

AN ASSESSMENT TOWARDS ESTABLISHMENT OF A POLICY
FRAMEWORK FOR MALAYSIA'S SPACE SECTOR DEVELOPMENT

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AN ASSESSMENT TOWARDS ESTABLISHMENT OF A POLICY
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DEDICATION

This thesis is dedicated to my mother, who plays a very significant role in every success that ever happened in my life.

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In preparing this thesis, I was in contact with many people, researchers, academicians, and practitioners. They have contributed towards my understanding and thoughts. In particular, I wish to express my utmost appreciation to my main thesis supervisor, Professor Dr. Mustafa Din bin Subari, for encouragement, guidance, critics and friendship. Without his continued support and interest, this thesis would not have been the same as presented here.

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ABSTRACT

Space sector is a part of key area that will contribute to the sustainable development of a nation. It is significant to the country's economic activities, adaptation to the emerging technologies and the well-being of humanity. As a developing country and is moving forward to become a developed nation, Malaysia has to look for a right approach to venture and sustain in its space endeavor. Thus, the main aim of this research is to explore and identify a set of guiding principles that could be the backbone for Malaysia's space sector development. This framework should suit the country's need and limitation to make the space sector sustains and eventually returns a huge benefit to the nation. Currently there is no policy framework yet to guide Malaysia on its space sector development, despite there is an increasing need for it. This research adopted a mixed-methods approach. A questionnaire survey of 100 respondents with space related background was done for the quantitative study while a semi structured interviews with 10 space expert respondents who had significant role in the past and current Malaysia's space endeavor was successfully carried out for the qualitative study. The quantitative data was analysed by using SPSS and the qualitative data was analysed by using framework analysis with the assistance of Computer Assisted Qualitative Data Analysis Software (CAQDAS). From the literature review on the documents that are related to the national space policy in Canada, Australia and Japan, it was discovered that there are at least 13 area of interests that were identified as the backbone to these respective countries' policy framework in their space sectors. These 13 areas of interest have been embedded into the survey questions and further narrowed down into 7 main areas of interests that eventually form up the interview questions. This study has managed to come out with five guiding principles for Malaysia's space sector development policy framework based on the inductive approach that was adopted during the interview sessions. The five guiding principles are; to drive the nation's economic growth, viable and cost-effective development, complete ecosystem of capacity building, clear action plan and regulation and public enculturation. This final set of principles could contribute significantly towards the constitution of Malaysia's space sector development policy framework and at the same time addressing the limitation that may hinder the nation's progress in this strategic sector.

ABSTRAK

Teknologi angkasa merupakan salah satu faktor utama yang menyumbang ke arah pembangunan mapan sesebuah negara. Ia amat signifikan kepada aktiviti ekonomi, adaptasi teknologi baharu dan seterusnya menjamin kehidupan sejahtera rakyat. Sebagai negara membangun yang giat menuju ke arah status negara maju, Malaysia perlu melihat pendekatan terbaik dalam meneroka sektor angkasa dan konsisten dalam usaha tersebut. Oleh itu, tujuan utama kajian ini adalah mengkaji dan mencadangkan teras panduan bagi kerangka dasar pembangunan sektor angkasa negara. Kerangka dasar ini perlu sesuai dengan keperluan dan kekangan negara bagi memastikan sektor angkasa kekal relevan dan seterusnya memberi pulangan yang besar kepada negara. Ketika ini tiada lagi kerangka dasar bagi memandu Malaysia dalam pembangunan sektor angkasa, walaupun keperluan untuk negara mempunyai kerangka dasar ini semakin meningkat. Kajian ini menggunakan kaedah gabungan iaitu kajian kuantitatif berdasarkan set soalan yang diedarkan kepada 100 orang responden berlatarbelakangkan sektor angkasa dan kajian kualitatif berdasarkan temu bual separa berstruktur terhadap 10 orang individu yang mempunyai peranan signifikan dalam pembangunan sektor angkasa negara. Data kuantitatif dianalisis menggunakan perisian *Statistical Package for the Social Science* (SPSS) dan data kualitatif dianalisis menggunakan kaedah analisis kerangka dengan bantuan *Computer Assisted Qualitative Data Analysis Software* (CAQDAS). Berdasarkan sorotan kajian terhadap kerangka dasar berkaitan sektor angkasa di Kanada, Australia, dan Jepun didapati terdapat sekurang-kurangnya 13 tema yang menyumbang kepada pembentukan teras panduan bagi kerangka dasar tersebut. Tiga belas tema ini telah dijadikan panduan dalam kajian kuantitatif dan seterusnya difokuskan kepada tujuh tema utama dalam pembentukan soalan temu bual bagi kajian kualitatif. Akhirnya, kajian ini berjaya menghasilkan lima teras panduan bagi kerangka dasar pembangunan sektor angkasa negara berdasarkan pendekatan induktif yang diterapkan semasa sesi temu bual tersebut. Lima teras panduan tersebut adalah memacu pertumbuhan ekonomi negara, pembangunan yang kos efektif dan berdaya maju, ekosistem pembangunan kapasiti yang lengkap, pelan tindakan dan peraturan yang jelas serta pembudayaan masyarakat. Kelima-lima teras panduan ini dilihat berupaya menyumbang secara signifikan ke arah penggubalan kerangka dasar pembangunan sektor angkasa negara dan seterusnya membantu mengatasi kekangan yang menghalang pembangunan sektor yang strategik ini.

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Development Policy Framework

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LIST OF ABBREVIATIONS

ANGKASA	-	Agensi Angkasa Negara
BAKSA	-	Space Science Studies Division
CAQDAS	-	Computer Assisted Qualitative Data Analysis Software
DOS	-	Department of Space
EOS	-	Earth Observation Satellite
GDP	-	Gross Domestic Product
GEO	-	Geostationary Orbit
GPS	-	Global Positioning System
HCOC	-	The Hague Code of Conduct Against Ballistic Missile Proliferation
KAIST	-	Korea Advanced Institute of Science and Technology
KARI	-	Korea Aerospace Research Institute
LEO	-	Low Earth orbit
MACSat	-	Medium-Sized Aperture Camera Satellite
MEASAT	-	Particle Swarm Optimization
MTCR	-	Missile Technology Control Regime
NGO	-	Non-Governmental Association
PPP	-	Purchasing power parity
QDDR	-	Quadrennial Diplomacy and Development Review
SPSS	-	Statistical Package for Social Sciences
SSO	-	Sun Synchronous Orbit
UCS	-	The Union of Concerned Scientists
UNCOPOUS	-	United Nations Committee on the Peaceful Uses of Outer Space
UNOOSA	-	The United Nations Office for Outer Space Affairs

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CHAPTER 1

INTRODUCTION

1.1 Chapter Overview

The introductory chapter outlining the background of the research topic and describes the problem statements that motivate this research. It then moves to specify the objectives of the study and enlist the research questions. It will be then followed by a description of the significance of the study and the conclusion of the chapter.

1.2 Background to the Research

1.2.1 Space In Modern Era

Living in this modern world, many of our daily technology usage are either directly depending on or at least somewhat related with outer space. On the daily basis, civilian uses satellite navigation system such as Global Positioning System (GPS) to guide their way, communication satellite to watch a live telecast show on their flat screen television, and relying on a weather forecast to assist scheduling their activities. All of these are examples of downstream space applications apart from the more complex usage of the space technology normally used by the military or government intelligence such as reconnaissance satellite and applications used by the government to monitor land, sea, and state's border.

Therefore, space programs and technologies expansion related to it are becoming a fundamental part of the strategic and developmental policies of many

relatively wealthy developing states. The motivation for the countries to involve in space is one of the efforts to elevate their international status, security, and economic future (Harding, 2013). This strategic initiative has long been adopted by the wealthiest developed nations since 1950s led by Soviet Union and United States and gradually followed by the big European and Asian countries. At first, space exploration is based on the desire to show the country's supremacy in order to guard their national security and symbolic of ideological superiority, as demonstrated by USSR and US in their Space Race. But as the space technology shows a promising potential to ease human's life as previously mentioned, more countries get into space and broaden the scope in their space endeavour. It also mentioned that the first age of space development, characterised by the race to the Moon and the first explorations of the solar system is over (Pace, 2016).

In Southeast Asia, apart from Malaysia's significance achievement in space, Indonesia, Vietnam, Thailand and Singapore also have their range of satellites currently orbiting the earth. Even Laos has its own satellite albeit the satellite was designed, developed, and launched into orbit by one of Asia's giant space player, China. Looking at the pace of developing countries involvement in space, Malaysia surely needs a clear and comprehensive framework for the nation's space policy. Space venturing is not only about human spaceflight mission, lunar landing or Mars probe, but space in this context includes all the technologies related to it which brings direct benefits to the people back on earth.

1.2.2 Strategic Space Sector

Whenever a government of the countries decided to invest in one specific sector, there must be a strong demand and clear benefits on what they will get back from the investment. Same occurs to the country who decided to involve seriously in space venturing. Since the project of space venturing involved millions up to billions dollar of investment, it surely has lots to offer to country and for the sake of its people.

Below are the strategic sectors that most countries who venture into space is putting their whole efforts into it.

(i) Space for communication and earth observation

Since 1970s, both developed and developing countries have been expanding their investment in multiple space-related areas, including satellites for communication, weather monitoring, reconnaissance, and global positioning (GPS) as well as ground-based hardware and software to process the data received (Harding, 2013). The demand of Earth Observation Satellite (EOS) images for various Remote Sensing (RS) applications is ever increasing in both public and commercial sectors, with dominance in the public sector. EOS images and RS applications has become an important administrative tool (Subari & Hassan, 2014). Earth observation satellites can benefits various of applications such as application for environment, natural resources, strategic applications, mapping & GIS, urban characteristic identification, agricultural growth monitoring, updating geographical maps, and disaster monitoring (Arshad & Othman, 2007).

Apart from EOS and RS, satellite for navigation is also widely used by civil and military operation. As for civil, Global Positioning System (GPS) is currently the world most utilized satellite navigation system. This system is operated and maintained by the U.S Airforce. To ensure the availability of the signals, there were 31 operational satellites in the GPS constellation as of April 2016 (Office, 2016). Another global satellite navigation systems that's available for civil use are GLONASS by the Russian government, Galileo by European Union and European Space Agency, and BeiDou by China.

According to The Union of Concerned Scientists (UCS), based on the 4,077 satellites orbiting the earth as stated by The United Nations Office for Outer Space Affairs (UNOOSA) as of end of August 2015, 1,305 satellites were still active consists of communication, navigation, earth observation, technology demonstration and space science satellites (Andy, 2015). At this niche of space technology, Malaysia is not left far behind by having a communication satellites run by a private company as early as

1996, continued by government's first earth observation satellite in 2000 and scheduled to launch its third government satellite in 2016.

(ii) Space for security and sovereignty

Another strategic benefit offered by space is in term of safeguarding nation's security and sovereignty. For instance, satellite images can be used to monitor country border and prevent illegal immigrant and attempt of intrusion. As for sovereignty and 'power' factor, some countries have focusing on their military presence in space technology, allocating a huge amount of budget becoming a 'space force' and this is related to the concept of whoever owns such capabilities is clearly advantaged due to the increased presence, perspective, persistence, agility and the disruptive potential at global scale (Fredriksson, 2006). In the international diplomacy perspective, space is used as measurement of power and prestige and will influence the country political leverage in international affairs (Harding, 2013).

(iii) Space for economic growth

Space industry generates billions every year. According to the 2014 Satellite Industry Indicators Summary, \$203.0 billion global revenues had been generated in 2014 and its consist of satellite services (\$122.9B), ground equipment (\$58.3B), satellite manufacturing (\$15.9B) and launch industry (\$5.9B). As from 2005 (\$89B) to 2014 (\$203B), there were 2.3 times increment in ten-years global industry growth (The Tauri Group, 2014).

In Malaysia, MEASAT Satellite Systems Sdn. Bhd. is considered as a pioneer and big player in Malaysia satellite industry. According to company's CEO Paul Brown-Kenyon, in 2013, the company chalked up US\$99 million revenue from its three existing satellites, namely MEASAT-1, MEASAT-3 and MEASAT-3a and they also forecasting US\$260 million for 2017 revenue if they successfully launched Measat 3c in 2016 (Bernama, 2014).

1.2.3 Categorization of Space Program In Developing Countries

Nowadays, besides Russia (previously Soviet Union) and United States, there were more space faring nations continuously made their glittering success in space explorations and make good use of it. Among notable space faring nations besides the two pioneers are China, India, Japan, Brazil and the European countries such as France, Germany, Italy and United Kingdom. According to the studies conducted before, there are various of trend and level of approach used by countries into space venturing. There are countries who give full fledge effort in their space activities and some focus on specific areas.

Wood D and Weigel A (2012) had introduced Space Technology Ladder to demonstrate the level of achievement in space activities of developing countries. This ladder's focusing on investment in the areas of satellites and launch vehicle of the selected countries. Four major categories have been included in this Space Technology Ladder starting with first category; establishing a national space agency, followed by second category; owning and operating a national satellite in low Earth orbit (LEO), the third category; owning and operating a satellite in geostationary orbit while the fourth category is for the country who has independent capability to launch a satellite (Wood & Weigel, 2012). The summary view of the Space Technology Ladder is as Table 1.1 and the detailed view is as Table 1.2. Malaysia obviously falls in the second ladder with the launching of Tiungsat satellite in 2000 and RazakSat in 2009.

Table 1.1 The Space Technology Ladder – summary view

The Space Technology Ladder – summary view
Launch Capability
Satellite in Geostationary Orbit
Satellite in Low Earth Orbit
National Space Agency

Table 1.2 The Space Technology Ladder – detailed view

Fourth Ladder	Launch Capability	-Satellite to GEO -Satellite to LEO
Third Ladder	Satellite in Geostationary Orbit (GEO)	-Build locally -Build through mutual international collaboration -Build locally with outside assistance -Procure
Second Ladder	Satellite in Low Earth Orbit (LEO)	-Build locally -Build Through mutual international collaboration -Build locally with outside assistance -Build with support in partner's facility -Procure with training services
First Ladder	National Space Agency	-Establish current agency -Establish first national space office

Another Asian countries mentioned in the studies by Wood D and Weigel A (2012) are India and South Korea. India had an impressive record with their range of LEO and GEO satellites. In 2001 the country successfully launched its own geostationary satellites with its Geostationary Satellite Launch Vehicle, making them a country in the category of fourth ladder in Space Technology Ladder. Meanwhile for South Korea, the country started the Korean Aerospace Research Institute in 1989 and since then their endeavour in space making significance progressed and also successfully sent their carrier rocket to the space and placed a satellite into low earth orbit. South Korea's activities in space will be discussed further in the next section.

Harding (2013) categorizes each of the country's space program into one of three tiers of development, based not only on the level of technology used, but also on how each program fits within the country's overall national security and/or development policies. Brazil, China and India, have been categorized under the first-tier states. With the similarity on the fast-growing economies of the post-Cold War period and strong political support, they have achieved the capability to autonomously produce space technology, have developed their own launch capability for both orbital

and geosynchronous satellite placements and obviously a national space agency with thorough involvement in space development of the countries.

Not much different from the first-tier states, the ‘second-tier’ states are those that produced some of their own space technology, with basic launch capacity, having own national space agency and frequently collaborate with more advanced states’ programs in the production of space technology.

According to Harding, four countries has been categorised into this ‘second-tier’ category. Those countries involved are Iran, Iraq, Israel and South Africa. The only setback is for Iraq, besides the illustrious achievement in space technology, including becoming the ninth country to have independent orbital launcher, the country space program has now stopped due to the UN sanction and American invasion in 2003.

As for the ‘third-tier’ states, among the criteria are the countries occasionally make contributions in space-related technology, almost always purchase space-related technology from more advanced producers, and almost always collaborate with other more developed space actors in achieving their space policy goals. By these loose criteria set by Harding, almost any developing country who has puts their step on space endeavour and have set up a national policy related to space, can be categorized into third tier space actors. These include Malaysia and others country in South East Asia such as Singapore, Thailand and Vietnam.

1.2.4 South Korea: Example of Latecomer in Space Venturing

According to the list by World Bank and CIA World Factbook, in 2014 South Korea has a market economy that ranks 13th in the world by nominal gross domestic product (GDP) and purchasing power parity (PPP). With the strong per capita GDP and ranked highly on quality of life metrics, South Korea is widely regarded as one of developed Asian countries. It is one of world’s fastest growing economies from the early 1960s to the late 1990s, and continuously staying strong in the 2000s.

In line with this strong background in economy and a big influence in technology market worldwide, South Korea also making a steady progress in space development. Nevertheless, despite the achievement and the progress shown by South Korea, this country only started its space activities seriously almost 40 years behind the advanced countries (Lee & Chung, 2011).

Since 1990s, Korea Aerospace Research Institute (KARI), Satellite Technology Research Center (SaTReC) in KAIST and Korea Telecom (KT) become the main actors in the civilian space programs (An, 2015). KT was chosen as the sole investor for purchasing a satellite from advanced countries. In 1989, KARI was established. This institute respectively pursuing the development of communication satellites, scientific satellites and sounding rockets. At the same time, in August 1989, Professor Choi Soondal founded the Satellite Technology Research Center (SaTReC) inside a public research university. KAIST as a university-based research facility meant to promote the education and training of satellite engineers through research programs in satellite engineering, space science, and remote sensing. KARI as a parent agency also has Naro Space Center as the facility to build satellite and missile with local technology and it was established in 2009.

As a strategy to promote South Korea's vision to be one of the world space power and to garner public support for their space program, South Korea launched the so-called "Astronaut Project" in 2004. The purposed of the project was to nurture the country's first-ever astronaut. More than 30,000 South Koreans have applied to be the first astronaut and the government have spent about 25.57 USD on the project. As a result, Yi So-yeon was sent to the International Space Station (ISS) on board a Russian rocket in 2008 (Kang, 2014).

To some extent, this mission also was similar with Malaysia's Program Angkasawan Negara in 2007. After completing the missions, both astronauts have made an active engagements with the public in an effort to inspire people especially in the field of science, technology and space industry. On another note, as mentioned earlier, South Korea also have used this mission to get public support for their space industry. In chapter 4 and 5 of the thesis, the element of public buy-in will be discussed

from Malaysia's perspective in term of its importance for the government to pursue in the space endeavour.

In terms of policy, in 1996, South Korea has introduced the basic plan for space development in the medium term and long term. Long-term objective in the development of space is to produce its own technology and subsequently joined the top 10 countries in the space industry in the international market. The country has also invested a considerable amount of investment in the success of its space policy. For example, in 2012, The Korea Aerospace Research Institute (KARI) has a budget of 194 million USD. Furthermore, throughout 2010 and 2021, the government decided to invest about 2 trillion won (USD 1.8 billion) for its space programs.

South Korea's strong presence in the field of space exploration and space technology was also much influenced by the formulation of three related acts; Aerospace Industry Space Development Promotion Act in 1987, the Space Development Promotion Act in 2005 and Space Damage Compensation Act of 2007. The latest acts in 2005 and 2007 set out a basic plan for the development of space activities in the country, establish a national space committee, allow for the registration of space objects, establish a national authorization system and contain provisions about liability.

The purpose of the Korean Space Development Act "is to promote the peaceful use and scientific exploration of outer space, to ensure national security, to further develop the national economy, and to raise the national standard of living through the systematic promotion of space development and the effective use and management of space objects" (Dunk & Tronchetti, 2015). The establishment of these acts were very significant to ensure the development and activities in space is under the control of the government and they have the guideline and law if anything occurred that needs action according to the perspective of law.

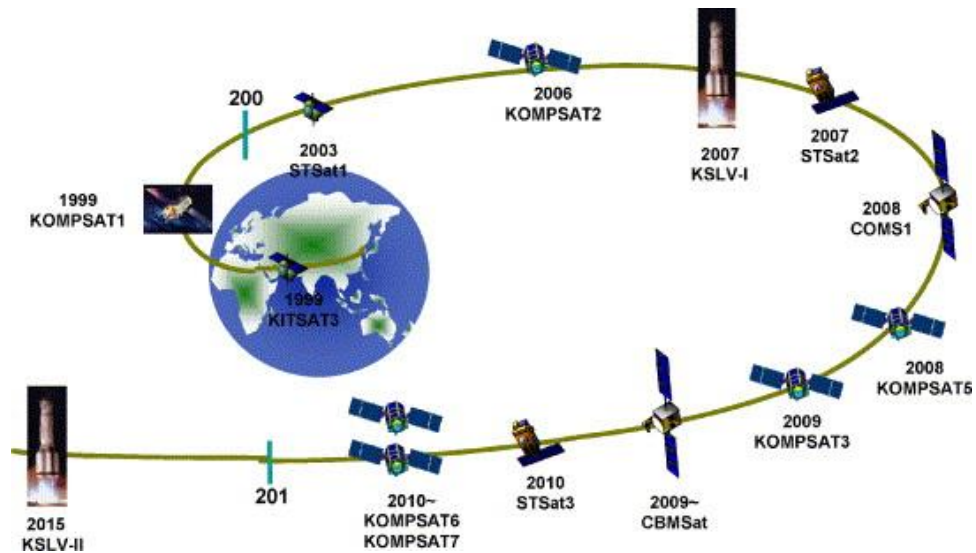


Figure 1.1 South Korea Space Development Plan (Hwang, 2006)

Despite being considered a late comer in space development, South Korea has developing an impressive space capability and has been recognised as one of emerging space faring nations (Gibbs, 2012). This significance achievement is much supported by the policy set by the South Korean government. Earlier Korean space policy was mainly focused on technology catch-up (Lee & Chung, 2011) and the Korean government established a long-term space development plan in 1996, which suggest a clear way forward for space development up to 2015. The long-term objectives of space development are to acquire the independent technological capabilities for space development and to join the top 10 countries in the space industry by competing in the global market (Hwang, 2006). Hwang (2006) further illustrates South Korea’s space development plan as Figure 1.1. The budget in space exploration and development also has been increased continuously, as the Korean government has seen space development as a way to reinforce its industrial competitiveness (Lee & Chung, 2011).

1.2.5 Malaysia’s History In Space Endeavour

Malaysia’s history in space exploration is much inspired with the setup of Planetarium Division under the Prime Minister’s Department back in 1989. In 1990,

the construction of the National Planetarium complex began and it completed in 1993. It serves as an education facility for the general public and until now plays a crucial role in promoting space science to society at large with the objective to inspire the general public about space through the consolidation of space science and local arts.

At the same year of the completion of National Planetarium complex, Space Science Studies Division (BAKSA) was established under the Prime Minister's Department and was transferred to Ministry of Science, Technology and Environment in July 1995. In 2002, Malaysia had join the list of countries which had an official space agency by establishing National Space Agency (ANGKASA) with a mandate to formulate policy and regulations, and to coordinate, implement and monitor space activities. In 2004, BAKSA amalgamated into ANGKASA and this national space agency under the Ministry of Science, Technology and Innovation continue with its mission to develop the country's potential in the space sector.

For the past twenty years, Malaysia had made a significance leap in its endeavour in the space sector development. It started with the initiative by Malaysian communications satellite operator Binariang Sdn Bhd (now Measat Satellite System Sdn Bhd) in signing a contract with Hughes Space and Communication Company (now Boeing Satellite Systems) for two Model 376 satellites in 1994. The effort to develop and launch Malaysia's first communication satellite system is to respond to the Vision 2020 plan laid out by the Prime Minister during that time, Tun Dr. Mahathir Mohamad for the development of Malaysia's communication infrastructure for the new millennium (MEASAT, 2016). In 1996, MEASAT-1 and MEASAT-2 was successfully launched into the geostationary orbit, led to a rapid increase in Malaysian infrastructure development in both the telecommunication and broadcasting industries, including the launch of the technologically advanced digital Direct-To-Home (DTH) Multi-Channel TV Service, Astro. MEASAT then continues to launch MEASAT-3 in 2006, MEASAT-3a in 2009, and MEASAT-3b in 2014.

It is interesting that with this series of commercial satellites launching, there are researchers who concluded that during the earlier stage, Malaysia has not demonstrated a desire for space capabilities to directly aid national development;

instead, Malaysia's leadership is motivated by potential economic investment in the fields of science and technology, gained as a by-product of inspiring spaceflight activities (Ansdell, Delgado & Hendrickson, 2011).

On the other hand, Government's initiative in space activities is also vibrantly progressed since the last fifteen years. The first was the launching of the first Malaysia microsatellite; TiungSAT-1 back in September 2000. TiungSAT-1 was launched for three missions, namely, for earth observations, scientific Cosmic-Ray Energy Deposition Experiment (CEDEX) as well as for simple communication applications (JURUTERA, 2009). Later in October 2007, there was the sending off the nation's first astronaut to the International Space Station (ISS). This 'Angkasawan Programme' was an offset agreement between Malaysia and Russia through the multi-billion purchase of 18 Russian Sukhoi-30MKM fighter jets for the Royal Malaysia Air Force. The achievement in sending the nation first astronaut had increased Malaysia's visibility as a space player by entering the exclusive list of countries that have successfully sent their people to space.

Two years after sending the nation first astronaut, a high-resolution Medium-Sized Aperture Camera Satellite (MACSat) with the official name RazakSat was launched into low earth orbit by a Falcon 1 rocket on 14 July 2009. This was intended to supply a high-resolution image for the benefit of extensive applications such as mapping & GIS, urban characteristics identification, agricultural growth monitoring, updating geographical maps, disaster monitoring, environment, natural resources, and others strategic applications.

1.3 Problem Statement

Space sector development is notably a strategic venture to be taken by the Government to ensure nation's survival in this fully high-tech world. It also has a lot to offer in contributing to the prosperity, security and sovereignty of the nation. As a developing country with some constraint in resources and capital, Malaysia needs to adopt a strategic approach in its space venture. Should Malaysia focus on developing

the technologies in house using all the local resources? On the other hand, the alternative is to buy some and built some. Which is more economically ideal for this small country? Or should Malaysia focus first on capacity building?

To answer those questions, there are lots of interests to be taken into account. It depends on what are the main priorities and agenda of the nation. Among the factors to be taken into consideration is the return of investment, direct benefit to the people, science and technology policy, nation's security and sovereignty, strengths in the economy, active public sector involvement, government's political agenda and public enculturation. South Korea is one of the examples for a country that started late in space development but with right policy planning and implementation, the country had breakthrough to become a space faring nation.

But can Malaysia adopt or adapt the strategy used by South Korea? Therefore, it is very important to answer all the above questions to make sure Malaysia's venturing in space is in line with the nation's capacity and capability. The needs for a clear policy framework which Malaysia do not has at the moment is very important to address the issues. At the highest level of national government, two of the most important decision to get right are properly prioritizing among competing missions, and balancing between short-term and long-term objectives (Cutts, 2009). This study will highlight on what factor should be the most prioritised and what is the best area in this space sector development for Malaysia to venture.

1.4 Objectives of the Study

Followings are the objectives of this study: -

- (1) To identify the principles that are being prioritised by other countries in their space sector development;
- (2) To evaluate and verify the areas of interest for Malaysia's space sector development;
- (3) To propose a set of guiding principles to constitute a policy framework for Malaysia's space sector development.

1.5 Research Question

According to Yusoff (2008), both research objectives and research questions are complementing to each other as it is because by answering the research questions that the objectives of the research will be achieved. Hence, below are the research questions listed for this study:

1. What are the guiding principles adopted by other countries in their space policy framework?
2. How should a small developing country like Malaysia ventures into space sector?
3. What are the appropriate guiding principles to be incorporated into Malaysia's space sector development policy framework?

1.6 Scope of the Study

This study will focus on identifying the set of guiding principles for Malaysia's space policy framework. It will not discuss to the extent of the strategic actions to be taken as it will involves a comprehensive study across all sectors involves.

For the literature review on what is the guiding principles adopted by other countries in their space policy, only Australia, Canada and Japan were chosen, due to the limitation of related policy documents that's available online. Nevertheless, these three countries have its own significance and relevance to be a bench marker for Malaysia. Australia and Canada, both has a population size around 28 to 36 million compared to Malaysia's 30 million people. As for Japan, even though it can be categorized as an active space player, but it still not at par with the United States of America that is more superior in term of experience and achievement in its space endeavour.

1.7 Research Methodology

This study will adopt a mixed-methods approach which consist of qualitative and quantitative study. It will comprise of primary and secondary data sources. Primary sources shall be in the form of interviews transcript and returned questionnaires. These primary sources will be analysed to answer research question number two and number three; *How should a small developing country like Malaysia ventures into space sector?* and research question number three; *What are the appropriate guiding principles to constitute Malaysia's space policy framework?*

The specific method to be used in the qualitative study is the framework analysis. Even though the qualitative data that are utilized in framework analysis are usually gathered in the form of participant observation, focus groups or interviews (Srivastava & Thomson, 2009) but due to budget and time constraint, data only collected through interview sessions. Interview with the expert is seems very significance in the process to get the input as the information coming from those who are very well versed in the topic of interest and can provide real-time and real-world knowledge (Hsu & Sanford, 2007).

The secondary sources shall comprise open source information gathering through Internet, journal, book, and others. The secondary sources will be fully utilized to assist in answering the research question number one, *what are the guiding principles adopted by other countries in their space policy framework?* This question will be answered in the Literature Review chapter and will be the basis for designing the questionnaire and interview's questions.

1.8 Significance of the Study

At the end of the studies, a set of guiding principles to constitute a policy framework for Malaysia's space sector development will be proposed. It is hoped that this framework will assist Malaysian government to develop a comprehensive policy to guide Malaysia's future space endeavour. The policy that will act as the blueprint

for the nation's future undertaking in space exploration, commercialisation and development program. The policy that will help our nation in harnessing space as a platform for knowledge generation, wealth creation and societal well-being, as mentioned by the vision set by Malaysian National Space Agency (ANGKASA).

1.9 Thesis Organisation

The introductory chapter outlining the background of the research topic and describes the problem statements that motivate this research. It also specifies the objectives of the study and enlist the research questions as well as the significance of the study. Chapter 2 will begin with a glimpse of policy cycle and definition of the policy framework. In order to get a thorough understanding of the elements that are most important in a policy framework document, sets of national level policy framework from various countries will be reviewed in this chapter. In order to learn a different approaches and perspectives in constituting a policy framework, the policy frameworks chosen are not only about space policy, but from various sectors.

Chapter 3 discusses on the research design and methods that will be used in the research to identify the best policy framework for Malaysia's space sector development. Relevant topics will be highlighted such as the research design, instruments that are going to be used, data collection, respondents and data analysis.

Chapter 4 is divided into two parts. Part one investigates the responses collected from the set of questionnaire distributed to the relevant individuals from government agencies, private sector and higher learning institutions. The second part investigates the data from the series of interviews conducted with ten experts and stakeholders in the space sector. In Chapter 5, further elaboration on the results from chapter 4 and also recommendation for future studies.

1.10 Conclusion

This chapter gives a brief overview on the importance of space sector and summary on current space endeavour in few selected countries including South Korea as an emerging space player that started late but grows fast. Then the problem of the statement that motivated this study to be conducted had been discussed, along with the objectives, scope, research questions and glimpses of research methodology that will be discussed further in chapter three. The chapter concluded with the significance of this study to the related party.

After discussing the introduction of this research, it is important to define what a policy framework and what constitutes it. These will be discussed in detail in the next chapter.

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Appendix A Survey Instrument Validation Form

Survey Instrument Validation Form
Validation by Space Legislation Expert

Title of Survey Instrument:

Malaysia's Space Policy Framework

I hereby acknowledge that the above mentioned survey instrument developed by Mohd Azlan bin Idris from Perdana School of Science, Technology and Innovation Policy, Universiti Teknologi Malaysia has been checked. The outcome is as follows:

No.	Item	Yes	No	Comment
1.	The objective of the instrument is stated clearly			Please refer to the 'comments and suggestions' column.
2.	The instrument format is appropriate and interesting	√		
3.	The instructions are clear	√		
4.	The meaning of every item is clear	√		

5.	The measurement scale is appropriate	√	
6.	The questionnaire is capable of generating data that will be of value and practical use to the sectors concerned in the investigation	√	
7.	Quick and complete data can be generated by the questionnaire within the time frame allowed to obtain the data	√	

Comments and Suggestions:

1) Item No.15 (Malaysia should continue its membership in UNCOPUOS ...):

- Grammar mistake: should continue (not 'continues').
- This item is more appropriate in respect of the question's focus on 'strengthening the relationship and supporting the world space organization' (rather than 'to guard national interest and security').
- You could also consider developing other item on the same issue/objective, such as how the respondent sees / in opinion of issue regarding signing and ratifying the space treaties by Malaysia.

2) Item No. 20 (Some countries have choose ...)

- Grammar mistake: should be 'have chosen.' (not 'have choose').

Signature . . :

Full Name : DR CHE ZUHaida BINtI SAARI

Designation : SENIOR LECTURER

Experience in space legislation (years): 6 YEARS

Stamp of Employer:

Date: 25 APRIL 2017

Appendix B Questionnaire First Draft

No.	Sections	Question's Focus	Expert Comments (if any)
No.	Section 1. Demography		
1	Name of department/organisation/learning institution	To get the background of the respondent and to verify their job or studies is related to space sector.	For person like myself, how to rated? 17 years of working experience but 1 st year at UTM KL. However for this questionnaire, I ranked myself as a student due to current position
2	Occupation/position		
3	Gender		
4	Age group		
5	Area of speciality (in studies/work)		
6	Length of service/semester of studies		

			ii) In studies – space policy / space management
	<p>Section 2. Space sector development policy framework (Respondent need to give answer based on Likert Scale: Strongly Disagree, Disagree, Neutral, Agree, Strongly Agree except for question no.2 and no. 11.</p>		
1	<p>Malaysia is on the right track in its space sector development</p>	<p>To get the respondent perception on the current achievement in Malaysia's space sector development</p>	<p>i) Question are too general ii) Please explain right track iii) Very open-ended question</p>

2	<p>Have you read Malaysia's National Space Policy (Dasar Angkasa Negara)?</p> <p>(If "yes", please answer question 3, if "No", please go to question 4)</p>	<p>To get the respondent view on the thrusts listed in</p>	<p>Most people will answer "no" because the document is not yet public domain (not officially publish yet)</p>
3	<p>The 5 thrusts listed in the document will steer the country to reach the policy goal</p>	<p>Malaysia's Space Policy</p>	<p>This question (no.3) just for people answer 'yes' in question no 2. And most people can't remember the thrust. So, that is the challenges to response this question</p>
4	<p>With proper effort by the Government, downstream industries in space sector will be more vibrant and have the potential to become high contributor in national GDP</p>		
5	<p>Apart from the downstream segment, companies in Malaysia should invest in upstream segment to boast higher return in profit, such as satellite manufacturing, ground support equipment, and satellite services.</p>	<p>Space sector industry/related activities as a</p>	

6	<p>Currently Malaysia only have the capability to build a small satellite, mainly in design and assembly phases. Government should invest the facilities and encourage local industries to produce more advanced components in satellite body, thus the whole satellite making process can be built in-house and the components also can be exported to generate high returned profits.</p>	contributor for the economic growth	
7	<p>Joint collaboration and strategic alliances in space programs with advanced and space emerging countries will help Malaysia to catch up with the technology cost effectively.</p>	Sustainable and cost effective development in space sector	
8	<p>Malaysia should continue smart partnership programs with international countries to build a satellite as the previously launched HengSat-1 (TungSAT-1) and RazakSat (RazakSAT)</p>		

9	Malaysia should fully utilized the facilities and human capital that it already had to build more space technologies in-house		
10	Capacity building is an essential element in assuring Malaysia's initiative in space sector development becoming a sustainable effort.	The importance of capacity building in the space sector	
11	Which element of capacity building that is/are important for Malaysia's space sector development? (Respondent can choose more than one answer) - Human resource - Technology - Infrastructure		
12	The number of experts in our countries should be increased in order for Malaysia to fully capable developing and managing space technologies.		

13	<p>Many space technology or spin-offs technologies such as earth observation satellite, GPS, GNSS satellite broadcasting, weather monitoring and many others applications have significantly enhanced the quality of life for people on Earth, hence venturing into space is actually bringing more benefits to the people.</p>	<p>Space technology to enhance quality of life</p>	
14	<p>The intrusion in Lahad Datu and the continuous abduction of people in Sabah's east coast are a call for Malaysia to further invest in space technology to ensure country's security and sovereignty remain intact.</p>	<p>To guard national interest and security*</p>	
15	<p>Malaysia should continue its active membership in UNCOPUOS – UN Committee on Peaceful Uses of Outer Space, and to ensure the peaceful uses of outer space and ensure space usage as non-military agenda.</p>	<p>*dual usage of space technology (civil and military)</p>	

16	Currently there are already a significant numbers of private companies in space industry, providing services in communication, broadcasting, remote sensing, earth observation and positioning. (in Malaysia or internationally?) Which one intended in this question)	Encouraging private sector involvement in space sector development	
17	Malaysian government has to work with local industry players to improve facilitation mechanism, identify and respond to barriers for industry participation, both domestically and internationally.		
18	Do you agree that it is the Government that should venture into space sector business?		Not government directly venture in space business but government should play an active role in facilitate the industry to become active venture in space business by providing the basic infrastructure (hard and soft), providing the incentive and play an strategic role in international diplomacy

19	Do you agree that formal education related to space science/technology/application in Malaysia is already sufficient?	Education and workforce development	
20	Some countries have chosen to put their military presence in space technology, allocating a huge budget to become a 'space force'. Do you agree this approach suitable for Malaysia?	Using space sector development for national prestige	The term "space force" like new to me. Where do you obtain this word? Do you mean space force as space power country or space faring country or something else
21	If Malaysia have a huge amount of budget in space development, do you agree that exploring Mars can be set as one of our mission in 20 years' time?		

Section 3. Vision for Malaysia's Space Sector Development		
1	From your point of view, what should Malaysia achieved by the year 2050 in space sector development?	To get new and fresh ideas from respondent

Signature : 

Full Name : MHD FAIROS BIN ASILLAM

Designation : PhD STUDENTS

Experience in space programme (years) : 1 Semester at UTM

Stamp of Employer:

Date: 25 April 2017

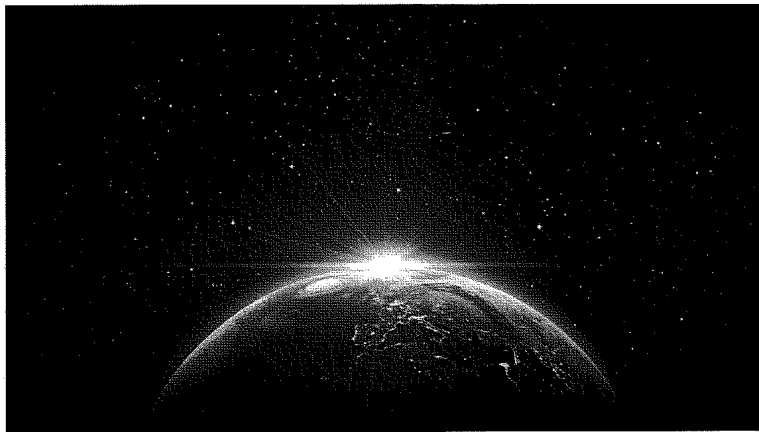
Appendix C Final Questions for Questionnaire

QUESTIONNAIRE – A POLICY FRAMEWORK FOR MALAYSIA'S... <https://docs.google.com/forms/d/1SLAeAwoeYH0V4m5kCth07YGDm...>

QUESTIONNAIRE – A POLICY FRAMEWORK FOR MALAYSIA'S SPACE SECTOR DEVELOPMENT

I am a student from Perdana School of Science, Technology and Innovation Policy, University Technology Malaysia. I am currently working on a Master's thesis and the topic is A Policy Framework for Malaysia's Space Sector Development. Therefore I would like to collect information on opinion and expectation in Malaysia's space sector development from various personnel who are working or studying in space sector or related field in science, technology and innovation. This survey will only take around 10 minutes to complete and all the responses will remain anonymous. In case you have any questions regarding the survey, please call or text (SMS/ Whatsapp) Mohd Azlan bin Idris at 0192621052. Thank you very much.

* Required



Section 1: Demographics

Please kindly answer all these questions in order to proceed. If you are a professional who are currently doing postgraduate study, please fill in only your name of department/organisation that you are currently attached and your length of services.

1. **1. Name of department/organisation/learning institution ***

.....

2. **2. Position ***

.....

3. 3. Gender *

Mark only one oval.

- Male
 Female

4. 4. Age group *

Mark only one oval.

- 17 – 25
 26 – 35
 36 – 45
 46 – 55
 56 – 65

5. 5. Area of speciality (in studies/work) *

.....

6. 6. Length of services/semester of studies *

.....

Skip to question 7.

Section 2: Space sector development policy framework

Instruction: Please indicate your level of agreement or disagreement with each of these statements regarding Malaysia's space sector development.

7. 1. Malaysia is on the right track in its venture into space *

Mark only one oval.

- Strongly disagree
 Disagree
 Neutral
 Agree
 Strongly agree

8. 2. Have you read Malaysia's National Space Policy (Dasar Angkasa Negara)? (If "yes", please answer question 3, if "No", please go to question 4) *

Mark only one oval.

- Yes
 No

9. 3. The 5 thrusts listed in the document will steer the country to reach the policy goal

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

10. 4. With proper effort by the Government, downstream industries in space sector will be more vibrant and have the potential to become high contributor in national GDP *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

11. 5. Apart from the downstream segment, companies in Malaysia should invest in upstream segment to boast higher return in profit, such as satellite manufacturing, ground support equipment, and satellite services. *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

12. 6. Currently Malaysia only has the capability to build a small satellite, mainly in design and assembly phases. Government should invest the facilities and encourage local industries to produce more advanced components in satellite body, thus the whole satellite making process can be built in-house and the components also can be exported to generate high returned profit. *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

13. **7. Joint collaboration and strategic alliances in space programs with advanced countries will help Malaysia to catch up with the technology cost effectively. ***

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

14. **8. Malaysia should continue smart partnership programs with international countries to build a satellite as the previously launched TiongSat-1 and RazakSat. ***

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

15. **9. Malaysia should fully utilise the facilities and human capital that it already has to build more space technologies in-house ***

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

16. **10. Capacity building is an essential element in assuring Malaysia's initiative in space sector development becoming a sustainable effort. ***

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

17. 11. Which element of capacity building that is/are important for Malaysia's space sector development? (You can choose more than one answer) *

Check all that apply.

- Experts
- Technology
- Infrastructure
- Resources

18. 12. The number of experts in our countries should be increased in order for Malaysia to fully capable in developing and managing space technologies. *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

19. 13. Many space technology or spin-offs technologies such as GPS, satellite broadcasting, weather monitoring and many other applications have significantly enhanced the quality of life for people on Earth, hence venturing into space is actually bringing more benefits to the people. *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

20. 14. The intrusion in Lahad Datu and the continous abduction of people in Sabah's east coast are a call for Malaysia to further invest in space technology to ensure country's security and sovereignty remain intact. *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

21. **15. Malaysia should continue its membership in UNCOPUOS – UN Committee on Peaceful Uses of Outer Space, and to ensure the peaceful uses of outer space and ensure space usage as non military agenda. ***

Mark only one oval.

- Strongly disagree
 Disagree
 Neutral
 Agree
 Strongly agree

22. **16. Malaysia should start its effort to become an active member in international initiative such as Missile Technology Control Regime (MTCR) and The Hague Code of Conduct against Ballistic Missile Proliferation (HCOC) ***

Mark only one oval.

- Strongly disagree
 Disagree
 Neutral
 Agree
 Strongly agree

23. **17. Currently there are already a significant numbers of private companies in space industry, providing services in communication, broadcasting, remote sensing, earth observation and positioning.**

Mark only one oval.

- Strongly disagree
 Disagree
 Neutral
 Agree
 Strongly agree

24. **18. Government only facilitate the activity in space industry by providing the basic infrastructure (hard and soft) and play a strategic role in local and international trade ***

Mark only one oval.

- Strongly disagree
 Disagree
 Neutral
 Agree
 Strongly agree

25. 19. Private sector should play an active role in Malaysia's space programme *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

26. 20. Do you agree that formal education related to space technology in Malaysia is already sufficient? *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

27. 21. Some countries have chosen to put their military presence in space technology, allocating a huge budget to become a 'space force'. Do you agree this approach suitable for Malaysia? *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree

28. 22. If Malaysia has a huge amount of budget in space development, do you agree that exploring Mars can be set as one of our mission in 20 years' time? *

Mark only one oval.

- Strongly disagree
- Disagree
- Neutral
- Agree
- Strongly agree


Section 3: Vision for Malaysia's Space Sector Development

29. 1. From your point of view, what should Malaysia achieve by the year 2050 in space sector development? (You can choose more than one answer)

Check all that apply.

- Capable of building our own satellite
- Capable of launching our own satellite
- Space sector industry and related activities contributing 10% in Malaysia's GDP (under Manufacturing and Services)
- Being a leading nation in space programme among South East Asia's countries
- Deep space exploration

Thank you for taking the time to complete this questionnaire.

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Appendix D Letter To Conduct Survey



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RUJUKAN TUAN:

17 Mei 2017

KEPADA SESIAPA YANG BERKENAAN

Tuan/Puan,

PERMOHONAN MENJALANKAN TINJAUAN AKADEMIK (ACADEMIC SURVEY) DAN TEMUBUAL BAGI MENDAPATKAN DATA BERKAITAN

Dengan hormatnya perkara di atas dirujuk.

2. Dimaklumkan bahawa pelajar seperti di bawah merupakan pegawai di bawah Skim Hadiah Latihan Persekutuan Jabatan Perkhidmatan Awam dan berada di semester ke empat program Sarjana Falsafah di Sekolah Perdana Polisi Sains, Teknologi dan Inovasi (UTM Perdana School), Universiti Teknologi Malaysia.

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3. Sehubungan itu, bagi menyiapkan tesis pelajar ini yang bertajuk *A Policy Framework for Malaysia's Space Sector Development*, satu tinjauan menggunakan borang *questionnaire* serta sesi temubual perlu dilakukan kepada pihak yang berkenaan.

4. Pihak UTM Perdana School memohon pertimbangan sewajarnya daripada pihak tuan supaya pelajar ini diberikan kebenaran untuk membuat tinjauan ke atas pegawai di jabatan tuan/puan. Adalah diharapkan dapatan kajian ini dapat memberi faedah untuk meningkatkan pengubalan dan pelaksanaan dasar-dasar kerajaan di masa akan datang.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Yang benar,

PROF. ZAMRI BIN MOHAMED

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