Faculty of Technology Management and Technopreneurship

THE CHALLENGES OF ELECTRIC BUS IMPLEMENTATION IN MELAKA

Husnul Laili Binti A Rahman

Master of Science in Technology Management

2024

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HUSNUL LAILI BINTI A RAHMAN

A thesis submitted
in fulfillment of the requirements for the degree of Master of Science in Technology Management

Faculty of Technology Management and Technopreneurship

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2024

DEDICATION

This thesis is special dedicated to:

My beloved parents Mr. A Rahman Bin Hj Hasim and Mdm. Sri Hani Binti Sardi,

My beloved husband Mr. Nur Izwan Bin Zakaria,

My dearest family and friends for their loves, endless support, encouragement, attention and prayers.

ABSTRACT

The implementation of green technology on road been drive a roadmap towards sustainable transportation agenda in urban and suburban areas. The Government State of Melaka through its aspiration supporting the National Policy aimed to become the green and clean city with the adoption of electric bus as green fleet technology in public transportation. The electric bus is a battery powered vehicles which emit no pollution, quiet and energy efficiency is suitable to be adopt as a main public transportation in urban area. However, Malaysia is lagging behind from the developed countries like China, Europe, US and South Korea in aspect of electric bus revolution implementation for public transportation. Corresponding from that, even though the EV industry in Malaysia is has just started, the EV adoption is noticeable still slow being implemented and use on road especially in public transportation. In this research where the case study took place in Melaka, the problem arise is when by the end of 2015 Government State of Melaka should receive a total of 40 electric buses on road but unfortunately until year 2018 the amount of electric bus should be on road is noticeable still not achievable. Therefore, this research is an attempt to acknowledge the problem arise by focusing on the study the challenges arise in adopting electric bus and to identify the strategies involved to overcome the challenges in electric bus adoption. In this study, the researcher pointed out the major challenges in electric bus adoption including high battery concern, high impact on grid, high cost, limited technical performance, consumer attitudes and motivation and limited number of charging infrastructure. In coherent with these challenges, the researcher also encountered with the strategies to overcome the challenges in electric bus adoption that highlighted on the battery-switching stations, connectivity to smart grid, government stimulus, on-board intelligent transportation system for battery management, awareness raising campaign and build more charging station. In order to achieve the research objectives, the qualitative data collection method is being used was applied in semi-structured interview session within 15 respondents from selected organizations by using open-ended questions as a guideline. In coherent with this, the four organizations were selected as respondents consist of Panorama Melaka Sdn. Bhd., Perbadanan Teknologi Hijau Melaka (PTHM), Malaysian Industry Government Group for High Technology (MIGHT) and AMDAC Sdn. Bhd. The explanation building also was used as the method of analysis in this research. On the whole, the researcher also proposed a framework in implementation of electric bus in Melaka as a contribution of this research that will beneficial to the academician, policy maker, R&D companies and industries which it can be widely spread and enlarge the application of green technology like electric bus in public transportation on road.

CABARAN PELAKSANAAN BAS ELEKTRIK DI MELAKA

ABSTRAK

Pelaksanaan kenderaan berteknologi hijau di jalan raya telah memacu hala tuju ke arah agenda pengangkutan yang mampan di kawasan bandar dan pinggir bandar. Kerajaan Negeri Melaka melalui aspirasinya menyokong Dasar Nasional yang bertujuan untuk menjadikan bandar hijau dan bersih dengan penggunaan bas elektrik sebagai kenderaan teknologi hijau dalam pengangkutan awam. Bas elektrik adalah kenderaan berkuasa bateri yang tidak mengeluarkan pencemaran, senyap dan memiliki kecekapan tenaga yang sesuai untuk digunakan sebagai pengangkutan awam utama di kawasan bandar. Walau bagaimanapun, Malaysia ketinggalan dari negara-negara maju seperti China, Eropah, AS dan Korea Selatan dalam aspek pelaksanaan revolusi bas elektrik untuk pengangkutan awam. Seiring dengan itu, meskipun industri EV di Malaysia baru sahaja bermula, penggunaan EV itu masih ketara perlahan dilaksanakan dan digunakan di jalan raya terutamanya dalam pengangkutan awam. Dalam kajian ini di mana kajian kes berlaku di Melaka, masalah yang timbul ialah apabila menjelang akhir tahun 2015 Kerajaan Negeri Melaka sepatutnya menerima sejumlah 40 bas elektrik di jalan raya tetapi malangnya sehingga tahun 2018 jumlah bas elektrik tersebut yang berada di atas jalan kelihatannya masih belum dapat dicapai. Oleh itu, kajian ini merupakan usaha untuk mengenal pasti masalah yang timbul dengan memberi fokus kajian kepada cabaran-cabaran yang timbul dalam penggunaan bas elektrik dan mengenal pasti strategi-strategi yang terlibat untuk mengatasi cabaran dalam penggunaan bas elektrik tersebut. Dalam kajian ini, penyelidik menunjukkan cabaran utama dalam penggunaan bas elektrik termasuklah kebimbangan bateri yang tinggi, kesan yang tinggi terhadap grid, kos yang tinggi, prestasi teknikal yang terhad, sikap pengguna dan motivasi serta bilangan pengecasan infrastruktur yang terhad. Kesinambungan daripada cabaran-cabaran ini, penyelidik juga menemui strategi untuk mengatasi cabaran-cabaran dalam penggunaan bas elektrik yang menekankan kepada stesen pemindah bateri, sambungan ke grid pintar, rangsangan kerajaan, sistem pengangkutan pintar ke atas pengurusan bateri, kempen peningkatan kesedaran dan membina lebih banyak stesen pengecasan. Untuk mencapai objektif-objektif kajian, kaedah pengumpulan data kualitatif telah digunakan dalam sesi temu bual separuh berstruktur bersama 15 responden dari organisasi yang terpilih dengan menggunakan soalan terbuka sebagai panduan. Oleh itu, empat organisasi dipilih sebagai responden yang terdiri daripada Panorama Melaka Sdn. Bhd., Perbadanan Teknologi Hijau Melaka (PTHM), Kumpulan Industri Kerajaan Malaysia untuk Teknologi Tinggi (MIGHT) dan AMDAC Sdn. Bhd. Pembinaan penjelasan juga digunakan sebagai kaedah analisis dalam kajian ini. Secara keseluruhannya, penyelidik juga mencadangkan satu rangka kerja bagi pelaksanaan bas elektrik di Melaka sebagai sumbangan penyelidikan yang akan memberi manfaat kepada ahli akademik, pembuat dasar, syarikat R&D dan industri yang dapat menyebar luas dan memperbanyakkan penggunaan teknologi hijau seperti bas elektrik di dalam pengangkutan awam di jalan raya.

ACKNOWLEDGEMENTS

In the name of Allah, the Compassionate, the Merciful, Praise be to Allah, Lord of the Universe, and Peace and Prayers be upon His Prophet and Messenger. With Grace and Blessing from Allah, I have succeeded in completing my thesis for the degree of Master of Science in Technology Management. First and foremost, Alhamdulillah, all praises to Allah for the Strengths and His Blessing, I have succeeded in completing this thesis. To whom I am forever indebted, my deepest gratitude goes to my beloved parents, Mr. A Rahman bin Hashim and Mdm. Sri Hani Binti Sardi and my loving brother, Mohd Maaruf Bin A Rahman for their endless love, prayers, care, encouragement, moral support and not forgotten whenever I am in need for financial assistance, they always be there throughout my journey. To my beloved husband, Mr. Nur Izwan Bin Zakaria thank you for your love and prayers.

Special appreciation also goes to my supportive supervisor, Associate Professor Ts. Dr. Chew Boon Cheong for his supervision and constant support during performing this thesis. His invaluable help of constructive comments and suggestions throughout this thesis works have contributed a lot to the success of this research. Not forgotten, I would like to express my appreciation to my beloved research mates, Siti Aishah Binti Ramli for her infinity moral support, motivation, kindness and commitment helped me completing this thesis successfully. The struggle is super real in completing this thesis but she always holds me up to keep in strong and remind me this journey will be a wonderful thing to go through with.

I am also obliged thanks to all my respondents by giving so much opportunities and cooperation during the data collection process. Last but not least, to whoever had directly or indirectly involved in my research including my senior and friends I would like to send my appreciation for your contribution ideas and support, your kindness mean a lot to me. I will always remember all your good deeds and may Allah repay all your kindness and good deeds that you already done to me in future. Thank you very much.

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LIST OF ABBREVIATIONS

AC	-	Alternating Current
Amps	-	Ampere/Unit of Current
BC	-	Bidirectional Charger
BRT	-	Bus Rapid Transit
BYD	-	Build Your Dream Company
DC	-	Direct Current
EV	-	Electric Vehicle
EEE	-	Environment, Economy and Equity or Inclusive Growth
GHG	-	Greenhouse Gases
ITS	-	Intelligent Transportation System
ICE	-	Internal Combustion Engine
kWh	-	Kilowatt Hour
kV	-	Kilovolt
MIGHT	-	Malaysian Industry-Government Group for High Technology
PEV	-	Plug in Vehicles
PTHM	-	Perbadanan Teknologi Hijau Melaka
SOC	-	State of Charge
ROI	-	Return on Investment
TNB	-	Tenaga Nasional Berhad
TPB	-	Theory of Planned Behavior
UC	-	Unidirectional Charger

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LIST OF PUBLICATION

Rahman, H.L.A., Cheong, C.B., Saptari, A., Azmi, F.R. and Roni, M., 2024. The Challenges in Adopting Electric Buses: A Case from Melaka, Malaysia. *Information Management and Business Review*, 16(3 (I)), pp.182-188.

CHAPTER 1

INTRODUCTION

1.1 Introduction

Positioning Malaysia as progressive nation in low carbon mobility and environmental sustainability embark towards the objective to be known as "Electric Mobility Marketplace" by 2020. The urban transportation trends of developed and developing countries is moving towards sustainable transport system. This interrelated with expanding the focused to the public transportation system too in order to achieve the sustainable solution. By shifting towards more sustainable modes of transport like public and non-motorized transport significantly plays an indispensable role to make the cities livable and less polluted (Mukhametdinov et al., 2017). However, there are few key challenges that in need to be identify while integrate the approach towards sustainable public transport system especially in Melaka.

In line to pursue the growth of sustainable public transport system, the contribution of this research is enlighten to propose a framework in electric bus implementation in Melaka City State. Therefore, in exploring this research the researcher has outlines through seven sections. Section 1.1 is elaborate the background of the study. Section 1.2 is briefing on the problem arise of this research. Whereas the section 1.3 come out with the research questions of this research. Based on the research questions, this research drive towards three research

objective that need to be achieve as been mentioned in section 1.4. Next, in section 1.5 is outline the scope and limitation of this research. The section 1.6 is points out the research significance of this research. Finally, in section 1.7 the summary of the whole work in this chapter.

1.2 Background of study

The introduction of energy efficient vehicle (EEV) use on road ultimately to support the National Automotive Policy (NAP) 2014 to make Malaysia a regional EEV hub by 2022. This happened is due to in line with promoting the EEV initiative in Malaysia as it has benefited to both consumer and environment also it contribute to the development of EEVs in Malaysia (Bernama, 2017). Furthermore, encouraging the adoption of EEV can contribute to minimizing the impact on the environment including reducing dependency on fossil fuel and fuel wastage besides emit emission of harmful gases and black smoke. This have been mentioned in 11th Malaysia Plan where the government will work with relevant private agencies to increase adoption of EEVs especially for public transport like buses and taxis (The Eleventh Malaysia Plan Blueprint, 2015).

The usage of EEVs on road is a complement to the initiative of Melaka Government State who firstly introduced the use of electric bus as public transportation real operated on road starting mid-August 2015. Melaka was declared as developed state by using Organization for Economic Cooperation and Development (OECD) Indicators by 6th Malaysia Prime Minister YB Dato' Seri Najib Abd Razak in year 2010. Whereas in year 2011, Melaka establish as Green Technology Council and one of their objectives is to plan and monitor the green technology development and application in the state. Since Melaka is known as Green City State, the Green City Action Plan (GCAP) was produced in 2014.

Therefore, by operating electric bus to access around heritage area which been recognize as tourist spot area is one of the short term plan in prepare a comprehensive transportation plan that related to the tourism activities in Melaka (Green City Action Plan Framework, 2014).

Moreover, the implementation of electric bus as public transportation is one of the effort of Melaka government state to going green and at the same time improving the mass public transport system for tourist and local residents. This is due to Melaka is a perfect city for testing electric buses because it is a historic city with a 500 year old building and with the purpose not to coat these building with soot and sulphuric acid (Yusof, 2015). Other than that, by operating electric bus on road it encourage the implementation of sustainable public transport planning that will bring beneficial impact towards community and environment as the whole. This is because the electric bus is quiet, exhaust emission-free, less noisy vehicles and more energy-efficient than conventional diesel-powered buses. John (2015) highlight that this electric bus was meant to deliver environmentally friendly fleet that reduced the carbon emission, improved air quality and lowered pollution because it is powered by nine lithium iron phosphate batteries.

However, meanwhile moving towards sustainable public transport planning the government state of Melaka will face a few challenges to integrate towards sustainable solution. Ariffin and Zahari (2013) believes that some well-intended policies have been formulated and implemented to rectify transportation problems in the area, but, they do not indicate the trend towards achieving sustainable transport agenda. Therefore, this research in need to study the challenges in adopting electric bus and identify the strategies involved to overcome the challenges in electric bus adoption in Melaka.

1.3 Problem statement

In aspect of electric bus revolution implementation in public transportation, Malaysia is lagging behind from the other developed countries like China, Europe, US, and South Korea. This is because according to report by India Smart Grid Forum (2018), there are 16359 electric buses in operation in Shenzhen City, China whereas there were 956 electric buses in entire Europe and less than 500 in entire United States. However, in Malaysia this EV industry has just started but the EV adoption is noticeable still slow being implemented and use on road especially in public transportation. Besides that, there is a huge amount of EV been targeted to operate on the road by 2020 but this EV still not widely implemented in Malaysia even though the 6th Malaysia Prime Minister YB Dato' Seri Najib Abd Razak already launched the National Automotive Policy (NAP) and the National Green Technology Policy on 24th July 2009 that emphasize to the development and promotion of green vehicles. Subsequently Malaysia been targeted for 100,000 electric cars and 2,000 electric buses on the road by 2020 (Salehen et al., 2017).

In this research where the case study took place in Melaka, John (2015) highlighted that Melaka Government State become the pioneer state in the country using the electric buses on public roads and it would receive a total of 40 electric buses by the end of 2015. Moreover, since February 2016, there are two 'hop on hop off' green technology electric buses had been operating around the Unesco World Heritage Site in Bandar Hilir, Melaka (Bernama, 2016). Besides that, Xavier (2017) emphasize that Melaka is moving towards green technology where it received the first two electric buses which being used to enhanced the tourist transportation and more electric buses were received at the end of 2015. However, in year 2017 as Melaka wants to introduce more sustainable transport options, this city is still boasts with the only two electric buses used real operated on road and the other 38

electric buses should be receive and operated on road by Government State of Melaka in the end of 2015 is noticeable still not achievable. Furthermore, based on the statement of GM Panorama Melaka Sdn. Bhd., Abu Bakar, on the electric stage bus service which had been suspended two months ago, the company had sought the services of a technical group from China to address the problem (The Star, 2018). Therefore, referring to this statement, the researcher identified the challenges arise to bring in more electric buses to Melaka City that encompasses towards the challenges of high battery concern, high impact on grid, high cost, limited technical performance, consumer attitudes and motivation also the limited number of charging infrastructure.

This research begins it explorations with focus to the study on the challenges in adopting electric bus and the strategies involved to overcome the challenges in adopting electric bus possessing towards the sustainable public transport planning. Hence, this research can be a guideline to the Government State of Melaka to address and look into the challenges arise and strategies involved in order to support its successfulness of implementation electric bus towards sustainable public transport planning agenda in Melaka.

1.4 Research question

Based on the problem arise in adopting electric bus, it emphasizes on the three research questions that involved in the challenges, the strategies to overcome the challenges and the contribution in proposed framework of implementing electric bus.

The research questions arise is:

i. What are the challenges of adopting electric by Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd.?

ii. What are the strategies to overcome the challenges in adoption electric bus by Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd.?

iii. How far the proposed framework could contribute empirically to Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd. for adoption of electric bus in Melaka?

1.5 Research objective

The primary objective of this research is to study the challenges and the way of Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd. overcome the challenges in adoption of electric bus in order to sustain the public transport planning in Melaka.

Based on three research questions, three research objectives are formatted:

i. To study the challenges of adopting electric bus by Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd.

ii. To identify the strategies involve in order to overcome the challenges in adoption of electric bus by Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd.

iii. To proposed a framework for electric bus implementation in Melaka.

1.6 Scope and limitation of the study

The research scope of this project is focuses in green and sustainable practices. Firstly, the researcher needs to study the challenges in adopting electric bus by Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd. towards sustainable public transport planning in Melaka. Secondly, the research scope is focuses on identifying the

strategies involve to overcome the challenges in adoption of electric bus by Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd. The researcher seeks to conduct the research in the Melaka Green City State at Panorama Melaka Sdn. Bhd. and PTHM and at the same time the researcher also conducts an interview with a few organizations that directly involve in this electric bus adoption project that is MIGHT and AMDAC Sdn. Bhd. where its base in Cyberjaya and Kuala Lumpur to gain adequate and comprehensive information.

There are two limitations are identified while conducting this study. Firstly, the cases study is conducted in Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd. which it can be generalized on the similar industry only. Secondly, the cases study is only assumed the respondents to give the honest answer during interview session and the respondents do not have an adequate knowledge regarding adoption electric bus for sustainable public transport planning in Melaka.

1.7 Research significance

This research is important and beneficial towards three party after conducting the cases study. Firstly, this study is beneficial towards practitioner and academician. This study is significance for practitioner and academician to conduct more in-depth analysis regarding the phenomenon of green transportation on road. In addition, the researcher believes that with the construction of new proposed framework it can lead the practitioner and academician make more R&D and innovation for future improvement while conducting the other application of EV in public transportation on road such as the usage of hydrogen bus, hybrid bus or solar bus that real operated on road.

Moreover, the research significance also important towards the industries. This is because the findings of this study will attract and open opportunities among companies in the growth of development EV industry in Malaysia. The proposed framework will be benefit towards these EV companies in industry which they can be a pioneer in manufacturing companies especially in supplying the electric bus mechanical parts like battery, motor and chassis to the marketplace. Hence, with the establishment of this EV companies in the industry it shows the growth and competencies in EV and automotive industry which can avoid the government from importing EV such as electric bus from abroad.

Finally, this study is also significance to the four stakeholders which is Panorama Melaka Sdn. Bhd., Perbadanan Teknologi Hijau Melaka (PTHM), Malaysian Industry-Government Group for High Technology (MIGHT), and AMDAC Sdn. Bhd. Based on the selection of organizations, this study will be able to provide a different perspective in between each of executing body who responsible with overall operation of electric bus on road in Melaka. Besides, the proposed framework that contributed by the researcher can be a guideline and reference to the Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd. to make improvement in handling green transportation and enlarge the number of green transportation for future sustainable public transport planning in Melaka and Malaysia as the whole. Thus, this study is significance to this four stakeholder to measure their successfulness of implementation electric bus operation in Melaka

1.8 Summary

First and the foremost, in support of National Automotive Policy (NAP) 2014 the usage of EEVs on road is a complement to the initiative of Melaka Government State who

firstly introduced the use of electric bus as a main public transportation to sustain public transport planning in Melaka Green City State. The problem arises when in aspect of electric bus revolution implementation in public transportation, Malaysia is lagging behind from the other developed countries like China, Europe, US and South Korea. However, the EV adoption is noticeable still slow being implemented and use on road even though this EV industry has just started in Malaysia. In line with the slow process of EV adoption in Malaysia, Melaka Government State become the pioneer state in the country using the electric buses on public roads and it would receive a total of 40 electric buses by the end of 2015. However in 2017, this city is still boasts with the only two electric buses used real operated on road since 2015 and the other 38 electric buses should be receive by Government State of Melaka in the end 2015 is noticeable still not achievable. Therefore, this research begin its explorations with focus to study on the challenges in adopting electric bus and the strategies involve to overcome the challenges in adopting electric bus possessing towards the sustainable public transport planning in Melaka.

The objective of this study is comprises to study the challenges in adoption of electric bus by Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd., to identify the strategies involve in order to overcome the challenges in adopting electric bus by Panorama Melaka Sdn. Bhd., PTHM, MIGHT and AMDAC Sdn. Bhd. and to proposed a framework for electric bus implementation towards sustainable public transport planning in Melaka. The research scope of this cases study is focus in green and sustainable practices. Therefore, the study is conducted in Melaka at Panorama Melaka Sdn. Bhd. and Perbadanan Teknologi Hijau Melaka (PTHM) and at the same time the researcher seeks information on Malaysian Industry-Government Group for High Technoloy (MIGHT) and AMDAC Sdn.

Bhd. that base in Cyberjaya and Kuala Lumpur to gain sufficient and comprehensive information.

Besides that, the limitation of this cases study is this research could not be generalized on the similar industry and only assumed the respondents give the honest answer also at the same time the respondents only have an adequate knowledge regarding adoption of electric bus for sustainable public transport planning in Melaka while conducting the interview session. Lastly, this research significance is important and beneficial towards three party that is practitioner and academician, industries and four stakeholder involve that is Panorama Melaka Sdn. Bhd., PTHM, MIGHT, and AMDAC Sdn. Bhd.