that the majority of gender of the respondents are male with the total numbers are 102 male respondents. At the education level, the Diploma/Degree qualification are the

majority of education level with the total of respondents of 88 respondents.

Table 5 Respondent demographic profile in middle zone state, Malaysia.

Job Title	Number
Transportation equipment employees	79
Automobiles Operational employees	60
Car and service employees	80
Metal factory worker employees	57
Sales and Manufacturing employees	50
Engineering workers	48
Government employees	61
Students at higher level education	52
Private companies employees	48
Executives and Administrative employees	58
Publics from various job positions	48
Total	641

Table 6 The demography profile of respondents.

Demographic Categories	Category	Selangor State (Shah Alam)	Kuala Lumpur City Centre	Perak State (Ipoh)
Gender	Male	75	20	12
Citizen	Citizen	Malaysian	Malaysian	Malaysian
Age	31- 45 Years	45	22	17
Race	Malay	25	29	19
Religion	Muslim	44	30	17
Education Level	Diploma/Degree	32	45	11
Work Experience	5-15 years	25	35	18
Monthly Income	RM 1,001 – RM 5,000	42	20	15

4.2 Section B: The Findings of the Environmental Variables

The findings of the perceptions on the environmental

variables are presented as follows:

4.2.1 HFCV Internal Environmental Management

The findings on perceptions of HFCV Internal Environmental Management is shown in Table 7.

The findings on perceptions of HFCV Internal Environmental Management shows that the average total score of the items statement is 45.5 percent for Shah Alam, 50.5 percent for KL City Center and Ipoh 45 percent.

4.2.2 HFCV Eco Design

The findings on perceptions of HFCV Eco Design is shown in Table 8.

The findings on perceptions of HFCV Eco Design shows that the average total score of items statement for Selangor state is 30 percent, Kuala Lumpur is 32 percent and Perak state is 26 percent.

4.2.3 HFCV Environmental Organizational Culture

The findings on perceptions of HFCV Environmental Organizational Culture is shown in Table 9.

The findings on perceptions of HFCV Environmental Organizational Culture shows that the average total score of the items statement in Selangor State is 40 percent, KL City Centre is 42 percent and Perak State is 34 percent.

4.2.4 HFCV Environmental Leadership

The findings on perceptions of HFCV Environmental Leadership is shown in Table 10.

Table 7 The perception of agreement on implementation of HFCV internal environmental management.

HFCV Internal Environmental Management	% of Agreement on Implementation		
Items Statement	Shah Alam %	KL City Centre %	Perak State (Ipoh) %
Commitment and support of HFCV environmental practices from top management towards	34	45	33
HFCV Environment Total Quality Management	49	51	60
HFCV Environmental compliance and auditing program	56	50	32
HFCV Environmental Program Systems	43	56	54
Average Total Score	45.5	50.5	45

Table 8 The perception of HFCV eco design.

HFCV Eco Design	% of Agreement on Implementation		
Items Statement	Shah Alam %	KL City Centre %	Perak State (Ipoh)%
Design of HFCV for reduced consumption of material/energy	34	30	22
Design of HFCV for reuse, recycle, recovery of material and/or component parts	32	34	34
Design of HFCV to avoid or reduce use of hazardous and/or their manufacturing process	25	31	23
Average Total Score	30	32	26

Table 9 The perception of HFCV environmental organizational culture.

HFCV Environmental Organizational Culture	% of Agreement		
Items Statement	Shah Alam %	KL City Centre %	Perak State (Ipoh) %
The company concerns the knowledge of environmental management and protection of HFCV	43	45	32
The company concerns the collaboration of environmental management and protection of HFCV	44	38	37
The company concerns of environmental agreements of HFCV	43	45	32
The company concerns of the responsiveness of environmental management and protection of HFCV	31	38	35
Average Total Score	40	42	34

Table 10 The perception of HFCV environmental leadership.

HFCV Environmental Leadership Items Statement	% of Agreement		
	Shah Alam %	K. Lumpur City Centre %	Perak State (Ipoh) %
The leaders within the company inspire a shared vision of the organization as environmentally sustainable, creating or maintaining green values throughout the company	45	49	41
The leaders within the company utilize well-developed approaches to environmental management which generally centre around a program customized to the company's specific business and market	32	45	40
The leaders within the company create partnerships with the company's stakeholders to solve environmental problems and to accomplish environmental goals	49	32	29
The leaders within the company can take on the responsibility of environmental education with the intent of engaging employees in environmental management initiatives	43	48	41
Average Total Score	42	43.5	38

The findings on perceptions on HFCV Environmental Leadership shows that average total score of the items statement in Shah Alam, Selangor is 42 percent, KL City Centre is 43.5 percent and Ipoh, Perak is 38 percent.

4.2.5 HFCV Environmental Performance

The findings on perceptions on HFCV

Environmental Performance are shown in Table 11.

The findings on perceptions of HFCV Environmental Performance shows that the average total score of the items statement in Shah Alam, Selangor State is 37 percent, KL City Centre 36 percent and Ipoh, Perak State is 33 percent.

Table 11 The perception of HFCV environmental performance.

HFCV Environmental Performance Items Statement	% of Agreement on Significant		
	Selangor State (Shah Alam) %	K.Lumpur (%)	Perak State (Ipoh) %
Reduction of air emission	45	52	29
Reduction of effluent waste	32	43	32
Reduction of solid waste	39	41	33
Decrease in consumption for hazardous/harmful/toxic materials	41	55	41
Decrease in frequency for environmental accidents	28	21	32
Improvement in and environmental situation	43	42	45
Reduction of Water and land contamination	41	34	33
Reduction of Air and noise pollution	47	32	44
Reduction of Waste management	51	41	40
Average Total Score	37	36	33

5. Recommendation and Conclusions

Based on the study findings, the following recommendations to strengthen the environmental

impact positively towards the adoption of HFCV are as in Table 12.

Table 12 Findings and recommendations.

Findings	Recommendation
HFCV Internal Environmental Management shows that the average total score of the items statement is 45.5 percent for Shah Alam, 50.5 percent for KL City Center and Ipoh 45 percent.	Implementation of IT in Internal Environmental
HFCV Eco Design shows that the average total score of items statement for Selangor state is 30 percent, Kuala Lumpur is 32 percent and Perak state is 26 percent.	Increased Eco Design materials
HFCV Environmental Organizational Culture shows that the average total score of the items statement in Selangor State is 40 percent, KL City Centre is 42 percent and Perak State is 34 percent.	Strengthen Environmental Culture
HFCV Environmental Leadership shows that average total score of the items statement in Shah Alam, Selangor is 42 percent, K1 City Centre is 43.5 percent and Ipoh, Perak is 38 percent.	Building the leadership skills and effectiveness
HFCV Environmental Performance shows that the average total score of the items statement in Shah Alam, Selangor State is 37 percent, KL City Centre 36 percent and Ipoh, Perak State is 33 percent.	Desire to improve environmental performance

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