National space legislation : future perspectives for Malaysian Space Law

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1 Malaysian Space Experiences and Activities: Past, Present, and Future

1.1. INTRODUCTION

Worldwide recognition was given to Sputnik I when it made a significant impact on outer space activities, opening an episode of a 'prestige-driven race to the moon', as expressed by Professor Frans von der Dunk[1], especially among the space superpowers. With the development of rockets and the advancement in engineering and other technologies, it became possible to send machines, animals and then people beyond the Earth's atmosphere into outer space. Although the possibility of exploring space had long excited people in many walks of life, few could afford the very high costs of launching people and rockets into space. Despite this constraint, the possibility of sending human beings into outer space generated wide interest in the exploration and use of outer space and celestial bodies.

Inspired by this, after 50 years of independence, Malaysia made a bold step when the Government of Malaysia decided to send its first man into outer space. This decision was realized when the first Malaysian astronaut, Dr Sheikh Muszaphar Shukor, made his way to the International Space Station (ISS) through *Program Angkasawan* (Astronaut Programme)[2] on 10th October 2007. Since then, the word '*angkasawan*' has been accepted as synonymous with the words astronaut and cosmonaut. As a matter of fact, Malaysia has been involved in space activities since 1960. This was evidenced in 1960 when the country built the first Malaysian earth satellite station in Pahang, one of the states of Malaysia. However, the real work in space technology started in early 1990, when Malaysia embarked on her plan to design micro-satellites, crafting research programmes in satellite technology along with educational programmes. The impediment to progress in this industry is in fact mainly caused by economic fluctuations as well as lack of local technical expertise and support in the related

[1] Dunk, F.G. von der, Inaugural Lecture, *As Space Law Comes to Nebraska, Space Comes Down to Earth,* Space and Telecommunications Law, University of Nebraska College of Law's, Lincoln, 1st May 2008, at 2.
[2] For further information on *Program Angkasawan* read Chapter 1 of the thesis (1.4.6. *Program Angkasawan Negara*).

domain.[3] Nevertheless, those obstacles are viewed as challenges to further improvement of the related field.

While Malaysia has demonstrated positive progress in gearing up towards involvement in the space frontier and technology, little effort has been made to set up a fully-fledged and proper national space policy and law. This is evidenced by the last 54 years of Malaysian involvement in space activities as there is still a question about Malaysia's ability to put the law into practice. At this juncture, one can consider that space law is still in its infancy in Malaysia.

This chapter discusses the Malaysian space experiences and activities through past, present and future perspectives. Thus, the study highlights three major areas to describe Malaysian participation in space-related activities. The first area is in respect of policy and laws. To address this point, the study aims to scrutinize the applicable policy and numerous laws that are available nationally for Malaysian space-related activities. The second area is technological development and research. At this juncture, the study examines the Malaysian space technological development and research with respect to three areas: (1) the governmental sector; (2) the non-governmental sector; and (3) the higher educational institutions. Thus, to examine Malaysian space-related experiences in terms of technological development and research, the study explores the involvement of Malaysian governmental and non-governmental sectors in such activities. The study also examines the space-related technological and legal education offered by the Malaysian higher educational institutions. The third area is in respect of applications and activities. To address such points, a discussion on various past, present and future space applications and activities in Malaysia will end this chapter.

1.2. POLICY AND LAWS

This section describes Malaysia's space experiences with respect to its policy and laws. In general, Malaysia has no specific comprehensive space legislation to regulate its outer space

[3] Ahmad Sabirin Arshad, "Pembabitan Bangsa Melayu Dalam Bidang Angkasa Lepas", *Proceeding on Wacana Minda Melayu Conference at Kuala Lumpur, Malaysia, October 7-9, 2003,* at 1.

activities.[4] Nevertheless, there are a number of existing laws to control and regulate certain sections of Malaysian space-related activities. These are particularly concerned with the multimedia and telecommunication industries. To name but a few, the laws include the Malaysian Federal Constitution, the Malaysian Communications and Multimedia Act 1998 (Act 588), the Malaysian Communications and Multimedia Commission Act 1998 (Act 589) and the Communications and Multimedia (Licensing) Regulations 2000. Meanwhile, prior to discussing the aforesaid laws and regulations, the study provides information on the Malaysian Space Policy and its Outer Space Bill.

1.2.1. The Malaysian Space Policy and the Malaysian Outer Space Bill

The growth of Malaysian public interest in space activities and industries around 2002[5] inspired the Government of Malaysia to summon Professor Datuk Dr. Mazlan Othman[6] to set up the Malaysian Space Agency (ANGKASA)[7]. ANGKASA, a department under the Malaysian Ministry of Science, Technology, and Innovation, has been entrusted by the Malaysian Government with developing the Malaysian space policy, which is the blueprint for the country's future space activities, particularly when dealing with private enterprises. In conjunction with this, ANGKASA, in collaboration with the Malaysian Attorney General's Chambers (Malaysian AG Chambers),[8] has also initiated a draft Malaysian Outer Space Bill.[9] It is an effort towards formulation of specific space legislation to regulate Malaysia's outer space activities.

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[4] In spite of the fact that Malaysia had already successfully launched several satellites into orbit, *i.e.,* TiungSAT-1, RazakSAT, the MeaSAT systems, and proudly sent its astronaut to the ISS, all matters regarding space launches and activities have been executed only through bilateral agreements between the parties involved.

[5] As a matter of fact, Malaysia has been engaged in space research since the 1970s but it officially started its space satellite programme in 1990s. See http://cns.miis.edu/research/space/malaysia, accessed: 14 September 2008.

[6] Prior to joining the agency in July 2002, Professor Datuk Dr. Mazlan Othman was a Director of the United Nations Office for Outer Space Affairs (UNOOSA) in Vienna, Austria, in 1999, where she coordinated international cooperation on the peaceful uses of outer space. Around January 2008, she was re-appointed as the Director of the UNOOSA in Vienna.

[7] ANGKASA was formerly known as *Bahagian Kajian Sains Angkasa* (BAKSA) or Space Science Studies Division which is responsible for research and development, policy formulation and strategic planning on issues related to space activities. See http://www.angkasa.gov.my/, accessed: 15 May 2014. For further information, read Chapter 1 of the thesis (1.3.1 (b) Malaysian National Space Agency (ANGKASA).

[8] Malaysian AG Chamber is the office of the Attorney General of Malaysia, the country's chief law officer or the principal legal advisor to the Malaysian Government. The Chamber is within the purview of the Malaysian Prime Minister's Department. Its official website is at http://www.agc.gov.my/, accessed: 15 May 2014.

[9] See http://www.angkasa.gov.my/?q=polisi/undang-undang-angkasa, accessed: 15 May 2014. See also Pracha, Mehmood, "Studies on National Space Laws and Policies in Asia Pacific Region", (2008) 50 *IISL Colloquium on the Law of Outer Space* 24.

In many ways, the idea of a Malaysian Space Policy and Malaysian Space Act has received great attention over the previous years[10]. As a matter of fact, the effort to compose the draft Malaysian Outer Space Bill was started by the Malaysian AG Chambers in December 2004[11]. As ten years have now elapsed, there is an impression that the development of the Malaysian outer space legislation is slow and lethargic. The situation is the same in regard to the progress in drafting the Malaysian space policy. The progress has been dilatory[12] for a number of reasons including scarce local expertise in this area. On top of that, for a certain period, ANGKASA has had other commitments in need of urgent attention and participation by the committee members, including the commitment to the *Program Angkasawan Negara*[13] which includes all subsequent research carried out in outer space. Another notably important reason is deficiency in skilled resources in ANGKASA itself. Hitherto, ANGKASA is still in the course of recruiting its staff and 95 per cent of them are new graduates with no working experience.[14]

In the process of developing the Malaysian space policy, the major aim of development should be, *inter alia*, to set out the vision and goals of space activities in Malaysia for the coming century.[15] Another purpose is to offer the strategic context for investments in the exploration, exploitation, and use of outer space by the Malaysian Government and industry. Apart from that, the aim of the development of the policy is to mobilize and organize the financial and human capital, and institutional resources. This must be done in order to drive investment in work for the nation. Such a situation, indeed, will enhance the productivity and

[10] Mohd Aimi Zaini Mohd Azhar, *Prinsip Undang-Undang Antarabangsa Yang Mengawal Aktiviti Penerokaan dan Penggunaan Angkasa Lepas Serta Penglibatan Awal Malaysia Dalam Industri Aeroangkasa*, (LL.B Project Paper, Faculty of Law, University of Malaya, Kuala Lumpur, 1995), at 149.

[11] Noor Asima Osman, a Senior Federal Counsel, International Affair Division, Attorney General's Chambers Malaysia (previously served as a Legal Advisor to ANGKASA from January 2005-April 2007), "Draft Malaysian Outer Space Bill", Email to author, 7 January 2009.

[12] In November 2008, it was stated that the draft of the Malaysian Space Policy was not yet even at the stage of being drafted and ANGKASA had just started working on the policy by appointing the drafting committees (Interview with Dr Mustafa Din Subari, Director of ANGKASA, on 21 November 2008). However, in October 2011, it was stated that ANGKASA was at the stage of building the programme content of the Malaysian space policy and, upon the Malaysian Ministry of Science, Technology, and Innovation's approval; it shall then be presented at a national workshop with the presence of invited stakeholders. In October 2012, it was reported that the first draft is expected to be finalised in the last quarter of the year. Mustafa Din bin Subari, "Malaysian Space Policy", email to author, 12 October 2011. Read also Statement by Colonel Nazari Abd Hadi, representative of Malaysia, on Agenda Item 51: International Cooperation in the Peaceful Uses of Outer Space, at the Fourth Committee of the 67th Session of the United Nations General Assembly, New York, 18 October 2012, http://www.un.int/malaysia/GA/67/2012-10-18%20Outer%20Space.pdf, accessed: 15 June 2013.

[13] *Program Angkasawan Negara* is a Malaysian Government space programme to send a Malaysian to the International Space Station. For more information, refer to Chapter 1 of the thesis (1.4.6. *Program Angkasawan Negara*).

[14] Noor Asima Osman, "Malaysian Space Policy", email to author, 12 October 2008. Read also *supra* note 11.

[15] See http://www.angkasa.gov.my/?q=en/node/109, accessed: 15 May 2014.

skill levels of the economic sectors as well as the generation of high-value-added products, processes and services. Moreover, its aim is to set up the framework for various actors to ensure effective performance in the exploration, exploitation, and use of outer space, including engagement with external parties.[16]

Meanwhile, to bring the Malaysian Space Policy and Outer Space Act into effect, it is strongly suggested that the Malaysian Government organize regular consultations and discussions with the relevant stakeholders. This effort is imperative in order to ensure that outer space legislation is drafted for mutual benefits of both public and private sectors, thus enabling them to tackle the problems they encounter effectively.

1.2.2. The Malaysian Federal Constitution

The Malaysian Federal Constitution,[17] like many other constitutions, has evolved from events of the past. To present an accurate view of the Malaysian Federal Constitution that might contribute to the creation of the Malaysian outer space legislation, this section will, of necessity, explore the historical background to the making of the Federal Constitution. The discussion concentrates, firstly, on the pre-British era which covers the Malacca Sultanate, the Portuguese invasion, and the Dutch periods. Secondly, the study examines selected events that took place during the British period which influenced the creation of the Independence Constitution 1957, before elaborating on the current Malaysian Federal Constitution[18]. It also explicates the types of Malaysian legislatures with a view to ultimately explaining the legislative competencies in Malaysia with respect to outer space law, policy, and activities. Special reference is made to the Federal List, the State List, and the Concurrent List provided in the Ninth Schedule of the Malaysian Federal Constitution. First, however, a brief explanation of the meaning and nature of a 'constitution' is presented to begin this section.

[16] *Id*.
[17] In this section, 'Malaysian Federal Constitution' or 'Federal Constitution' refers to the Malaysian Federal Constitution as at 1st February 2013. All Sections and Parts mentioned in this section, unless specified otherwise, should refer to those written in the Constitution.
[18] *Id*.

(a) Meaning and Nature of a Constitution

The term 'constitution' in its literal sense refers to the body of legal and non-legal rules concerning the government of a state.[19] According to the *Oxford Dictionary of Law*,[20] constitution denotes the rules and practices that determine the composition and function of the organs of central and local government in a state and regulate the relationship between the individual and the state. It signifies the basic framework which provides the foundations for governance. It has to be developed and explained in accordance with needs and changing circumstances.[21] In general, constitutions are divided into two categories: written and unwritten constitutions. A written constitution means that the system of government is contained in a single document. The Malaysian constitution is thus categorised as a written constitution since it is codified in a single document known as the Malaysian Federal Constitution.[22] The advantages of codified constitutions are that they tend to be more coherent, easily understood, and simpler to read. However, an unwritten constitution describes one in which the rules and principles of the constitution are scattered in the forms of statutes, charters, political conventions, and practices,[23] as can be seen in the constitutions of the United Kingdom and New Zealand, amongst of them.

(b) The Historical Background of the Malaysian Constitution

The discussion of the historical background of the Malaysian Constitution is divided into two phases. The first phase is the pre-British era starting from the Malacca Sultanate period in 1402 until the end of the Dutch period in 1824. The second phase is the British period commencing from 1786 when the British first interfered in Malay local affairs until the Independence Day of Malaya (Malaysia) in 1957.

[19] Wan Arfah Hamzah and Ramy Bulan, *An Introduction to the Malaysian Legal System,* (Shah Alam: Penerbit Fajar Bakti Sdn Bhd, 2004), at 25.
[20] Martin, Elizabeth A. And Jonathan Law, eds., *Oxford Dictionary of Law*, (New York: Oxford University Press Inc., 2006), at 119.
[21] Abdul Aziz Bari, *Malaysian Constitution: A Critical Introduction,* (Kuala Lumpur: The Other Press, 2003), at 15-16.
[22] Among other states that have written constitutions are United States of America, India, and Australia.
[23] Abdul Aziz Bari, *supra* note 21, at 7-9.

i. Pre-British Period: Malacca Sultanate, Portuguese and Dutch Periods

It is emphasized that the Malaysian Federal Constitution today has not entirely originated from the British period. In fact, the indigenous community had already developed their own constitutional systems when the British came to Malaya in 1786.[24] Hence, the discussion on the historical background of the Malaysian Federal Constitution should begin from the pre-British days, specifically the beginning of the Malacca Sultanate period.[25] During the Malacca Sultanate, the role of ruler was portrayed as the source of law and fountain of justice.[26] There were two important digests of laws or legal codes applicable to the Malacca Sultanate: *Undang-Undang Melaka* (the Laws of Malacca)[27], and *Undang-Undang Laut Melaka* (the Maritime Laws of Malacca)[28]. Both digests are based on the patriarchal law of the *Adat Temenggung*[29] and Islamic law of the *Shafi`i* school of law.[30] Therefore, it has been

[24] *Id,* at 21.

[25] The reign of the Malacca Sultanate (1402 -1511) centred on the modern town of Malacca, one of the states of Malaysia. It stretched from the Muslim Malay settlements of *Bukit* (Phuket), *Setol* (Satun), *Pantai ni* (Pattani) bordering *Ayutthaya* Kingdom of Siam (Thailand) in the north to Sumatra in the Southwest. The Sultanate of Malacca was founded by Parameswara (a Hindu Srivijayan prince) in 1402. Parameswara, who was the ruler of Palembang, was attacked by Majapahit in 1390s. As a result, he fled his palace and reached Temasik Island. Parameswara ruled Temasik for about 4 years. Later, he was attacked by the Majapahit. He then fled to Muar. In 1402, Parameswara established a kingdom named Melaka (Malacca). In 1409, he embraced Islam when he married the Princess of Pasai. He then assumed the title of 'Sultan Iskandar Shah'. It was well-known that Malacca was a well-defined government with a set of laws. The Sultanate thrived on entrepot trade and became the most important port in Southeast Asia during the 15th and the early 16th century. It commanded the main sea route between India and China. It was a major player in the spice trade, serving as a gateway between the Spice Islands and high-paying Eurasian markets. One of the contributing factors to the rise of Malacca was the monsoon winds that enabled the Arab and Indian traders from the west to travel to China in the east and vice versa. Malacca was also a centre of Islam, where religious people met and discussed religious matters. On top of that, Malacca also had a good relationship with the Ming Dynasty. In 1409, the Sultan paid tribute to the Ming emperor to ask for protection against Siam (Thailand); thus, the kingdom was made a protectorate of Ming China. One of the Malacca sultans, Mansur Shah, married a Ming princess, Hang Li Po. By the mid-1430s Malacca had become a major commercial emporium, and by the mid-15th century it was an important territorial power as well. The period of its ascendancy is considered the golden age of Malay history as it encouraged literature, learning, and a lively political and religious life. The city fell to the Portuguese in 1511. See http://en.wikipedia.org/wiki/Malacca_sultanate, accessed: 14 May 2014.

[26] Terms such as *titah* (command), *daulat* (ruler's divinity), *murka* (wrath), *kurnia* (royal grace), *anugerah* (royal bounty), which contain legal values, had already been in use for about 18 centuries. The ruler has power to determine the penalties for crimes such as killing, stabbing, slashing, battery, robbery, theft and others. The ruler also has absolute power to pardon and set free the offender. Ahmad Ibrahim and Ahilemah Joned, *The Malaysian Legal System,* (Kuala Lumpur: Dewan Bahasa dan Pustaka, 1987), at 15. See also Yusoff Iskandar and Abd. Rahman Kaeh, *Sejarah Melayu, Satu Perbincangan Kritis dari Pelbagai Bidang,* (Kuala Lumpur: Heinemann, 1978), at 67-80.

[27] It is also variously referred to as *Hukum Kanun Melaka* and *Risalat Hukum Kanun*. It has forty-four chapters, and it mentions, *inter alia*, the responsibilities of the ruler and his chiefs, the prohibitions amongst members of the community, the penalties for criminal and civil offences, and the family law. For details, read Ahmad Ibrahim and Ahilemah Joned, *id*, at 15-18.

[28] The Malacca Maritime Laws has twenty-five chapters. It is concerned with maritime matters such as the duties of a ship's crew, and the sea voyage rules and trade. For details, see *id.*

[29] *Adat Temenggung* is one of the branches of customary laws in Malaysia. The other form of *adat* is *Adat Perpatih* (developed in a matrilineal kinship structure in areas occupied by the *Minangkabau* people in Sumatra

established that the indigenous community already had their own constitutional system during those periods.

The Portuguese and the Dutch were the first two European powers to arrive in Malacca. Malacca fell to the Portuguese under the command of Alfonso de Albuquerque in 1511.[31] Their interest was more in trade than in political power. They did not exert their influence over the Malays or other Asian communities. As a result, many of the former Malay administrations were retained. Later on, after 130 years of Portuguese occupation, Malacca fell to the Dutch in 1641.[32] Like the Portuguese, the Dutch were also solely interested in trade, especially the spice islands of Maluku and Batavia (Java). In 1795, due to the Napoleonic Wars in Europe, Malacca was surrendered by the Dutch to the British. But in 1818 Malacca was returned to the Dutch, and according to the Anglo-Dutch Treaty of 1824

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and Negeri Sembilan). *Adat Temenggung* has, on the other hand, patrilineal characteristics. Both *adats* fall under the unwritten law sources. They developed prior to the 15th century. It is strongly believed that *Adat Temenggung* is fundamentally based on the Malacca Law. This is evidenced by the fact that several texts on *Adat Temenggung* are fundamentally based on the Malacca law. In general, the *Temenggung* system was organized on the basis of territorial units, with constitutional and judicial authority vested in a group consisting of *Sultan* (King), *Bendahara* (Chief Minister), *Temenggung* (Chief of Police), *Shahbandar* (Harbour Official) and others. It was agreed that *Adat Temenggung* dealt with aspects of both private and public law. But for some reasons only certain branches of these laws prevailed. For example, only certain aspects of family law, inheritance, and property, that is *harta sepencarian* (jointly owned property), were recognised and received judicial sanction. In respect of inheritance and family law, the *adat* is fundamentally based on Islamic law, although it has been modified by the local custom. At present, the law is now administered by each state, as written in the Schedule Ninth (List 11) of the Malaysian Constitution and in also the Administration of Muslim Law Enactment of each state. See Abdul Monir Yaacob, *An Introduction to Malaysian Law,* (Bangi: Universiti Kebangsaan Malaysia, 1989). See also http://en.wikipedia.org/wiki/Law_of_Malaysia, and, http://www.britannica.com/EBchecked/topic/5341/Adat-Temenggong, accessed: 15 May 2014.

[30] *Shafi'i* school of law is one of the Muslim schools of law which was named after Abu Abdullah Muhammad ibn Idris al-Shafi'i (or well-known as imam *al-Shafi'i*). Other schools of law include *Hanafi*, *Maliki*, and *Hanbali* schools of law. The followers of those schools have different opinions on issues that are not the core of Islamic belief, for instance different views on some laws and obligations of the Islamic law. However, in terms of the basic and fundamental beliefs of the Islamic religion, they believe the same. See http://en.wikipedia.org/wiki/Shafi'i, accessed: 14 May 2014.

[31] The Portuguese established a military and civil administration in Malacca. During the time of the administration, Malacca was governed by a Governor or Captain, who had power over all inhabitants, subjects, and foreigners. In civil affairs, he was assisted by a Council composed of the *Ovidor* (Chief Justice), *Viador* (Mayor), the Bishop or his deputy and a Secretary of the State. In military affairs, he had to consult the Captain-General of War (Commander-in-Chief) and the Sergeant Major. In criminal matters, sentences pronounced by the Chief Justice or a Magistrate were subject to his confirmation. The Chief Justice had civil and criminal jurisdiction. However, the Portuguese left the administration of justice amongst their non-Christian Asian subjects in the hands of their community leaders while the Portuguese came under the jurisdiction of Portuguese judges. See Ahmad Ibrahim and Ahilemah Joned, *supra* note 26, at 18-19.

[32] During the Dutch administration, Malacca was headed by a Governor who had supreme power of authority. He was assisted by a Council, consisting of Collector, Fiscal, Mayor, Upper Merchant, and a Secretary. A *Politie Raad* (Police Council) formed the executive, while the *Raad van Justitie* administered justice. The ecclesiastical affairs were managed by a special council. While Europeans were governed by Dutch laws based on colonial statutes, it is uncertain what law applied to the local and other Asian inhabitants. However, it was Dutch practice in Java to leave the natives to their own customs and laws, so it may be safely assumed that this was also the case in Malacca. See *id.,* at 19-20, and Wan Arfah Hamzah and Ramy Bulan, *supra* note 19*,* at 20-21.

Malacca was exchanged for the island of Benkulen in Sumatra. This treaty is important as it carved the Malay Peninsula and Archipelago into British and Dutch spheres of influence. It fixed the boundary between what is now Malaysia and Indonesia, and simultaneously marked the end of the Dutch claims to Malacca.[33]

Based on the observation made about the administration system practised by the Portuguese and the Dutch in those days, they did not have much influence on the constitutional system of Malaysia. However, the situation was different with respect to the British occupation as they interfered with the administration system of the local community.[34] As a result, the present legal and political system in Malaysia greatly reflects the era of British rule.

ii. British Period: The Making of the Federation of Malaya Constitution 1957 and Some Influencing Factors

This section elaborates on how the Federation of Malaya Constitution 1957 (also known as the *Merdeka* or Independence Constitution) came into existence and explains some factors that influenced the process of drafting it.

Generally speaking, apart from laying down the framework of government, a constitution of a state is very much influenced by the problems and circumstances surrounding its drafting. Since the present Malaysian Federal Constitution grew out of the Malaya Constitution 1957, a review of the historical events behind the drafting process of the Malaya Constitution 1957 is important for providing a comprehensive perspective. It will concentrate on the preliminary period of the British invasion of Malaya up to the Independence Day in 1957.

In the early stages, the British came to Malaya as traders but they ended up interfering in the affairs of sultanates, starting with the cession of Penang in 1786 from the Kedah Sultanate and the acquisition of Singapore from the Johor Sultanate in 1819. In 1824, the British formally gained Malacca from the Dutch after signing the Anglo Dutch Treaty. Afterwards, in 1826, the British formed a unified administration called the Straits Settlements, a

[33] Wan Arfah Hamzah and Ramy Bulan, *supra* note 19, at 12-13.
[34] The British started interfering in local affairs after the cession of Penang in 1786.

collection of territories[35] of the British East India Company[36] in Southeast Asia. The British rule in the Malay states started with the signing of the Pangkor Engagement[37] in 1874 with Perak. Various other treaties were also concluded with other Malay state sultanates, including treaties with the state of Selangor in 1874, Negeri Sembilan in 1879, and Pahang in 1881. Consequently, in 1895 those four states - Perak, Selangor, Negeri Sembilan and Pahang - came under British protection. Thus, they were known as the 'Federated Malay States'. This was when the 'federal system'[38] was first introduced by the British to the Malay states.

The subsequent step taken by the British was to set foot in the northern Malay states, namely the state of Perlis, Kedah, Kelantan, and Terengganu, through a treaty signed with the Siamese in 1909. The last state to come under British protection was Johor, after the signing of a treaty in 1914. At first, the states of Perlis, Kedah, Kelantan, and Terengganu were pressured and persuaded by the British to join the federation. However, the states declined as

[35] The territories comprise three trading centres: Penang, Singapore and Malacca. They were given collective administration in 1826 as a crown colony. The colony was dissolved in 1946. Singapore with its dependencies became a separate crown colony, while Penang and Malacca were included in the Malayan Union which became a Federation of Malaya in 1948. See http://en.wikipedia.org/wiki/Straits_Settlements; and http://encyclopedia2.thefreedictionary.com/Straits+Settlement, all accessed: 15 May 2014.

[36] The British East India Company (1600-1874) was also known as East India Trading Company or English East India Company. It was an early English joint-stock company, chartered by Queen Elizabeth I for the exploitation of trade with Asia. It was incorporated by royal charter on 31 December 1600 under the name of 'Governor and Company of Merchants of London Trading into the East Indies'. Starting as a monopolistic trading body, the company became involved in politics and acted as an agent of British imperialism in India from the early 18th century until the mid-19th century. The company settled down to trade in cotton and silk piece goods, indigo, and saltpetre, with spices from South India. It then extended its activities to the Persian Gulf, Southeast Asia, and East Asia. See http://www.britannica.com/eb/article-9031775/East-India-Company; http://en.wikipedia.org/wiki/East_India_Company, all accessed: 15 May 2014; and "East India Company, British", *The Columbia Encyclopaedia, Sixth Edition, 2001-2007,* at http://www.bartley.com/65/ea/EastIndB.html, accessed: 20 January 2012. For further reading, refer to Lawson, Philip, *The East India Company: A History,* (London: Longman, 1993); and Farrington, Anthony, *Trading Places: The East India Company and Asia, 1600-1834,* (London: British Library, 2002).

[37] The Pangkor Engagement was a treaty signed in 1874 between the British Government and Malay chiefs in Perak. It was the first step in the establishment of British dominion over the Malay states. In January 1874, Governor Sir Andrew Clarke of the Straits Settlements, prompted by the local trading community, organized a meeting between British, Malay, and Chinese leaders to settle a Perak succession dispute and to stop warfare between Chinese secret societies. The Perak succession controversy was settled in favour of Raja Abdullah. In return for British backing, Raja Abdullah agreed to accept a British resident (adviser), with broad power at his court. See "Pangkor Engagement" *Encyclopaedia Britannica,* http://www.britannica.com/EBchecked/topic/441250/Pangkor-Engagement, accessed: 15 May 2014.

[38] The British sought to consolidate and centralize control by federating the four states of Selangor, Perak, Negeri Sembilan and Pahang into the Federated Malay States. With Kuala Lumpur as the capital, Residents-General administered the federation but compromised by allowing the Rulers to have powers limited only to the role as authority on Islam and Malay customs. Modern legislation was introduced to the Malay states with the creation of the Federal Council. Federation brought benefits through cooperative economic development; for instance, Pahang was developed using funds from the revenue of Selangor and Perak. This period of centralization between the 1890s and 1910s, effectively marked the transition of the idea of Malay states as a collective land governed by feudal rulers. See http://en.wikipedia.org/wiki/British_Malaya, accessed: 15 May 2014.

they were unhappy with the British treatment of the Malay rulers of the Federated Malay States. Hence, this group was then categorised as 'Un-federated Malay States'. This situation ended with the division of the peninsula into three groups of states:[39] (1) the Straits Settlements, (2) the Federated Malay States, and (3) the Un-federated Malay States.

With respect to the establishment of the federation, those states that wished to be members had to sign a treaty with the British. They had to agree to constitute themselves into a federation to be known as the Protected Malay States. In such circumstances, they would be administered under the advice of the British Government. Among the clauses of the federation treaty was the acceptance of the office of the British Resident-General[40] by the Malay Rulers. After introducing the post of Resident in the Federated Malay States and the post of Adviser in the Un-federated Malay States, the British then continued to spread their power and influence via what the Malays alleged was 'indirect rule'[41]. It was understood that the term 'Federation' applied during those days was as much a misnomer as 'advice' in respect of the Resident's relationship with the Malay Rulers.[42] Nevertheless, whatever the situation, the seeds of federalism and constitutional government had already been sown during that period.

The next important event was the establishment of a Federal Council[43] by the British on 20 October 1909. An agreement was signed between the Governor of the Straits Settlements and the Malay Rulers for a constitution of the Federal Council as a result of requests by local

[39] The Straits Settlements were declared a British colony, whereas, the Federated Malay States and Un-federated Malay States were categorised as British protected states.

[40] The British Resident-General was responsible to the Governor of the Straits Settlements. There were four British Residents under the Resident-General. The post of Resident-General was later abolished in 1910 and replaced by Chief Secretary.

[41] It was called 'indirect rule' as the Sultans continued to be the Malay states' rulers, but for all intents and purposes the British officers were in charge. It was also commonly referred to by historians as the 'Residential System'. It was a system in which each Sultan had to accept a British Resident whose advice had to be asked and acted upon in all matters of administration and revenue, except for Malay religion and customs. In this system, it was claimed that even though, in the *de jure* position, the sultans possessed the power to rule, in the *de facto* position it was the British who actually ran and governed the states. In practice, despite the sovereign position of the Malay Rulers applied during those periods, the reality was that the High Commissioner and the Resident-General always took precedence over them, for example in circumstances where laws were passed irrespective of the rulers' presence in the meeting. See Abdul Aziz Bari, *supra* note 21.

[42] Wu Min Aun, *The Malaysian Legal System,* 3rd. ed., (Petaling Jaya: Pearson Malaysia Sdn Bhd, 2005), at 143.

[43] Federal Council consists of the High Commissioner as President, the Resident-General, the four Rulers, the four British Residents, and four unofficial members nominated by the High Commissioner.

entrepreneurs'.[44] As a matter of fact, the establishment of the Federal Council 1909 was significant for the constitutional development towards a parliamentary system in Malaya. However, the article[45] in the Federal Council Agreement was unclear with respect to the division of powers between the federal government and the states. It neither conferred specific power on the Federal Council nor defined the limit of the federal authority. The article merely stated the primacy of the federal laws over the state laws in the event of repugnancy. However, as far as the Islamic and Malay affairs were concerned, the article clearly mentioned that those matters should be exclusively reserved to the State Council.

The establishment of the Malayan Union in 1946 also influenced the drafting process of the Independence Constitution. After the Japanese surrender in 1945,[46] the British administration was resumed. In the initial stage, the British established a Military Administration to govern the country. But later on, they felt that radical reform was necessary for Malaya. In such circumstances, they introduced a unified system of government by proposing the creation of a unitary state,[47] known as the Malayan Union.[48] This scheme, however, lasted only for two years due to strong opposition from the Malays, especially with regard to Malayan Union

[44] This effort was made due to the rapid increase in the commercial, mining, and planting communities in the Malay states, in which it was felt there should be a central body to control the finances and direct the course of legislation. See Wu Min Aun, *supra* note 42, at 24.

[45] Article 9 of the Federal Council Agreement stated that, 'Laws passed or which may hereafter be passed by the State Councils shall continue to have full force and effect in the state except insofar as they may be repugnant to the provisions of any law passed by the Federal Council, and connected with the *Muhammadan* Religion, Mosque, Political Pensions, Native Chiefs and *Penghulus* and any other questions which in the opinion of the High Commissioner affect the rights and prerogatives of any of the above-named Rulers or which for other reasons he considers should properly be dealt with only by the State Councils shall be exclusively reserved to the State Councils'.

[46] The Japanese invaded Malaya on 8 December 1941. The invasion took place after the Japanese landed their troops on the beaches at Kota Bharu, Kelantan (a state of Malaysia located in the north-east of Peninsular Malaysia).

[47] Under the Malayan Union, the British dissolved the Straits Settlements. Penang and Malacca were grouped with the Malay states to form a union on 1 April 1946. However, Singapore was left out for economic and political reasons and then became a Crown colony.

[48]Malayan Union was formed on 1 April 1946 by the British with Sir Edward Gent as its first governor. It introduced a concept of broad-based citizenship, where all citizens had equal rights regardless of race. Citizenship was automatically granted to people who were born in any state in British Malaya or Singapore and were living there before 15 February 1942. The same situation applied to those who born outside British Malaya or the Straits Settlements only if their fathers were citizens of the Malayan Union. The situation was similar for those who had reached 18 years of age and had lived in British Malaya or Singapore for 10 out of 15 years before 15 February 1942. People eligible for citizenship application had to have lived in Singapore or British Malaya for 5 out of 8 years preceding the application, had to be of good character, understand and speak the English or Malay language, and had to take an oath of allegiance to the Malayan Union. The Malay rulers had to concede all their powers to the British crown except in religious matters. See http://en.wikipedia.org/wiki/Malayan_Union, accessed: 15 May 2014; and "Encyclopaedia Malayan Union", *Nation Master Encyclopaedia*, http://www.nationmaster.com/encyclopedia/Malayan-Union, accessed: 10 October 2011.

citizenship.[49] The Malays registered strong opposition when they realised that the MacMichael Treaties[50] reduced the status of Malay states to a colony and deprived the Malay Rulers of sovereignty. Consequently, the Malayan Union was dissolved and replaced by the Federation of Malaya 1948.

On 1 February 1948, the Federation of Malay Agreement was substituted as a compromise. It then brought into being a new Federation of Malaya.[51] The Malay Rulers became constitutional monarchs and members of *Majlis Raja-Raja Negeri Melayu* (Conference of Malay Rulers).[52] Written constitutions were introduced to all Malay states with the exceptions of Johor and Terengganu.[53] Each state had its own Executive Council and Council of States to deal with matters not specifically reserved for the Federation.[54] This demonstrated that the Federation of Malay Agreement 1948 had established a pattern of a federal system of strong central government with wide legislative powers.

It was the wish of the United Kingdom Government and the Malay Rulers that progress be made towards eventual self-government.[55] This demonstrated the serious intention and preparation of the British and the Malay Rulers to move towards the higher stage of political advancement. Finally, in 1955, the first federal elections were held for 52 seats on the Federal Legislative Council. The Alliance[56] consisted of three main ethnic parties: the United Malay National Organization (UMNO), the Malayan Chinese Association (MCA) and the Malayan

[49] The Malays believed that the Malayan Union proposal would result in the abandonment of the policy of recognising the Malay states as *Tanah Melayu* (Land of the Malays), thus depriving them of their special position and privileges. It also raised the fear of non-Malay domination. Refer Wan Arfah Hamzah and Ramy Bulan, *supra* note 19, at 27.

[50] For the establishment of the Malayan Union, the British sent Sir Harold McMichael to Malaya to obtain cooperation from the Malay Rulers. In 1945, the British emerged with a treaty called the 'MacMichael Treaties' for the Rulers to sign agreeing that the British would have full power and jurisdiction over all Malay states.

[51] The new Federation consisted of all territories of the former Malayan Union, nine Malay states together with Penang and Malacca. But Singapore remained a separate crown colony. It was not included in deference to the fear of the Malays that the Malayan Chinese would outnumber them. A federal government was then set up in Kuala Lumpur under a British High Commissioner. The other primary organs were an Executive Council and a Legislative Council, the representatives of which came from all races.

[52] The Conference of Malay Rulers still exists today and was officially established under article 38 of the present Malaysian Federal Constitution. It comprises nine rulers from nine states (Selangor, Negeri Sembilan, Perlis, Pahang, Terengganu, Kedah, Kelantan, Johor and Perak), and four governors from four other states (Penang, Melaka, Sabah and Sarawak) that have no rulers. Its main task is the election of the *Yang di-Pertuan Agong* (the King of Malaysia), and *Timbalan Yang di-Pertuan Agong* (Deputy) every five years. It organizes meetings generally three times a year. See http://en.wikipedia.org/wiki/Conference_of_Rulers, and http://en.wikipedia.org/wiki/Yang_di-Pertuan_Agong, accessed: 15 May 2014.

[53] Johor and Terengganu already possessed their own constitutions promulgated in 1895 and 1911.

[54] The Federal Government was responsible for defence, police, railways, labour, broadcasting, post and finance including income tax and custom duties.

[55] See the preamble of the Federation of Malaya Agreement 1948.

[56] The Alliance's leader, Tunku Abdul Rahman, became the first Chief Minister.

Indian Congress (MIC); won 51 of the 52 seats. It was proved that the Alliance had majority support from all ethnic groups. Hence, with a sense of confidence and courage, they felt it had become possible to make preparations for full self-government.[57]

After the overwhelming victory in the election, the Alliance leaders turned their attention to the independence issue. They proposed to set up an independence commission to draft a constitution. This was agreed by the British. Consequently a Commonwealth Constitutional Commission[58] was set up and was known as the Reid Commission.[59] It was led by Lord Reid[60] who was nominated by the British Government. The other Commission members were Sir Ivor Jennings[61] (also nominated by the British), Sir William McKell[62] (nominated by the

[57] In actual fact, the Alliance was very much influenced by the political developments in other parts of Asia including India, Pakistan, and Ceylon, which gained independence. For a speedier approach to self-government, they felt that there was a need for a Federal Legislative Council with an elected majority. Among the shrewd political strategies employed by the Alliance was its decision to focus its campaign on the independence issues. The election campaign banners were filled with the word *merdeka* (independence). Tunku Abdul Rahman made a statement that 'bad self-government was better than good foreign government'. A thorough discussion is available in Chapter 2, Fernando, Joseph M., *The Making of the Malayan Constitution,* (The Malaysian Branch of the Royal Asiatic Society, 2002).

[58] The Commonwealth Constitutional Commission was proposed by the Alliance and was accepted in the London Conference (18 January - 6 February 1956). It was also agreed that the British would nominate the Commission Chairman and an additional member. At the same time, Australia, Canada, India, and Pakistan were to nominate a member each. They started work in May 1956.

[59] The function of the Reid Commission was to draft a new Federal Constitution in the sense that they had to provide legal frameworks for a strong central government with a measure of autonomy for the states. Among their tasks were to safeguard the position of the Malay Rulers as constitutional monarchs, to create a common nationality for the Federation, and to safeguard the special position of the Malays and the legitimate interests of other communities. This posed two main problems: a suitable scheme for the division of power and resources between the Federal government and the States, and one to safeguard the rights and interests of the Malays and non-Malays. See Fernando, Joseph M. *supra* note 57, at 116.

[60] Lord Reid, the oldest member, was the chairperson of the Commission. He was a prominent Appeal Court Judge and served as a Solicitor-General for Scotland. He was a politician, legislator and law officer. He contributed tremendously to the Commission using his legal expertise and political astuteness. This was proved in his cross-examination during the hearing of the oral evidence and in the debates within the Commission. His careful handling of the private hearing helped the Commission to elucidate the Alliance proposal in the memorandum and the problems that they were likely to pose. See *id.*, at 106.

[61] Sir Ivor Jennings was a former King's Counsel. He served as a vice-chancellor of Cambridge University and was a Master of Trinity Hall, Cambridge. He was the constitutionalist *par excellence* in the Commission. He had published several important works on constitutional matters. His easy-going and unassuming style put the other members of Commission at ease in his company, professionally as well as personally. He composed the actual fifth and final draft of the Constitution. The fluency, clarity, and legal precision of the language in the draft are a testimony to his excellent command of the legal nomenclature. His knowledge of Commonwealth constitution and experience in drafting the Pakistan Constitution gave him a clear advantage over the others. In fact he became the *de facto* master draftsman. Having been part of a commission on university education in Malaya and constitutional adviser to Marshall's government in Singapore in 1955, he was more familiar with the political and geographical conditions in Malaya than the other members. His personal friendship with Tunku Abdul Rahman also gave him a deeper insight into the working of Malayan politics. *Id.*

[62] Sir William McKell was a former Governor-General of Australia. He had served as a minister in several Australian Cabinets, once as Justice Minister, and brought with him considerable experience in political administration. He gained intimate knowledge on the Federal concept in Australia and his experience as a Cabinet member in the Australian Government assisted the Commission to formulate the principles regulating the working of the Federal system in the Constitution. See *id.*

Australian Government), Justice B. Malik[63] (nominated by the Indian Government), and Justice Abdul Hamid[64] (nominated by the Pakistan Government). However, the Canadian Government did not send a representative to the Commission.[65] The most prominent feature of these five members of the Commission was that they were all steeped in English constitutionalism. Despite coming from different countries, they shared a common background of legal training and experience in Commonwealth parliamentary traditions and constitutions derived largely from English constitutionalism.[66] Their task was enormously complex.[67] The Commission, indeed, borrowed ideas from the Constitutions of India, Ceylon, Australia, the United States and constitutional precedents in Britain.[68] Examination of the constitutional documents indicates that Reid, Jennings, and Hamid were the leading players in the shaping of the Malayan Constitution 1957.[69]

The other central factor shaping the drafting process of the Malayan constitution 1957 was the Alliance memorandum.[70] This served as an important foundation for the Commission to draft the new Constitution. In this memorandum, the Alliance leaders did not attempt to draw up the details of the constitutional provisions but left the Reid Commission to work on them. There were two committees[71] appointed by the Alliance to draft the memorandum: the first dealt with communal issues,[72] whereas the second dealt with the structure and function of

[63]Initially, the Indian Government nominated Justice P.Govinda Menon, Madras High Court judge, who also served on the International Military Tribunal for the prosecution of Japanese war criminals in 1946. But when he declined, the Indian Government offered the service to Justice B. Malik, a former Chief Justice of Allahabad. He made a significant contribution in drafting the provisions on the fundamental liberties which were largely drawn from the Indian Constitution. His knowledge regarding the practical problems of interpreting the provision on fundamental liberties faced by Indian Courts truly helped the Commission to avoid some of the pitfalls in framing the same provisions in the Malayan Constitution. See *id.* at 106.

[64] Justice Abdul Hamid was an experienced High Court Judge. He had served as Secretary to the Ministry of Law in West Pakistan. He was involved in drafting Pakistan's Constitution with Sir Ivor Jennings. He contributed to the Commission by preparing the basic drafting and working papers for discussion. He provided an extra dimension to the Commission particularly on the working of the federal principles in Pakistan. See *id.*

[65] The Commission was informed that the Canadian nominee was unable to take up the offer due to health reasons.

[66] *Id.*

[67] They had to frame their recommendations in light of the norms of parliamentary democracy and the principles of a modern constitution taking into account the Malaysian political environment.

[68] *Id.* at 97.

[69] *Id.* at 114.

[70] It was a 20-page memorandum debated in private by a core group from UMNO, MCA, and MIC between April and September 1956. The memorandum not only outlined the general principles of agreement on constitutional issues between the communal leaders of UMNO, MCA and MIC, but also represented the visions, hopes and aspirations of the Alliance leaders for the emerging nation state. See *id.* at 65.

[71] The committee did not include the foreign legal expertise in the discussion probably for reasons of secrecy as it involved the sensitive nature of issues of local communities such as the Malay special position.

[72] The examples of communal issues are citizenship, language and the Malay special position. The first committee comprised Tunku Abdul Rahman, Datuk Abdul Razak, Dr Ismail Abdul Rahman, Ismail Mohamed Ali, Mohamed Khir Johari, Abdul Khir Shamsuddin, Abdul Aziz Ishak and Mohamed Daud (all from UMNO);

government, the Federal-State division powers and resources, the judiciary and others.[73] The second committee, in fact, encountered little difficulty and easily reached an agreement.[74]

The Alliance, indeed, favoured a Westminster-style parliamentary democracy[75] with a Malayan constitutional monarchy and an independent judiciary since they were trained in British parliamentary traditions and English constitutionalism. They proposed a bicameral legislature consisting of a partially elected upper house (*Dewan Negara*) and a fully elected lower house (*Dewan Rakyat*), each of which serves a term of office of five years. The memorandum also made reference to the principle of separation of powers.[76] At the same time, the judiciary was viewed as a check and balance to the power of the Executive and Legislature.[77] Regarding amendments to the Constitution, the Reid Commission established that they should be made by a majority of two thirds of the members of each house of Parliament, present and voting.[78]

For the Federal-State distribution of legislative powers and financial resources, the Alliance proposed greater powers for central government than those provided by the Federation of Malaya Agreement 1948.[79] The other area of great concern in the memorandum was the issue of fundamental liberties.[80] The fundamental source of reference was the Indian Constitution. As a matter of fact, the Reid Commission borrowed heavily from the provisions on

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H.S.Lee, Leong Yew Koh, Ong Yoke Lin, Tan Siew Sin, Dr Lim Chong Eu, Ng Ek Teong, Too Joon Hin, Yong Pung How and T.H. Tan (all MCA); V.T.Sambanthan, K.Ramanathan, K.L.Devaser, B.Kaher Singh, V.Manickavasagam and A.Krishnadas (all MIC). See *id.* at 68.

[73] The second committee comprised Abdul Kadir Shamsuddin and Senu Abdul Rahman (from UMNO); Ong Yoke Lin and Y.C. Kang (from MCA); and K.Ramanathan and A.Krishna Dass (from MIC). See *id.*

[74] The existing precedents in other commonwealth constitutions, particularly the British, India and Australian Constitutions, provided ample references to draft the constitutional provision outlining the functions and powers of Parliament, the Executive and the Judiciary.

[75] The main exception in Malaya was the inclusion of a provision in the Federal Constitution for the institution of an elected kingship, the Supreme Ruler, with five-year terms. This concept drew its inspiration from the traditional practices in Negeri Sembilan and Perak, where the head of state was elected from the various ruling chiefs. See *id.* at 117.

[76] The Memorandum declared that the judiciary should be completely independent both of the Executive and the Legislature.

[77] *Id.* at 68.

[78] This was identical to the article on constitutional amendment in the Indian Constitution.

[79] This was in accordance with their principal intention to create a strong government. They insisted that the Commission define clearly the legislative and executive powers of the Federal and State Governments in order to avoid possible difficulties in the event of the states being controlled by different parties from that controlling the Federal Government.

[80] Based on the communal tensions experienced by the Alliance during the Malayan Union scheme 1946, the 1948 Federation of Malaya Agreement and the on-going emergency, they wanted to ensure that all the basic rights and liberties of the individual would be guaranteed and written into the new Constitution.

fundamental rights in the Indian Constitution, although they adopted the style of phrasing used in the American Bill of Rights.[81]

The most contentious issues in the final memorandum were the issues of citizenship,[82] the Malay special position, and the national language. Under the Federation of Malaya Agreement 1948, Malays who were subjects of any of the nine Malay Rulers and also the British subjects in Penang and Malacca automatically became Federal citizens, while the other communities could acquire Federal citizenship by application if they fulfilled the residential requirements.[83] However, in the inter-communal constitutional bargain between UMNO and MCA, the Alliance agreed on the application of the principle of *jus soli,*[84] for those born in the Federation after independence.

In respect of language, the main problem was the status of Chinese and Tamil.[85] The Alliance, under a committee headed by the Education Minister, Datuk Abdul Razak, prepared a report called 'The Razak Report'.[86] The Prime Minister, Tunku Abdul Rahman, pointed out the important need for a common language to foster a common nationhood in the Federation.[87] He said that recognising Malay as the principal and national language in the Federal Constitution and simultaneously upholding the rights of others to use their own languages, script and culture was the right thing to do. Despite all these communal tension situations, both UMNO and MCA realised that they had to compromise in dealing with these sensitive issues if they really wanted to submit the memorandum to the Reid Commission.

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[81] *Id.* at 133.
[82] For example, the MCA and MIC did not agree with the UMNO proposal that those born in Malaya of alien parents on or after independence would cease to be nationals on reaching the age of 21 unless they made a declaration of the retention of their nationality within a year of reaching that age. For more information, see *id.,* at 74-75.
[83] Those born in the Federation and resident there for eight years could acquire Federal citizenship by application, while residents who had been born outside the Federation needed to fulfil a residential requirement of 15 years. However, this type of citizenship left a large number of domiciled non-Malays as non-citizens. See *id.* at 73.
[84] The principle of *jus soli* referred to the rule by which birth in a state is sufficient to confer nationality, irrespective of the nationality of one's parents. See Martin, Elizabeth A. And Jonathan Law, eds**.,** *supra* note 20, at 301.
[85] The non-Malays felt that the continuous use of their language was important for the preservation of their culture and identity.
[86] It emphasized the adoption of a common syllabus in schools irrespective of the medium of instruction and the introduction of Malay as a compulsory subject in line with the Alliance objective to promote it as the national language. Thus, the means of instruction were English, Malay, Mandarin, and Tamil. See Fernando, Joseph M., *supra* note 57, at 75.
[87] He made comparisons with the Indian Constitution, stating that India had adopted Hindi as the national language while retaining English as an official language for 15 years.

In January and February 1956, a Constitutional Conference was held in London and the proposals were accepted. As a result, the Constitution was then duly promulgated. Thus, on 31 August 1957 the Federation of Malaya became an independent state. The constitution in fact embodied the British and Indian constitutional concepts and also the traditional Malay elements.[88] Although the Malaysian Constitution was largely based on the Indian Constitution,[89] a written constitution with a chapter on fundamental rights with a Parliament vested with extensive powers on the grounds permitted by the Constitution itself, it is not a document hammered out by a constitutional assembly comprising representatives of the people. Rather it developed from an earlier constitution drafted by a commission of foreign experts in constitutional law.[90] Its evolution (and departure) from the original is, however, uniquely Malaysian.[91]

(c) The Malaysian Federal Constitution

As a federal country, Malaysia[92] is governed by the Malaysian Federal Constitution.[93] This Constitution emerged from several changes and amendments[94] of the Independence Constitution 1957. It consists of 15 Parts[95] and 13 Schedules.[96] It is the supreme law[97] of the

[88] See Mohamed Salleh Abbas, "The Traditional Elements of the Malaysian Constitution", *The Constitution of Malaysia: Further Perspectives and Developments,* F.A. Trindade and H.P. Lee, eds., (Singapore: Oxfords University Press, 1986), at 1-17; quoted also in Wan Arfah Hamzah and Ramy Bulan, *supra* note 19, at 26.

[89] The Indian Constitution was formulated by a local body, the Constituent Assembly of India comprising politicians, lawyers and other professionals. In Ceylon and Pakistan, this body included foreign constitutional experts, a combination of both local legislators and foreign constitutional experts, especially from the ruling colonial power, Britain. Wan Arfah Hamzah and Ramy Bulan, *supra* note 19, at 103.

[90] Malaya opted for an entirely non-Malayan constitutional commission. This decision was determined by the Alliance in their 1955 election manifesto which stated their preference for a non-Malayan commission, as they felt that such a body would be able to avoid local prejudices and perform its task with complete impartiality. *Id*.

[91] *Id.* at 26.

[92] Malaysia is a federation of 13 states and 3 federal territories. The 13 states are Johor, Kedah, Kelantan, Malacca, Negeri Sembilan, Pahang, Penang, Perak, Perlis, Sabah, Sarawak, Selangor, and Terengganu. The 3 federal territories are the Federal Territory of Kuala Lumpur, Federal Territory of Putra Jaya, and Federal Territory of Labuan. See Article 1, Malaysian Federal Constitution, *infra* note 93.

[93] In this section, the words 'Malaysian Federal Constitution' or 'Federal Constitution' refer to the Malaysian Federal Constitution as at 1st February 2013; all Sections and Parts, unless specified otherwise, also refer to those provided in the Malaysian Federal Constitution.

[94] The Independence Constitution 1957 had experienced some amendments, such as the constitutional crisis in 1983. Here, the amendment involved the questions of assent to Bills and the power of the King (*Yang di Pertuan Agong*) to declare emergencies. Others include the issues of the Malaysian Rulers' immunity 1993, where a special court for the Rulers was established, but apparently the immunity was not removed. For more details, see Abdul Aziz Bari, *supra* note 21, at 29-34.

[95] These 15 Parts are: Part I (The States, Religion and Law of the Federation); Part II (Fundamental Liberties); Part III (Citizenship); Part IV (The Federation); Part V (The States); Part VI (Relations Between the Federation and the States); Part VII (Financial Provisions); Part VIII (Elections); Part IX (The Judiciary); Part X (Public Services); Part XI (Special Powers Against Subversion, Organized Violence, and Acts and Crimes Prejudicial to the Public and Emergency Powers); Part XII (General and Miscellaneous); Part XIIA (Additional Protections

country on which the system of the Malaysian Government and its legal system are based. The Federal Constitution incorporates some indigenous characters,[98] for instance the sultanates or the monarch,[99] the position of Islam,[100] the position of the Malay language,[101] and the special position of the Malays[102].

For States of Sabah and Sarawak); Part XIII (Temporary and Transitional Provisions); Part XIV (Saving For Rulers' Sovereignty, *etc.*); Part XV (Proceedings Against the *Yang Di-Pertuan Agong* and the Rulers).

[96] The 13 Schedules are: *First Schedule* (Oath of Applicants for Registration or Naturalization); *Second Schedule* (Citizenship); *Third Schedule* (Election of *Yang di-Pertuan Agong* and *Timbalan Yang di-Pertuan Agong*); *Fourth Schedule* (Oaths of Office of *Yang di-Pertuan Agong* and *Timbalan Yang di-Pertuan Agong*); *Fifth Schedule* (The Conference of Rulers); *Sixth Schedule* (Forms of Oaths and Affirmations); *Seventh Schedule* (Election and Retirement of Senators); *Eighth Schedule* (Provisions to be inserted in State Constitution); *Ninth Schedule* (Legislative Lists); *Tenth Schedule* (Grants and Sources of Revenue assigned to State); *Eleventh Schedule* (Provisions of the Interpretation and General Clauses Ordinance, 1948 (Malayan Union Ordinance No.7 of 1948), applied for interpretation of the Constitution); *Twelfth Schedule* (Provisions of the Federation of Malaya Agreement, 1948 as applied to the Legislative Council after Merdeka Day-Repealed); *Thirteenth Schedule* (Provisions relating to delimitation of constituencies).

[97] Supreme means the highest in ranking or authority and even means being in an all-powerful position. Even the *Yang di-Pertuan Agong, i.e.*, the supreme ruler, has been created by the Constitution and is therefore subject to the Constitution and law. See Tun Mohamed Suffian, *An Introduction to the Legal System of Malaysia,* 2nd ed., (Petaling Jaya: Penerbit Fajar Bakti Sdn Bhd, 1989), at 15-17; Rau and Kumar, *General Principles of the Malaysian Legal System,* (Shah Alam: International Law Book Services, 2006), at 43-44 and at 50-53; Abdul Aziz Bari, *supra* note 21, at 35; and Wan Arfah Hamzah and Ramy Bulan, *supra* note 19, at 33-35.

[98] Indigenous character here refers to the elements that are unique in the sense that they can only be found in the Malaysian constitution.

[99] The constitutional monarchy refers to the office of *Yang di-Pertuan Agong* (the King), *Sultans* (the Malay rulers) and the Conference of Rulers. Malaysia has nine Sultanates. Each of them takes turn, according to the constitutional rules and practices, to be the King. The King shall be elected by the Conference of Rulers for a term of five years. He is the Supreme Head of the Federation. The King is the head of states, while Prime Minister is the head of government. The King is said to have power to reign, while the Prime Minister has power to govern. See *Chapter 1-The Supreme Head* (Article 32-37), *Chapter 2-The Conference of Rulers* (Article 38), *Chapter 3-The Executive* (Article 39-43A) of the Federal Constitution. See Ahmad Ibrahim and Ahilemah Joned, *Sistem Undang-Undang di Malaysia,* 3rd printing (2nd. ed.), (Kuala Lumpur: Dewan Bahasa dan Pustaka, 2005), at 178; Ahmad Ibrahim and Ahilemah Joned, *The Malaysian Legal System, supra* note 26, at 187-189; Abdul Aziz Bari, *supra* note 21, at 44-46; Wu Min Aun, *supra* note 42*,* at 58-66; Tun Mohamed Suffian, *supra* note 97, at 20-49; Rau and Kumar, *supra* note 97, at 55-58.

[100] The Federal Constitution affirms that Islam is the religion of the Federation but simultaneously guarantees the freedom of religion. In other words, other religions may be practised in peace and harmony in the country. The Federal Constitution establishes that every person has the right to profess and practise his religion freely. Persons under eighteen years of age will have their religions determined by their parents or guardians. See Article 3(1), Article 11, Article 12 of the Federal Constitution. See also Abdul Aziz Bari, *supra* note 21, at 46-47.

[101] The Federal Constitution declares the position of the Malay language as the national language. It was the Malay Rulers who insisted that Malay language should be the language of the administration. But the usage of the Malay language is still subject to some practical exemptions, for instance when it involves the international community thus necessitating the use of other languages such as English, Arabic, Mandarin and others. See Article 152 of the Federal Constitution. See also Abdul Aziz Bari, *supra* note 21, at 47-50.

[102] The Federal Constitution is also concerned with protecting the Malays and natives of the States of Sabah and Sarawak and the legitimate interests of other communities. The King may exercise his function under the constitution to safeguard the special position of the Malays and natives of Sabah and Sarawak as he may deem reasonable of position, such as in the public service, scholarships, exhibitions, and other similar education or training privileges, or special facilities given or accorded by the Federal Government. See Article 153 of the Federal Constitution.

This section aims to analyse the Articles in the Federal Constitution that might be applicable to the country's outer space activities. The major concern is to determine the type of legislatures that have legislative competencies with respect to the country's outer space law, policy, and activities. This issue was mooted in view of the fact that there are two main legislative actors in the Federation of Malaysia: the Federal Legislature (*i.e.* the Parliament)[103] which acts for the Federal Government, and the State Legislature (*i.e.* the Legislative Assembly)[104] which acts for the State Government.

As far as the exercising of the legislative power conferred by the Federal Constitution is concerned, the Parliament may make laws for the whole or any part of the Federation and these laws have effect both outside and within the Federation. However, the State Legislature may make laws for the whole or any part of that state only.[105] Chapter 1 of Part VI,[106] the Federal Constitution, deals with the distribution of legislative powers between the Federal Legislature and the State Legislature. Article 74(1) of the Federal Constitution[107] confers legislative power on the Parliament, which may make laws with respect to any matters enumerated in the 'Federal List or the Concurrent List' in the Ninth Schedule of the Federal Constitution. On the other hand, the legislative power of the State Legislature was conferred by Article 74(2) in which the State Legislature may make laws with respect to any matters enumerated in the 'State List or the Concurrent List' in the Ninth Schedule of the Federal Constitution.

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[103] The Federal Legislature is also known as the Parliament, in which the legislative authority of the Federation is vested. The Parliament consists of *Yang di Pertuan Agong* (the King) and two chambers (*Majlis* or Houses of Parliament). The first chamber is *Dewan Negara* (Senate), the upper house, and the second chamber is *Dewan Rakyat* (House of Representatives), the lower house. See *Chapter 4 – Federal Legislature* (Article 44 – Article 65) of the Federal Constitution. For further details, read Tun Mohamed Suffian, *supra* note 97, at 32-33; Rau and Kumar, *supra* note 97, at 58-59; Wu Min Aun, *supra* note 42, at 82-92; and, Ahmad Ibrahim and Ahilemah Joned, *supra* note 99, at 187-204.

[104] The State Legislature, by virtue of the Essential Provision, is a unicameral body with the name *Dewan Undangan Negeri* (the Legislative Assembly). Each State Legislature consists of the Ruler or the *Yang di-Pertua Negeri* and a number of elected members as may be provided by the Legislature. See *Part V – The States* (Article 70 – Article 72), Federal Constitution. For details, see Rau and Kumar, *supra* note 97, at 55-58 and 89-90; Tun Mohamed Suffian, *supra* note 97, at 35-36; Wu Min Aun, *supra* note 42, at 92-96; and, Ahmad Ibrahim and Ahilemah Joned, *supra* note 99, at 240-251.

[105] See Article 73 of the Federal Constitution.

[106] Part VI of the Federal Constitution deals with 'Relations between the Federation and the States'.

[107] Article 74(1) of the Federal Constitution mentions: *'Without prejudice to any power to make laws conferred on it by any other Article, Parliament may make laws with respect to any of the matters enumerated in the Federal List or the Concurrent List …'*

The matters on which the Parliament may make laws under the Federal List[108] are summarized as follows:[109] (1) External affairs; (2) National defence; (3) Internal security; (4) Civil and criminal law and procedure and the administration of justice; (5) Federal citizenship and naturalization; aliens, (6) The machinery of government; (7) Finance; (8) Trade, commerce and industry; (9) Shipping, navigation and fisheries; (10) Communications and transport; (11) Federal works and power; (12) Surveys, inquiries and research; (13) Education; (14) Medicine and health; (15) Labour and social security; (16) Welfare of the aborigines; (17) Professional occupations; (18) Holidays, standard of time; (19) Unincorporated societies; (20) Control of agricultural pests, protection against pests, prevention of plant diseases; (21) Newspapers, publications, publishers, printing, printing presses; (22) Censorship; (23) Theatres, cinemas, public amusements; (24) Federal housing and improvement trusts; (25) Co-operative societies; (26) Prevention and extinguishment of fire, including fire services and fire brigades.

With respect to the State Legislature, the matters on which it may make laws under the State List[110] are as follows:[111] (1) Islamic law and personal and family law of Muslims, Malay customs, offences by Muslims, *Syariah* Courts; (2) Land; (3) Agriculture and forestry; (4) Local government; (5) Local services; (6) State works and water; (7) Machinery of the State Government; (8) State holidays; (9) Offences against State Law; (10) Inquiries for State purposes; (11) Indemnity; (12) Turtles and riverine fishing.

The matters on which both the Parliament and the State Legislature may have power to make laws under the Concurrent List[112] are condensed as follows:[113] (1) Social welfare, social services, protection of women, children and young persons; (2) Scholarships; (3) Protection of wild animals and wild birds, National Parks; (4) Animal husbandry; (5) Town and country planning; (6) Vagrancy and itinerant hawkers; (7) Public health, sanitation and prevention of diseases; (8) Drainage and irrigation; (9) Rehabilitation of mining land which has suffered soil erosion; (10) Fire safety measures and fire precaution in the construction and maintenance of buildings.

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[108] See Annex 1: List I-Federal List, under the Ninth Schedule, Malaysian Federal Constitution.
[109] Lee Mei Pheng, *General Principles of Malaysian Law,* 4th ed., (Shah Alam: Penerbit Fajar Bakti Sdn. Bhd., 2001), at 6-7.
[110] See Annex 2: List II – State List under the Ninth Schedule, Malaysian Federal Constitution.
[111] *Id.,* at 7.
[112] See Annex 3: List III – Concurrent List under the Ninth Schedule, Malaysian Federal Constitution.
[113] *Id.,* at 6-7.

It is obviously observed that all articles as well as items enumerated in the three Legislative Lists (the Federal List, the State List, and the Concurrent List) have no literal or direct article, item or even word mentioning the words 'space' or 'outer space'. However, recourse could be made to certain words or subject matters written in the three preceding lists that might seem applicable to outer space activities.

With reference to the Federal List, Item 1 mentions 'external affairs'.[114] This word is then further explained in sub-clauses (a) and (b)[115] by which it may include international treaties, agreements and conventions and also the implementation of the treaties, agreement, and conventions with other countries. At this juncture, it is believed that the term 'external affairs' may perhaps encompass outer space activities (even though it is not always the case). It is relying on the fact that outer space matters normally deal with external affairs of the country, which involves negotiation and agreements with foreign states. In addition, this is indeed made possible by virtue of Article 74(1) of the Federal Constitution,[116] if read together with the Federal List under Item 1(a) and (b), as it will then conclude that the Federal Parliament has the exclusive power to make laws relating to the state's external affairs including matters in respect of space treaties, agreements, and conventions. It also has the power to implement such treaties, agreements and conventions with other countries and to make them operative domestically.[117] Thus, by virtue of Item 1 of the Federal List, it is submitted that the Federal Legislature has legislative competencies with respect to the country's outer space law, policy, and activities.

Item 10 is another Item in the Federal List that may be applicable to outer space activities. It states the words 'communication and transport'.[118] This Item then further provides that the words 'communications and transport' may also include 'telecommunications,[119] wireless,

[114] Item 1, List I - Federal List, Ninth Schedule, Federal Constitution, *supra* note 108.
[115] Item 1(a) and (b), List I - Federal List, Ninth Schedule, Federal Constitution; see Annex 1. Item 1 prescribes: *'External affairs, including: (a) Treaties, agreements and conventions with other countries and all matters which bring the Federation into relations with any other country;(b) Implementation of treaties, agreements and conventions with other countries'.*
[116] See Article 74(1), Federal Constitution, *supra* note 107.
[117] Abdul Ghafur Hamid @ Khin Maung Sein, "Judicial Application of International Law in Malaysia: An Analysis", *The Malaysian Bar,* 31 March 2006, http://www.malaysianbar.org.my/international_law/judicial_application_of_international_law_in_malaysia_an_analysis.html, accessed: 14 May 2014.
[118] Item 10, List I - Federal List, Ninth Schedule, Federal Constitution, *supra* note 108.
[119] Item 10(g), List I - Federal List, Ninth Schedule, Federal Constitution, *supra* note 108.

broadcasting, and television,[120] which are certainly considered part of or interrelated with outer space matters.

A similar possible connection is observed in other Items listed in the Federal List, such as in Item 2 (national defence), Item 3 (internal security), and Item 9 (shipping, navigation and fisheries) since they might involve certain activities with respect to outer space interest. This happens particularly in the application of remote sensing satellites. In addition, Item 4 (civil and criminal law) of the Federal List also seems relevant for it may possibly have their genesis in outer space.

As for the subject matters itemized under the State List of the Federal Constitution, Item 3 (forestry and agriculture) is clearly correlated to outer space activities as it also involves the operation of remote sensing satellites. This is also accurate with respect to Item 3 (protection of wild animals and wild birds) of the Concurrent List. This contention is made since the technology of remote sensing satellites might be utilized for the protection of wild animals and birds.

Hence, based on this preliminary presentation, there are a number of subject matters listed under the Federal List that seem to correspond with outer space-related activities although, in a way, it seems that, with regard to the State List and the Concurrent List, only a few items are involved. Therefore, there are strong grounds for believing, at this particular point, that the legislative jurisdiction and power with respect to outer space law, policy and activities, in pitch and substance, is mainly a competence of the Federal Government.

1.2.3. The Malaysian Communications and Multimedia Act 1998 (Act 588).

The need for national space legislation is no longer in dispute since the burgeoning of commercialization and the involvement of public and private sectors in space activities. Communication is probably one of the most active parts of outer space activities, since satellite communication technology is the most mature, commercial, and obviously practical of all space benefits and applications. It's amazing capacity to reach people in remote areas, on ships on the high seas and in aeroplanes, and also to improve education, healthcare and

[120] Item 10(h), List I - Federal List, Ninth Schedule, Federal Constitution, *supra* note 108.

standards of living does it credit. Thus, in such circumstance, legislation is required to govern the national activities in addition to the international treaties. Numerous countries have the space legislation with respect to communications. They include, to name but a few, the United States of America (Telecommunications Act 1996), the United Kingdom (Telecommunications Act 1984), and Australia (Telecommunications Act 1997).

At present, space law is considered an embryonic domain in Malaysia even though the country has actively participated to a considerable extent in outer space-related activities. Currently, the available and most reliable domestic law governing outer space-related activities is found in the multimedia and communication spheres. The legislative mandate for regulation of these sectors comes from the Malaysian Communications and Multimedia Act 1998 (Act 588) (referred to as 'the MCMA 1998').[121] It is beyond the scope of this section to describe the law in detail. This section, however, aims to provide a general overview of the legal rules specified by the Act.

The MCMA 1998 principally prescribes the licensing system connected with Malaysian communication and multimedia activities. The idea behind the Act came when the Malaysian Government found it difficult to differentiate between telecommunications, broadcasting and information technology industries due to technological advances in Malaysia.[122] For that reason, the Government of Malaysia decided to pass the Act in 1998 to cater for the convergence era of telecommunications, broadcasting and computer technology industries in Malaysia. It is important to note that, prior to the enforcement of this Act in April 1999, the three industries - telecommunications, broadcasting and information technology - were regulated by different legislation. The telecommunications industry was previously regulated under the Malaysian Telecommunications Act 1950, and the broadcasting industry was administered by the Malaysian Broadcasting Act 1988, while the information technology industry was not governed by any specific legislation.[123]

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[121] It came into force on 1st April 1999. In this section, all Sections and Parts, unless specified otherwise, refer to those in the Malaysian Communications and Multimedia Act 1998 (Act 588) as at 15th March 2013.

[122] Safinaz Mohd Hussein, "Service Provider Licensing System in the Malaysian Communications and Multimedia Industry", (2004) 3 *Journal of Information, Law and Technology (JILT),* http://www2.warwick.ac.uk/fac/soc/law2/elj/jilt/2004_3/hussein/, accessed: 15 May 2014. See also Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia,* (Petaling Jaya: Prentice Hall, 2002), at 1; Lee, Casey, "The Institutional and Policy Framework for Regulation and Competition in Malaysia", *Regulation, Competition and Development: Setting A New Agenda, CRC International Workshop,* (Manchester, 4-6 September 2002), at 5 and 7, http://www.cassey.com/fea2002-7.pdf, accessed: 20 November 2011.

[123] Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, id.,* at 1-2.

The preamble of the MCMA 1998 clearly sets out the purpose of the Act in general. It aims to provide for and regulate the converging communications and multimedia industries, in addition to incidental matters. Section 3 (1) lists four main objectives of the Act:

(1) To promote national policy objectives[124] for communications and multimedia industries;

(2) To establish a licensing and regulatory framework in support of national policy objectives for the communication and multimedia industries;

(3) To establish the powers and functions for the Malaysian Communications and Multimedia Commission;

(4) To establish powers and procedures for the administration of this Act.

In general, the MCMA 1998 consists of 282 Sections and 11 Parts.[125] The core person and body responsible in the regulatory framework is the Minister in charge of communication and multimedia (referred to as 'the Minister') and the Malaysian Communication and Multimedia Commission (referred to as 'the Commission'). The Minister means the Minister currently charged with the responsibility for communication and multimedia.[126] The Commission means the Malaysian Communications and Multimedia Commission established under the

[124] Among the national policy objectives for the communications and multimedia industry in Malaysia are: (1) to establish Malaysia as a major global centre and hub for communications and multimedia information and content services; (2) to promote a civil society where information-based services will provide the basis of continuing enhancements to quality of work and life; (3) to grow and nurture local information resources and cultural representation that facilitate the national identity and global diversity; (4) to regulate for the long-term benefit of the end user. See Section 3(2), MCMA 1998.

[125] The 11 parts provided in the MCMA 1998 are: Part I - Preliminary; Part II - Ministerial Powers and Procedures; Part III - Appeal Tribunal; Part IV - Licences; Part V - Powers and Procedures of the Malaysian Communications and Multimedia Commission; Part VI - Economic Regulation; Part VII - Technical Regulations; Part VIII - Consumer Protection; Part IX - Social Regulation; Part X - General; Part XI - Transitional Provision.

[126] See Section 6 (Interpretation), MCMA 1998. It should be noted that, prior to the enforcement of the MCMA 1998, the Ministry responsible for regulating the telecommunications and broadcasting industries was the Ministry of Energy, Telecommunications and Post, and also the Ministry of Broadcasting. However, when the Act came into force the Malaysian Government restructured the functions of both Ministries, and the power of the Minister of Information was restricted to matters related to Radio Television Malaysia (RTM). The power under the MCMA 1998 has been given directly to the Minister currently charged with responsibility for communications and multimedia. At the time of writing, the Minister in charge is the Minister of Communications and Multimedia. He is the head of Ministry of Communications and Multimedia Malaysia (Previously, this Ministry was known as the Ministry of Information, Communication, and Culture. This is due to the restructuring of the Malaysian cabinet that was announced by the Malaysian Prime Minister, Dato' Sri Mohd Najib Abdul Razak on 15 May 2013). The Minister of Communication and Multimedia obtains his power to regulate the industries under Part II (Ministerial Powers and Procedures), MCMA 1998. For more information, refer to Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 4-5. See http://www.kkmm.gov.my/; accessed: 15 May 2014.

Malaysian Communications and Multimedia Commission Act 1998.[127] The MCMA 1998 outlines four types of powers conferred on the Minister: ministerial direction,[128] ministerial determination,[129] ministerial declaration[130] and, lastly, ministerial regulations.[131] The power and procedures of the Commission are enumerated in Part V.[132]

Besides the Minister and the Commission, another essential body that regulates the communication and multimedia industries is the Appeal Tribunal (referred to as 'the

[127] See Section 6 (Interpretation), MCMA 1998. The Malaysian Communications and Multimedia Commission official website is available at http://www.skmm.gov.my/, accessed: 15 May 2014. For more information, read Chapter 1 of the thesis (1.2.4. The Malaysian Communications and Multimedia Commission Act 1998 (Act 589).

[128] The Minister may, from time to time, issue a direction to the Commission of general character or otherwise. The direction must be consistent with the objects and provisions of the MCMA 1998. The Commission shall exercise its powers conferred in a manner which is consistent with the direction. It should also be registered by the Commission as soon as practicable. The Minister, however, may modify, vary or revoke the direction at any time. Some examples of the registered ministerial directions: 'Ministerial Direction on General Licensing Policies'; 'Ministerial Direction on the Standards on International Mobile Telecommunications 2000 Terrestrial Component'; 'Ministerial Direction on Equal Access'; 'Ministerial Direction on Quality of Service'. Refer to Chapter 1 (Ministerial Direction) of Part II, MCMA 1998. Read also Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 11-12.

[129] The Minister has the legal right, from time to time, to determine matters under the MCMA 1998, without consultation with any other person including the licensees. The determination should be consistent with the provision of such Act, and only effective from the date of registration by the Commission. The Minister also has the right, at any time, to make modification, variation, or revocation. An example of the registered ministerial determination is 'Ministerial Determination on Spectrum Reallocation'. Refer to Chapter 2 (Ministerial Determination) of Part II, MCMA 1998. Read also Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 13-14.

[130] The Minister may, from time to time, make a declaration that a licence is subject to such conditions or enjoys such benefits as the Minister deems fit. The declaration should be in written form. Unlike determination and direction, the declaration has its own procedure to be followed. Before making the declaration, the Minister must give written notice and a copy of the draft direction to the affected licensee. It must also be registered by the Commission. Refer to Chapter 3 (Ministerial Declaration) of Part II, MCMA 1998. Read also Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 14-15.

[131] The Minister may, on the Commission's recommendation or otherwise, make a regulation to be published in the *Gazette*, for the purposes listed in section 16(1), MCMA 1998. To name but a few, these include any fees, charges or rates to be imposed, the compounding of offences, any redress, compensation, penalties in respect of breach of or offence against any subsidiary legislation, *etc*. Some examples of the ministerial regulations: 'Communications and Multimedia (Technical Standards) Regulations 2000'; 'Communications and Multimedia (Spectrum) Regulations 2000'; 'Communications and Multimedia (Licensing) Regulations 2000'. Refer to Chapter 4 (Ministerial Regulations) of Part II, MCMA 1998. Read also Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 15-34.

[132] The powers conferred on the Commission, among others, are: power of issuing directions (Chapter 1); power to make a determination (Chapter 2); power to hold a public inquiry in response to a written request or on its own initiative (Chapter 3); power to maintain a register in both physical and electronic media form for all matters that must be registered (Chapter 6). Examples of matters required for registration: individual licence (Section 42); class licence (Section 49); dispute resolution decision (Section 88); ministerial direction (Section 9); ministerial determination (Section 12); ministerial declaration (Section 15); Commission's direction (Section 54); and Commission's determination (Section 57). See Chapter 6 (Register) and Part V (Powers and Procedures of the Malaysian Communications and Multimedia Commission), MCMA 1998. Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 16. More information on the Commission is available in Chapter 1 of the thesis (1.2.4. The Malaysian Communications and Multimedia Commission Act 1998 (Act 589).

Tribunal').[133] The Minister, on an ad hoc basis, has the right to establish the Tribunal based on certain conditions.[134] The designated function of the Tribunal is to review any appealed matter based on a decision or direction of the Commission.[135] The decision made by the Tribunal is final and binding on the parties, and is not subject to any further appeal.[136]

There are two types of licences introduced under Part IV[137]: individual licences and class licences.[138] An individual licence is granted to a person who conducts an activity which requires a high degree of regulatory control. Examples of local telecommunication companies holding such licences: Telekom Malaysia Bhd.; Digi telecommunications; Celcom (Malaysia); and Maxis International.[139] The class licence, however, is designed to cater for the needs of small operators and has a lighter form of regulatory control and minimal procedural requirements. Examples of multimedia local companies registered under this licence: Information Network Services and Time dot Net Bhd.[140]

Licences are granted to those who provide services and/or facilities that fall under these four categories:[141]

(1) The network facility: this means any element or combination of elements of physical infrastructure used principally for, or in connection with, the provision of network services, but does not include customer equipment such as earth stations, satellite hubs and satellite control stations.[142]

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[133] See Part III (Appeal Tribunal), MCMA 1998. For more information, read Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 34-37.
[134] The Appeal Tribunal could be established by the Minister, either when he considers necessary, or for the good cause and in the interest of justice, or to assist the Commission in performing its functions, or in the public interest. Read Section 17(1), MCMA 1998.
[135] Section 18(1), MCMA 1998.
[136] Section 18(2), MCMA 1998.
[137] Part IV, MCMA 1998. More information is available in Chapter 1 of the thesis (1.2.5. The Communications and Multimedia (Licensing) Regulations 2000).
[138] An individual licence means a licence for a specified person to conduct a specified activity and may include conditions to which the conduct of that activity shall be subject. See Section 6 (Interpretation), and Chapter 1 (Individual Licence) of Part IV, MCMA 1998; a class licence means a licence for any or all persons to conduct a specified activity and may include conditions to which the conduct of that activity shall be subject. See, Section 6 (Interpretation) and Chapter 2 (Class Licence) of Part IV, MCMA 1998.
[139] Safinaz Mohd Hussein, "Service Provider Licensing System in the Malaysian Communications and Multimedia Industry", *supra* note 122, at 3.
[140] *Id*.
[141] More discussion on the four licensable services and/or facilities is available in Chapter 1 of the thesis (1.2.5. The Communications and Multimedia (Licensing) Regulations 2000).
[142] Examples of companies providing the network facility are Telekom Malaysia Bhd., Digi Telecommunications Sdn. Bhd., Telekom Cellular Sdn. Bhd., Asiaspace Dotcom Sdn. Bhd. See Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 42. See also "Table 4-8: Licensing in Malaysia [4.5.3] ICT Regulation Toolkit", http://www.ictregulationtoolkit.org/en/PracticeNote.2554.html,

(2) The network services: this refers to a service for carrying communications by means of guided and/or unguided electromagnetic radiation such as a broadcasting distribution service, and bandwidth services[143]

(3) The application service: this refers to a service provided by means of, but not solely by means of, one or more network services, such as data services and electronic commerce.[144]

(4) The content application service: content application service means an application service which provides content, such as satellite broadcasting, and subscription broadcasting.[145]

The MCMA 1998 also offers four different modes of regulation: economic, technical, consumer protection and social. The economic regulation mechanism is intended to establish a regulatory framework that aims to escalate the market value. It takes place through licensing of network facilities, network services, and application services. The licensees should provide these facilities and services according to the terms and conditions of the licence granted. General competition practices are initiated under such regulation when the law states that, for example, entering into a collusive agreement that provides for rate-fixing, market sharing, and boycotting of a supplier or other competitor is prohibited.[146]

The technical regulation, which is intended to assist the economic regulation, aims to alleviate the network interoperability by regulating the technical aspects. It takes effect, for instance, by offering the effective regulatory framework of spectrum assignment, numbering, electronic addressing, and technical standard. For example, no person shall use any part of a spectrum to provide a network service unless he/she holds a spectrum assignment, and it is an

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accessed: 8 September 2012. See also Section 19, Communications and Multimedia (Licensing) Regulations 2000, and Section 6, MCMA 1989.

[143] Examples of companies providing network services: Digi Telecommunications Sdn. Bhd.; Telekom Malaysia Bhd.; Fiberail Sdn. Bhd.; Maxis Broadband Sdn. Bhd.; and MIMOS Berhad. See *id*. See also Section 20, Communications and Multimedia (Licensing) Regulations 2000, and Section 6, MCMA 1989.

[144] Examples of companies providing application services: Asia Online Utusan Sdn. Bhd.; Reach Internet Service (MSC) Sdn. Bhd.; United Multimedia Sdn. Bhd.; and NTT MSC Sdn. Bhd. See Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 43. See also "Table 4-8: Licensing in Malaysia [4.5.3] ICT Regulation Toolkit", *supra* note 142, and Section 6, MCMA 1998.

[145] Examples of companies providing content application services: Sistem Television Malaysia Bhd.; Natseven TV Sdn. Bhd.; Measat Radio Communications Sdn. Bhd.; and NTT MSC Sdn. Bhd. See *id*. See also, Section 21, Communications and Multimedia (Licensing) Regulations 2000, and Section 6, MCMA 1998.

[146] Part VI (Economic Regulation), MCMA 1998. Safinaz Mohd Hussein, *Undang-Undang Komunikasi & Multimedia, supra* note 122, at 6. See also Lee, Casey, *supra* note 122, at 7-8.

offence for a person to use any technical equipment or system which hinders the network interoperability. [147]

The consumer protection regulation provides a regulatory framework that aims at protection of consumers' rights, and elevates the quality of services in the communication and multimedia industries. It is has been proved, for example, that the providers under the law should deal reasonably with consumers and adequately address consumer complaints. With regard to disputes arising between consumers and licensees, certain procedures should be followed and observed. [148]

The social regulation mechanism is intended mainly to provide a regulatory framework that regulates the content application services. Since these services, for instance broadcasting services, have a great impact on society, a mode of social regulation is offered in the MCMA 1998. It is applied through the licensing system; for instance, no person is permitted to provide a content application service unless they hold a valid licence to provide such services. In terms of content requirements, the law prohibits the provider from providing content that is indecent, obscene, false, menacing and offensive in character with intent to annoy, abuse, threaten or harass any person. [149]

In summary, the MCMA 1998 establishes three major rules: Firstly, the rules with respect to the powers and procedures relating to the three regulatory bodies: the Minister, the Commission, and the Tribunal; secondly, the licensing system; thirdly, the four modes of regulations: economic, technical, consumer and social regulations. Thus, as a final point, the four facilities or services provided by a provider, after being granted a licence, must be controlled and regulated by the Minister and the Commission within the scope of the four modes of regulations. These interrelationships are vital for the purpose of achieving the Government's national objective with respect to communications and multimedia industries.

[147] Part VII (Technical Regulation), MCMA 1998. See *id*.
[148] Part VIII (Consumer Protection), MCMA 1998.
[149] Part IX (Social Regulation), MCMA 1998.

1.2.4. The Malaysian Communications and Multimedia Commission Act 1998 (Act 589)

States control their telecommunications industries by enacting specific legislation. Some of them also establish special regulatory bodies to monitor and regulate the related telecommunications activities of the countries. To name a few, the United States of America established a Federal Communications Commission (FCC), while the United Kingdom has an Office of Telecommunications (Oftel) later superseded by an Office of Communications (Ofcom). Australia set up an Australian Communications and Media Authority (ACMA), while Argentina has a *Secretaría de Comunicaciones*, and Bangladesh has the Bangladesh Telecommunication Regulatory Commission.

With respect to Malaysia, its principal regulatory body is known as the Malaysian Communications and Multimedia Commission (referred to as 'the Commission').[150] It was established by the Malaysian Communications and Multimedia Commission Act 1998 (Act 589) (referred to as 'the Commission Act 1998').[151] In principal, the Commission Act 1998 deals with the establishment of the Commission with the power to supervise and regulate communications and multimedia activities in Malaysia, as well as to enforce the communications and multimedia laws[152] and other related matters in Malaysia. In general, the Commission Act 1998 is structured to have 55 Sections and 6 Parts.[153] This section aims to present a general idea of the legal rules laid down by the Act.

The Commission was established on 1st November 1998 pursuant to the provision of the Commission Act 1998[154]. It was set up with its mission and vision[155] when Malaysia adopted

[150] The Malaysian Communications and Multimedia Commission is the regulator for the converging communications and multimedia industry. The Commission is one of the agencies under the Malaysian Ministry of Information, Communication, and Culture. Its official website is available at http://www.skmm.gov.my; or http://www.mcmc.gov.my/, both accessed: 15 May 2014.

[151] The Commission Act 1998 obtained its Royal Assent on 23rd September 1998 and came into operation on 1st November 1998. In this section, all Sections and Parts, unless specified otherwise, refer to those in the Malaysian Communications and Multimedia Commission Act 1998 (Act 589), as at 15th March 2013.

[152] The words 'communications and multimedia laws' refer to the Commission Act 1998, and the MCMA 1998. This also includes any subsidiary legislation made under those laws and any other written laws under which the Commission is to exercise any function. See Section 3 (Interpretation), the Commission Act 1998.

[153] Those 6 Parts are: Part I - Preliminary; Part II - The Commission; Part III - Powers and Functions of Commission; Part IV - Employees of Commission; Part V – Finance; Part VI - General Matters.

[154] Section 4, the Commission Act 1998.

[155] Its vision states: 'A globally competitive, efficient and increasingly self-regulating communications and multimedia industry generating growth to meet the economic and social needs of Malaysia', whereas its mission states: 'We are committed to:

(a) Promoting access to communications and multimedia services;
(b) Ensuring consumers enjoy choice and a satisfactory level of services at affordable prices;

a convergence regulation model with respect to the communications and multimedia sectors.[156] The principal role of the Commission is to implement and promote the national policy objectives for the communications and multimedia sector. It also oversees, in accordance with the national policy objectives set out in the MCMA 1998, the new regulatory framework for the converging industries of telecommunications, broadcasting and on-line activities, as well as postal services and digital certifications.[157] The members of the Commission[158] shall be appointed by the Minister[159] and each appointment is for a term of two years. They shall be eligible for reappointment but they cannot hold the office for more than 5 years[160].

The Commission Act 1998 outlines the powers and functions of the Commission in Section 16. The Commission is responsible for advising the Minister[161] on all matters concerning the national policy objectives for communications and multimedia activities. It has the power to implement and enforce the provisions of the communications and multimedia laws and also to regulate all matters related to such activities which are not provided for in the communications and multimedia laws. The Commission can also consider and recommend reforms to the communications and multimedia laws, as well as promote and maintain the integrity of all persons licensed or otherwise authorised under such laws. Apart from that, the

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(c) Providing transparent regulatory processes to facilitate fair competition and efficiency in the industry;
(d) Ensuring best use of spectrum and number resources; and
(e) Consulting regularly with consumers and service providers and facilitating industry collaboration.

[156] Two legislations were enacted to give effect to the new regulatory model: the MCMA 1998 which sets out a new regulatory licensing framework for convergent communications and multimedia industries, and the Commission Act 1998, which creates a new regulatory body, namely the Malaysian Communications and Multimedia Commission. When the MCMA 1998 came into force, the Telecommunications Act 1950 and the Broadcasting Act 1988 were repealed. On 1st November 2001, the Commission also took over the regulatory functions of the Postal Services Act 1991 and the Digital Signature Act 1997. See http://www.skmm.gov.my/About-Us/History.aspx, accessed: 15 May 2014.

[157] See http://www.skmm.gov.my/, accessed: 15 May 2014.

[158] The membership consists of a Chairman, three members representing the government and not less than two but not more than five other members. See Section 6, the Commission Act 1998.

[159] See *infra* note 161.

[160] Section 10, the Commission Act 1998.

[161] 'Minister' means the Minister charged with the responsibility for communications and multimedia. See Section 3 (Interpretation), the Commission Act 1998. In this case, it now refers to the Minister of Communications and Multimedia under the Ministry of Communications and Multimedia Malaysia (previously known as the Ministry of Information, Communications, and Culture). This happens following the restructuring of the Malaysian cabinet announced by the Malaysian Prime Minsiter, Dato' Sri Mohd Najib Abdul Razak, on 15 May 2013. (The Ministry of Information, Communications, and Culture actually combined the earlier previous Ministry of Information, Ministry of Unity, Culture, Arts, and Heritage, and the communications component from the previous Ministry of Energy, Water, and Communications. This merger was a result of the Malaysian Cabinet reshuffle following the appointment of the Prime Minister on 3rd April 2009). See http://www.kpkk.gov.my/, accessed: 5 September 2012; http://www.kkmm.gov.my/, accessed: 15 May 2014.

Commission is given the obligation to supervise and monitor the related activities, in addition to encouraging and promoting self-regulation in the industries.[162]

In respect of cooperation, the Commission has the responsibility to render assistance in any form to promote cooperation and coordination amongst persons engaged in the activities. It also promotes and encourages research and training in the relevant area. Its final role is to carry out any function under any written law as may be prescribed by the Minister by a notification published in the Gazette.[163] The Commission also issues licences under the MCMA 1998, as under the Postal Services Act 1991 and the Digital Signature Act 1997.

From the preceding description, it is well understood that the Commission Act 1998 only emphasizes provisions surrounding the establishment of the Commission as well as its functions and powers with respect to Malaysian communications and multimedia interests. There are no words relating to space, outer space or similar matters mentioned in the Act.

1.2.5. The Communications and Multimedia (Licensing) Regulations 2000.

Having an appropriate licence is among the main requirements for operating a telecommunications system. Domestic laws published by the states normally prescribe the contents, scope, and procedures for granting such licences. Different states have different types of licences to govern their telecommunications activities. These licences normally accommodate the activities of the providers and concern themselves with the categories of services provided to the customers and users.

In the Malaysian situation, upon exercising the power conferred by Section 16 of the MCMA 1998, the Minister in charge[164] has the legal right to make regulations. One of the salient regulations is the Communications and Multimedia (Licensing) Regulations 2000 (referred to as the 'Licensing Regulations 2000')[165]. This elaborates the licensing rules and procedures

[162] Section 16(a), 16(b), 16(c), 16(e), 16(h), 16(g), the Commission Act 1998. See also Ahmad Shamsul Abdul Aziz, "Undang-Undang Media", *Undang-Undang Multimedia,* Siri Perkembangan Undang-Undang Di Malaysia, Eds., Ahmad Shamsul, Khadijah Mohamed and Mazita Mohamed, (Kuala Lumpur: Dewan Bahasa dan Pustaka, 2007), at 72-73.
[163] Section 16(i), 16(f), 16(j), the Commission Act 1998.
[164] See *supra* note 161.
[165] It was published and came into operation on 1st April 2000. In this section, all Sections and Parts, unless specified otherwise, refer to those in the Communications and Multimedia (Licensing) Regulations 2000 as at 15th March 2013.

concerning communications and multimedia activities, as already outlined by the MCMA 1998.

In general, the Licensing Regulations 2000 consists of 37 Regulations and 6 Parts[166]. Parts III and IV specify two types of licences: the individual licence and the class licence.[167] It prescribes, *inter alia*, the standard conditions[168] that the licensee should observe. These include, for instance, the requirement for the licensee to take all proper and adequate safety measures to safeguard the lives and property of the public. In addition, he/she must take reasonable steps to ensure that the charging mechanism used in connection with its network facilities and/or services is accurate and reliable. The Regulation lists the categories of persons who are ineligible to apply for individual and class licences.[169] Apart from that, certain procedures must be followed by the applicants when applying the licences.[170]

The Licensing Regulation 2000 specifies mainly four types of licensable facilities and services that the provider can offer.[171] These facilities and services, as indicated earlier, are prescribed briefly in the MCMA 1998 and are illustrated and listed in detail in the Licensing Regulation 2000. These include the following: [172]

(1) The network facilities such as earth stations,[173] fixed link and cables,[174] radio communications transmitters and links,[175] satellite control station,[176] satellite

[166] These 6 Parts are: Part I – Preliminary; Part II – Licensing; Part III - Individual Licence; Part IV - Class Licence; Part V - Licence Fees; Part VI – General.
[167] See *supra* note 138.
[168] Section 3, the Licensing Regulations 2000.
[169] For the individual licence, persons who are ineligible to make an application are a foreign company as defined under the Companies Act 1965, an individual or a sole proprietorship, a partnership and other persons or classes of persons as may be decided by the Minister from time to time. For the class licence, persons who are not entitled to make such application are foreign individuals who are not permanent residents, and foreign companies as defined under the Companies Act 1965. The Minister, however, may, for a good cause or in the public interest, permit those persons to make applications to be registered under a class licence. See Sections 5 and 23, the Licensing Regulations 2000.
[170] For an individual licence application, an applicant, for instance, is required to fill out a specific form and provide some information including the applicant's particulars, anticipated operating, capital expenditure, proposed financing plan such as sources of financing, proposed operating procedures including the disaster recovery plan, description of the nature of the facilities, services, content and area of coverage and so forth. See Sections 6 and 7, the Licensing Regulations 2000.
[171] A further discussion is available in Chapter 1 of the thesis (1.2.3. The Malaysian Communications and Multimedia Act 1998 (Act 588).
[172] See Sections 19, 20, 22, and 30, the Licensing Regulations 2000.
[173] Earth station means an apparatus located either on the earth's surface, or within the major portion of the earth's atmosphere and intended for communication: (a) with one or more space stations; or, (b) with one or more stations of the same kind, by means of one or more reflecting satellites or other objects in space. See Regulation 2 of Part I (Preliminary), the Licensing Regulations 2000.
[174] Fixed link and cable means a network facility to enable communication between two stations, channels, or adjacent nodes of a network and which is part of a communications system. *Id*.

hubs,[177] space station,[178] submarine cable landing centre,[179] towers, poles, ducts and pits used in conjunction with other network facilities;

(2) The network services including bandwidth services,[180] broadcasting distribution services,[181] cellular mobile services,[182] access application services, space services,[183] switching services,[184] gateway services[185];

(3) The application services such as public cellular service,[186] public payphone services,[187] public switch data services,[188] directory services,[189] internet access services,[190] messaging services[191];

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[175] Radio communications transmitters and links mean: (a) a transmitter and link designed or intended to be used for the purpose of radio communications; (b) anything designed or intended to be ancillary to, or associated with, such transmitter and link for the purposes of radio communications. *Id*.

[176] Satellite control station means an earth station that performs the function of telemetry, tele-command, and control of the operation of a space station. *Id*.

[177] Satellite hub refers to a satellite ground station functioning as a network management facility and/or gateway. *Id*.

[178] Space station means a station used or intended for use in the space service. *Id*.

[179] Submarine cable landing centre means a network facility where submarine cables are transmitted. *Id*.

[180] Bandwidth service means a managed network service which enables the transmission of units of information over a link within a particular unit of time. *Id*.

[181] Broadcasting distribution service means a network service that distributes television or radio programmes to persons having equipment appropriate for receiving that network service regardless of the means of distribution but does not include: (a) a service (including a tele-text service) that provides only data or text; or, (b) a service that makes programmes available on demand on a point-to-point basis, including a dial-up service. *Id*.

[182] Cellular mobile services means a network service where: (a) an end-user can use a network service while moving continuously between places; (b) the cellular mobile access device used for or in relation to the supply of the network service is not in physical contact with any part of the network facility by means of which the network service is supplied; and, (c) the network service is supplied by use of a network facility that has inter-cell handover functions. *Id*.

[183] Space service reflects to radio communications service using a space station or any other stations located beyond, or intended to go beyond, or which has been beyond, the major portion of the earth's atmosphere. *Id*.

[184] Switching service means a network service that: (a) terminates many circuits; or (b) interconnects or routes traffic between and among circuits. *Id*.

[185] Gateway service means a network service which provides interconnection between a domestic gateway and an international gateway. *Id*.

[186] Public cellular service means an applications service involving a network of base stations or cells for the delivery of voice and data communications. *Id*.

[187] Public payphone service means an application service that is provided in places to which the general public has access that can only be used for communication (other than a free call or a call made with operator assistance) if the user, immediately prior to its use, makes or arranges to make a payment for that particular call but does not include a rented payphone. *Id*.

[188] Public switch data service means an applications service for non-voice services that involves switching of data emanating from one specific network facility to another, including telegram services, telex, ISDN and ATM. *Id*.

[189] Directory service means an applications service enabling a person to obtain the telephone number and limited information about a customer which is sought by such person and includes a directory assistance service or published directory service. *Id*.

[190] Internet access service means an applications service whereby a person is able to access Internet services and applications in conjunction with either a dial-up connection or a direct connection. *Id*.

[191] Messaging service means an applications service which involves the storage or forwarding of a message in multimedia form whereby the message is first routed through a central management centre before it is forwarded to the addressee. *Id*.

(4) The content application services include satellite broadcasting,[192] subscription broadcasting,[193] terrestrial free-to-air TV,[194] terrestrial radio broadcasting.[195]

In conclusion, it appears that the establishment of the Licensing Regulations 2000 has provided further explanation and information on the legal rules and procedures with respect to the licensing system that was already briefly outlined by the Communications and Multimedia Act 1998 (Act 588) in Chapter 1 of Part IV. Therefore, the Licensing Regulations 2000 should be read together with the Communications and Multimedia Act 1998 (Act 588) when dealing with the licensing system in respect of the communications and multimedia industry in Malaysia.

1.2.6. Other Applicable Laws

Further to the earlier discussion on the Malaysian space policy and laws, the Malaysian Government has also passed a number of other relevant laws. This section will list a corpus of existing laws that might have connections with space-related activities in Malaysia. They are, *inter alia*:

(1) The Environmental Quality Act 1974 (Act 127);
(2) The National Forestry Act 1984 (Act 313);
(3) The Protection of Wildlife Act 1972 (Act 76);
(4) The Fisheries Act 1985 (Act 317);
(5) The Merchant Shipping (Oil Pollution) Act 1994 (Act 515);
(6) The Merchant Shipping Ordinance 1952;
(7) The Carriage of Goods by Sea Act 1950 (Revised 1994) (Act 527);
(8) The Geological Survey Act 1974 (Act 129);
(9) The Civil Aviation Act 1969 (Act 3);
(10) The Carriage by Air Act 1974 (Act 148);
(11) The Aviation Offences Act 1984 (Act 307);
(12) The Airport and Aviation Services (Operating Company) Act 1991 (Act 467);

[192] Satellite broadcasting means a content applications service distributed by means of a satellite. *Id*.
[193] Subscription broadcasting means a content applications service whereby programme content is made available to the general public only upon the payment of a subscription fee. *Id*.
[194] Terrestrial free-to-air TV means a content applications service utilising UHF/VHF frequency bands. *Id*.
[195] Terrestrial radio broadcasting means a content applications service by means of radio waves that provides radio programmes that are: (a) are intended to appeal to the general public; (b) can be received by commonly available equipment; (c) are made available free to the general public. *Id*.

(13) The Telemedicine Act 1997 (Act 564);
(14) The Contract Act 1950 (Revised 1974) (Act 136);
(15) The Defamation Act 1957 (Revised 1983) (Act 286);
(16) The Insurance Act 1996 (Act 553);
(17) The Patents Act 1983 (Act 291);
(18) The Penal Code (Revised 1997) (Act 574);
(19) The Atomic Energy Licensing Act 1984 (Act 304);
(20) The Telecommunication Services (Successor Company) Act 1985 (Act 322);
(21) The Copyright Act 1987 (Act 332);
(22) The Digital Signature Act 1997 (Act 562);
(23) The Computer Crime Act 1997 (Act 563);
(24) The Computer Misuse Act 1998;
(25) The Communications and Multimedia (Technical Standards) Regulations 2000;
(26) The Communications and Multimedia (Spectrum) Regulations 2000;
(27) The Communications and Multimedia (Compounding of Offences) Regulations 2001;
(28) The Energy Commission Act 2001 (Act 610);
(29) The Communications and Multimedia (Rates) Rules 2002;
(30) The Communications and Multimedia (Universal Service Provision) Regulations 2002;
(31) The Malaysian Communications and Multimedia Commission Disciplinary Regulations 2007;
(32) The Malaysian Communications and Multimedia Commission (Disciplinary Committees and Disciplinary Appeal Boards) Regulations 2007.

As a final remark, it is concluded that Malaysia still does not have any definite outer space legislation, particularly with respect to launching objects into outer space, the national registration of such objects, indemnification, and liability clauses in case of damage or loss caused by such activities, especially when they involve non-governmental entities.

1.3. TECHNOLOGICAL DEVELOPMENT AND RESEARCH

As Malaysia continues to advance in space activities, significant progress has been observed particularly in space technological development and research. This involves three major sectors: the governmental sector, the non-governmental sector, and the higher educational institutions.

1.3.1. Governmental Sector

Since science and technology are the keys to excellence in today's modern economy, Malaysia in its 'Second National Science and Technology Policy' has set an apparent goal of accelerating the development of its capability and capacity in science and technology. Such policy is aiming, among others, to increase the national capability and capacity for research and development (R&D), as well as technological development, and acquisition. It also aims to encourage partnerships between public organizations and industry, as well as local and foreign companies, for co-development of technologies in order to increase indigenous technology capability. Furthermore, it aims to position Malaysia as a technology provider in the key strategic knowledge industries including the aerospace industry, information and communication technologies, and advanced manufacturing.[196]

In view of the above circumstances, Malaysia, through its Ministry of Science, Technology, and Innovation (MOSTI),[197] has set up a specific division, various departments, and a government-owned company for realizing the aforementioned goals. Thus, this section deals with the division, departments and company particularly responsible for Malaysian space-related activities. They include the Sea to Space Division (S2S), the Malaysian National Space Agency (ANGKASA), the Malaysian Remote Sensing Agency (Remote Sensing

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[196] See http://www.mosti.gov.my/index.php?option=com_content&view=article&id=2032&Itemid=611&lang=en, accessed: 15 May 2014.

[197] MOSTI was established at first under the name of the Ministry of Technology, Research, and Local Government in 1973. In 1976, when it was given additional responsibility as a leading agency pertaining to environmental matters, the name was then changed to the Ministry of Science, Technology, and Environment (MOSTE). Following the Malaysian Cabinet's decision on March 27, 2004, MOSTE was restructured and this led to the formation of the present MOSTI. Under this new entity, a cluster approach was initiated in February 2007 to introduce five categories. They are: biotechnology, ICT, industry, sea to space, and science and technology services. The MOSTI official website is available at http://www.mosti.gov.my/, accessed: 15 May 2014.

Malaysia), the Malaysian Meteorological Department (MMD), and the Astronautic Technology (M) Sdn. Bhd. (ATSB).

(a) Sea to Space Division (S2S)

The Sea to Space Division (S2S) is one of the divisions set up under the Ministry of Science, Technology, and Innovation (MOSTI).[198] It was established on 2nd February 2007 following the restructuring that took place in the MOSTI. Such restructuring involved the introduction of a cluster approach in the MOSTI. This was done in order to enhance and strategize the implementation of MOSTI's programmes and strategies.[199] Under the cluster approach, five categories have been instituted, inclusive of the Sea to Space Division. The other four categories are: biotechnology, ICT, industry, and science and technology services. The establishment of the Sea to Space Division is, indeed, a means of generating a new economic resource for Malaysia based on knowledge acquisition. This is focusing especially on the areas of space technology and oceanography. In fact, it is hoped that such a strategy will boost the Malaysian economy as well as the quality of life of Malaysian society.

The Sea to Space Division's vision is to humanise space, the atmosphere, and the ocean particularly for knowledge generation and sustainable resources management. It also aims at wealth creation and societal wellbeing. Its mission is to innovate and harness the total solutions that will be performed through science, technology, applications, and services. The related areas involved include oceanography, meteorology, remote sensing, and space. Such circumstances are furnished in order to meet the Malaysian nation's economic, social, security, and environmental needs.[200]

With regard to the objectives of establishing the Sea to Space Division, the Division was indeed formed with numerous purposes. Among the focal objectives are to develop and operationalize the Sea to Space Division infrastructure to benefit national needs, as well as to

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[198] Other divisions include National Biotechnology Division, Innovation and Commercialization Division, and others.

[199] See *supra* note 197.

[200] See http://www.mosti.gov.my/index.php?option=com_content&view=article&id=1764&Itemid=57&lang=en, accessed: 6 September 2012; http://www.mosti.gov.my/index.php?option=com_content&view=article&id=1551&Itemid=539&lang=en, accessed: 15 May 2014.

develop and provide services in its competency areas including meteorology, oceanography, remote sensing and space. Apart from that, the aim of establishing the Sea to Space Division is to market and commercialise the Division's solutions, both locally and internationally. The Division was also formed to produce and generate more researchers, scientists and engineers with respect to the related areas. It also aims to construct not only the user community and public awareness programmes, but also implement various activities in meeting their targets.

Thus, it is established that the Sea to Space Division, under the MOSTI, is an important Malaysian Government division that contributes significantly in improving and accelerating the growth and expansion of Malaysian space-related activities inclusive of the space technological development and research in Malaysia.

(b) Malaysian National Space Agency (ANGKASA)

The Malaysian National Space Agency (ANGKASA)[201] was established in 2002. It is one of the significant governmental departments under the Ministry of Science, Technology, and Innovation (MOSTI) that deals with space-related activities. It was set up following the growth of Malaysian public interest in space activities and industries around 2002, inspiring the Government of Malaysia to summon Professor Datuk Dr. Mazlan Othman[202] to assist in its formation. It was formerly known as *Bahagian Kajian Sains Angkasa* (BAKSA) or the Space Science Studies Division. ANGKASA is responsible for providing leadership in the Malaysian Space Programme, space education, and research development. It also assists the Malaysian Government in formulating the Malaysian national space policy. Its vision is to harness space as a platform for knowledge generation, wealth creation, and societal wellbeing. Its mission is to develop the country's potential in the space sector in order to support the development of the new economy, generating knowledge, and strengthening the national security infrastructure.[203]

[201] The ANGKASA official website is available at http://www.angkasa.gov.my/, accessed: 13 May 2014.
[202] Prior to joining the Agency in July 2002, Professor Datuk Dr. Mazlan Othman was a Director of the United Nations Office for Outer Space Affairs (UNOOSA) in Vienna, Austria in 1999, where she coordinated international cooperation on the peaceful uses of outer space. In January 2008, she was re-appointed to the same position in the UNOOSA in Vienna.
[203] See *supra* note 201.

The ANGKASA has four main divisions: (1) Operations and Space System Division;[204] (2) Technology Development and Space Applications Division;[205] (3) Space Science and Education Division;[206] and (4) Administration and Human Resource Division.[207] ANGKASA has set up three main campuses: (1) the National Planetarium; (2) the National Observatory; and, (3) the Malaysia Space Centre.

The National Planetarium's[208] activities are aimed at promoting and leading Malaysia towards the development of space science. It creates awareness among Malaysians about the significance of space science and technology through the consolidation of space science and local arts. The programme is executed through activities such as exhibitions and film shows open to the public. Various attractions at the Planetarium are available to visitors, such as the ancient observatory park, a binocular or viewing gallery, exhibitions, galleries, and others.[209] Meanwhile, the National Observatory,[210] also known as the Langkawi National Observatory, is a platform for Malaysian scientists and international astronomers conducting their research on space science and equatorial skies. In meeting this objective, the Observatory is accommodated with a telescope for night sky objects observations and a solar telescope for solar observations. The Observatory's other objectives are to equip the country with the basic astronomy infrastructure and encourage interest among Malaysians in understanding space science and its significance.[211]

[204] This is a division where the physical infrastructure for space activities of the country is established. The core infrastructures are the Mission Operation Centre (MOC), the Optical Calibration Laboratory, the Assembly, Integration and Test (AIT) Facility, and the Data Centre. The base of the operations centre is at the Malaysian Space Centre, Banting, Selangor, Malaysia.
[205] Its base is the Putrajaya Headquarter, at the address of the National Space Agency (Headquarters), Malaysia.
[206] This is where all the educational programmes and promotion strategies in space science are implemented. Its base is at the National Planetarium, Kuala Lumpur, Malaysia.
[207] Its base is at the Putrajaya Headquarters, at the address of the National Space Agency (Headquarters), Putrajaya, Malaysia.
[208] The National Planetarium is located at the National Space Agency, National Planetarium, Jalan Perdana, Kuala Lumpur, Malaysia. Its official website is at http://www2.angkasa.gov.my/planetarium/, accessed: 13 May 2014.
[209] Other attractions are available such as mini planetarium, picnic area, space ball, Space Theatre, free parking and many others.
[210] The National Observatory is located at the forest restricted area of Bukit Malut Reservoir Dam, Langkawi Island, Kedah, Malaysia. Its official website is at http://www2.angkasa.gov.my/langkawi_observatory/, accessed: 13 May 2014.
[211] *Ibid.*

The Malaysia Space Centre[212] is equipped with facilities such as Mission Operations Centre, Optical Calibration Lab, Mission Control Station, and Image Receiving & Processing Station. The Mission Operation Centre is one of the Malaysian ground stations[213] for remote sensing satellites.[214] Its main function is to control and maintain satellite operations. The Centre is equipped with communications equipment capable of communicating with satellites launched into lower orbits (LEO) and middle orbits (MEO). Its main role is tracking, telemetry, and monitoring of satellites. The Optical Calibration Lab was installed with a class 1000 clean room and equipped with an integrating sphere, spectro-radiometer, and satellite turntable. The facility was used to calibrate RazakSAT's optical system before its launch.[215] Meanwhile, the function of the Mission Control Station, in brief, is to perform the mission plan, command generation, telemetry reception, telemetry archiving, and analysis.[216] The task of the Image Receiving & Processing Station is to receive and archive the images data from satellites together with attitude and ephemeris telemetry data for post-processing and distribution.

The ANGKASA is responsible for the Malaysian satellite programme and launches into outer space. Malaysia has three main satellites: TiungSAT-1, RazakSAT™ and MeaSAT. The TiungSAT-1 was the first Malaysian satellite and its launch was considered Malaysia's initial success in her effort to explore the aeronautics technology field. The programme was developed by the Astronautic Technology (M) Sdn Bhd (ATSB).[217] The RazakSAT™, the country's small satellite, provides specific and timely data for Malaysian users and caters for the needs of countries located in the equatorial belt. It is also a programme of ATSB.[218]

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[212] The Malaysia Space Centre is situated in 400 acres in Sungai Long, Banting, Selangor, Malaysia. The site was selected for its flat geography and minimal radio interference. It houses two communications antennas operating the RAZAKSAT satellite which provides images for environmental assessment and monitoring. See http://www.angkasa.gov.my/?q=en/node/55, accessed: 13 May 2014.

[213] A ground station, also known as an Earth station, is the terrestrial end of a communication link to an object in outer space. It receives data from various satellites as well as providing data over selected areas. It is used to communicate with and monitor the satellites, checking their operational health and exact position in space. One satellite is able to communicate with several ground stations. See http://www.angkasa.gov.my/index.php?option=com_content&task=blogcategory&id=18&Itemid=190, accessed: 7 September 2012; http://www.angkasa.gov.my/?q=en/node/55, accessed: 13 May 2014.

[214] Another ground station for the remote sensing of satellites is MACRES Ground Receiving Station (MGRS). However, the ground station for communication satellites is called MEASAT Teleport and Broadcast Centre (MTBC). Further information on MGRS is available in Chapter 1 of the thesis (1.3.1(d): Malaysian Remote Sensing Agency (MRSA), while for MTBC read Chapter 1 (1.3.2(a): MEASAT Satellite System Sdn. Bhd.).

[215] See http://www.aprsaf.org/feature/feature_35.html, accessed: 11 July 2010.

[216] See http://www.angkasa.gov.my/welcome/space_technology/facilities.php?section_id=40, accessed: 11 July 2012; http://www.angkasa.gov.my/?q=en/node/55, accessed: 13 May 2014.

[217] Further discussion on ATSB is available in Chapter 1 of the thesis (1.3.1(c): Astronautic Technology (M) Sdn Bhd (ATSB).

[218] More information on TiungSAT and RazakSAT™ satellites are available at *id*; and in Chapter 1 of the thesis (1.4.5. Satellite Manufacturing and Launching).

Finally, the Malaysia East Satellite (MeaSAT) is the name of a line of communications satellites owned and operated by the Measat Satellite Systems Sdn. Bhd.[219] This satellite network consists of a number of satellites already launched into orbit as well as ones expected to be launched in the future. This matter will be discussed further in the forthcoming section.[220]

Apart from the satellites programme, the *Program Angkasawan Negara* is another essential programme initiated by ANGKASA. It is a programme for sending a Malaysian into outer space.[221] Besides that, the ANGKASA has also launched many educational programmes such as Yuri's Night, 100 Hours of Astronomy, National Space Challenge, Rocket Launching Technology Challenge, Workshop on Ionospheric Modelling for Malaysian SBAS, and others. Yuri's Night is a special event in memory of the first manned-spaceflight by Yuri Gagarin in 1961.[222] The 100 Hours Astronomy is a programme to celebrate the International Year of Astronomy.[223] The National Space Challenge is a programme that aims to instil talents and desires in the Malaysian young generation in the field of space science.[224] The Rocket Launching Technology Challenge is a competition programme intended to instil the culture in students with a creative and innovative mind-set.[225] Since Malaysia is planning to implement a Space Based Augmentation System (SBAS), the Workshop on Ionospheric Modelling for Malaysian SBAS is a workshop specifically designed to bring together ionospheric experts and identify the status of research activities in the related subjects. Other programmes include Planetarium Shows, Batik Competition, World Space Weeks, Carnival and Drawing Contest, and Astronaut Fashion Design Competition. The ANGKASA also

[219] Measat Satellite Systems Sdn. Bhd was formerly known as the Binariang Sdn Bhd.
[220] More information is available in Chapter 1 of the thesis (1.3.2(a): MEASAT Satellite System Sdn Bhd).
[221] More information on the *Program Angkasawan Negara* is available at Chapter 1 of the thesis (1.4.6. *Program Angkasawan Negara*).
[222] The event is celebrated on 12 April every year as a symbol of human achievement in space exploration. The date is recorded as a pioneering one in human space exploration by Yuri Gagarin and the first re-usable space vehicle, the Columbia. It is commemorated by students performing in choirs, dances and traditional instrumentals from various schools in Malaysia. See *supra* note 201.
[223] This was a collaboration programme with a learning higher institution, UiTM Arau, Perlis and FalakOnline, a club of Malaysian amateur astronomers. It comprised observation sessions, seminars, discussion*s etc*. See *supra* note 201.
[224] Its objectives are to build the students' scientific research skills, to teach the concepts and techniques of space science, to provide experience in science concepts and processes, to help them appreciate the need for space science and to inspire teamwork and cooperation. See *supra* note 201.
[225] This was first introduced in 2003 as a pioneer project. The students are required to create a satisfactory rocket model and launch it into the sky in the hope that it will use minimal frictional force in a very creative style. See *supra* note 201.

publishes online publications including the CAKERAWALA, SEMESTA e-Magazine, and others.

(c) Astronautic Technology (M) Sdn Bhd (ATSB)

Astronautic Technology (M) Sdn Bhd (ATSB)[226] is another Malaysian governmental department under the Ministry of Science, Technology, and Innovation (MOSTI) that is of great significance. It is the pioneer and leader in designing and manufacturing satellites in Malaysia. The ATSB has been actively involved in satellite technologies and has an innovative mission to develop advanced space systems and other related technologies in order to provide value-added applications for its global customers.[227] In accomplishing its target, its Chief Executive Officer[228] stresses staff commitment, discipline, successful strategic collaborations, and joint ventures with local and international partners. Apart from that, their strategic objectives are to lead in research and development of space and related technologies, to achieve operational excellence in delivering products and services, to create expertise in the field of space engineering and allied technologies, and many others.[229] Its building is well-equipped with facilities that include a class 100 000 clean room, an optical room, an environment test facility, and an electronic laboratory.[230]

Being the foremost company directly involved with space technological development and research, particularly of satellite technologies, the ATSB has developed a number of focal space projects. The most well-known are TiungSAT-1 and RazakSAT projects. Other projects include CubeSat and InnoSat. The TiungSAT-1[231] is a micro-satellite programme

[226] The ATSB official website is available at http://www.atsb.my/, accessed: 13 May 2014.
[227] See http://www.atsb.my/index.php?option=com_content&view=article&id=44:vision-a-mission-statement&catid=1, accessed: 13 May 2014.
[228] Its Chief Executive Officer (CEO) is Dato' Dr. Ahmad Sabirin Arshad. This fact is taken as of 13 May 2014.
[229] See http://www.atsb.my/index.php?option=com_content&view=article&id=6:atsbr-strategic-objectives-a-values&catid=1, accessed: 13 May 2014.
[230] See http://www.atsb.my/index.php/facilities.html, accessed: 28 June 2012; http://www.atsb.my/index.php?option=com_content&view=article&id=45:about-atsbr&catid=3, accessed: 15 May 2014.
[231] The TiungSAT-1 was a personal initiative of the former Malaysian Prime Minister, Tun Dr Mahathir Muhammad who was inspired after he visited Surrey Satellite Technology Ltd. (SSTL) in the United Kingdom in March 1997. It is hoped that such a project will develop Malaysia into an electronic high-technology provider and resonate with the Multi-media Super Corridor Program within the Malaysian vision of 2020**.** Martin Sweeting, Wei Sun and Mazlan Othman, "TiungSAT-1: Malaysia's Microsatellite Programme", *TiungSAT-1, From Inception to Inauguration,* Eds., Mazlan Othman and Ahmad Sabirin Arshad, (Kuala Lumpur: Astronautic Technology (M) Sdn Bhd, 2001), at 13. See also, The Satellite Encyclopaedia, http://www.tbs-satellite.com/tse/online/sat_tiungsat_1.html, accessed: 15 May 2014.

and the first Malaysian remote sensing micro-satellite. It was named after a strident Myna bird, and was also called MO-46. The TiungSAT-1 operates at LEO at an altitude of 650 km from the earth's surface and at 60 degrees inclination. It measures 690x366x366mm and weighs 50kg. The satellite was developed through a technology transfer and training programme between the ATSB and SSTL, United Kingdom.[232] The purpose of such a programme is to acquire advanced technology and expertise from the technology partner through construction, test, launch, and orbital operations of the TiungSAT-1. The programme consisted of four main tasks: (1) TiungSAT-1 micro-satellite construction, launch, and operation; (2) Its mission control ground station; (3) Technology transfer training; and lastly, (4) TiungSAT-1 micro-satellite technology license and documentation.[233] The satellite was then activated from the Earth control system at the ATSB Earth Control Station situated at Malaysia National University (UKM),[234] seven hours after it was launched into orbit.[235]

The TiungSAT-1 has three missions: (1) Earth observations; (2) scientific Cosmic-Ray Energy Deposition Experiment (CEDEX), and (3) Simple communication applications including communication for email, voice-mail, scientific data exchange, faxes, images, and internet access for small ground users.[236] It uses Radio Amateur Frequencies, giving the Radio Amateur Society access to its Earth images and communications capabilities. The TiungSAT-1 is equipped with two cameras: a Multi-Spectral Earth Imaging Camera system

[232] The SSTL is a British world premier provider of small satellite missions that specialises in designing, building, and launching small satellites. The TiungSAT-1 was built at the Surrey Space Centre under a UKP8.4m contract (1997), within a Know-How Technology Transfer and Training Programme between the SSTL and the ATSB. In this programme the Malaysian engineer teams from the ATSB worked alongside Surrey engineers for one year. The comprehensive training programme involved the building, integration, test, launch, and orbital operation. See the SSTL website at http://www.sstl.co.uk/. See also "TiungSat 1 (MySat 1, OSCAR 46, MO 46", *Gunter's Space Page*, http://space.skyrocket.de/doc_sdat/tiungsat-1.htm, all accessed: 13May 2014.

[233] For more information on TiungSAT-1 technology transfer programme, read Ahmad Sabirin Arshad, "TiungSAT-1 Technology Transfer Programme", *TiungSAT-1, From Inception to Inauguration,* Eds., Mazlan Othman and Ahmad Sabirin Arshad, (Kuala Lumpur: Astronautic Technology (M) Sdn Bhd, 2001), at 8. See also Martin Sweeting, Wei Sun and Mazlan Othman, "TiungSAT-1: Malaysia's Microsatellite Programme", *supra* note 231, at 16.

[234] UKM is one of Malaysia's public universities with its main campus located in Bangi, Selangor, Malaysia. Its official website is available at http://www.ukm.my/v5/, accessed: 13 May 2014.

[235] See Surrey Satellite Technology, "Third Satellite Launch this year for SSTL: TiungSAT 1 in Orbit", (27 September 2000), *SpaceRef*, http://www.spaceref.com/news/viewpr.html?pid=2696, accessed: 15 May 2014.

[236] TiungSAT-1 provides 80m resolution multi-spectral Earth imaging, 1.2 km meteorological Earth imaging, digital store-and-forward communications and a cosmic-ray energy deposition experiment. For more information on TiungSAT-1 mission design, read Astronautic Technology (M) Sdn Bhd. and Surrey Satellite Technology Limited, "TiungSAT-1 Microsatellite Mission Design", *TiungSAT-1, From Inception to Inauguration,* Eds., Mazlan Othman and Ahmad Sabirin Arshad, (Kuala Lumpur: Astronautic Technology (M) Sdn Bhd, 2001), at 29. See also Martin Sweeting, Wei Sun and Mazlan Othman, "TiungSAT-1: Malaysia's Microsatellite Programme", *supra* note 231, at 17.

and a Meteorological Earth Imaging camera system that has 72 m and 1.2 km resolutions.[237] The first camera can provide detailed information on the Earth's resources, environmental haze pollution, land use, or agricultural activities. The second camera is capable of monitoring weather patterns and providing hurricane warnings. This achievement, in fact, reflects the preliminary success of Malaysia in her endeavour to delve into aeronautics technology.

Since the Government of Malaysia is willing to spend a large amount of money to upgrade space-related technologies, including satellite technology with the hope of minimising the cost of leasing satellites from other countries,[238] the ATSB has continued to expand its efforts to develop a more advanced remote sensing satellite project. This project is called RazakSAT[239]. The RazakSAT system is a collaborative programme between the ATSB and the Satrec Initiative Co Ltd, South Korea.[240] It is a 180kg mini-satellite that gives a high-resolution Earth Observation mission capability. Its developing cost is approximately Ringgit Malaysia 150 million (about 43 million USD).[241] It was put into a unique Near Equatorial Orbit (NEqO) and become the first remote sensing satellite of its genre in history to orbit the Equator.[242] The images cover countries such as Malaysia, Indonesia, Singapore, Thailand, Brunei, India, Sri Lanka, the Philippines, some African countries including Somalia, Rwanda and Nigeria, and some South American countries. This successful event has bolstered the ATSB's aim of becoming the leading South-East Asian company in this class of satellite.

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[237] For details, read Norhizam Hamzah, Ahmad Sabirin Arshad and Mohammad Ridwan Hidayat, "TiungSAT-1 Earth Imaging System", *TiungSAT-1, From Inception to Inauguration,* Eds., Mazlan Othman and Ahmad Sabirin Arshad, (Kuala Lumpur: Astronautic Technology (M) Sdn Bhd, 2001), at 47.

[238] On top of that, such efforts can guarantee the safety of data and information gained from the technology. See "Dana Besar Majukan Satelit Jimat Kos Sewa", *Berita Harian,* 24 April 2009.

[239] The satellite was named 'RazakSAT' in tribute to the second Prime Minister of Malaysia, Tun Abdul Razak (known as "Bapa Pembangunan Malaysia" or Father of Malaysian Development) for his contribution towards Malaysia's development.

[240] Satrec Initiative Co. Ltd is a Korea-based company, located at Daejeon, South Korea. It engages in the provision of communication products that offer, *inter alia,* satellite platform for earth orbit small satellite missions, payloads including imaging systems for 100 kg class satellite, ground station systems including satellite image data receiving and processing stations and mission control stations. For details, refer to Satrec Initiative Co. Ltd website, https://www.satreci.com/eng/, accessed: 13 May 2014.

[241] The cost is considered lower than the cost of developing a satellite of the same capabilities due to the advanced technology and material used, as well as the competitive labour rates.

[242] The RazakSAT will orbit the equator every 100 minutes at an altitude of 685km. In view of the fact that it provides a high number of passes over the equatorial region, for example 14 times per day over Malaysia, it will provide great benefits to the equatorial region as the imaging opportunities will be three times greater than the usual sun-synchronous orbit. This unique feature gives the RazakSAT the ability to maximise its imaging opportunity and significantly increase its re-visit time over the coverage area. Refer http://www.atsb.my/index.php/products-a-services.html. Read also Norhan Mat Yusoff and Norhizam Hamzah, "The Role of RazakSAT in Remote Sensing", in *The Geospatial Resource Portal,* http://www.gisdevelopment .net/magazine/Malaysia/2006/apr-jun/26_1.html, all accessed: 28 December 2009; http://www.atsb.my/index.php?option=com_content&view=article&id=67&Itemid=56, accessed: 13 May 2014.

The RazakSAT is equipped with a Medium-sized Aperture Camera (MAC)[243] to capture useful high-resolution images for agriculture, town planning, natural disasters, fish migration, security, and forest management. The satellite is a three-axis stabilised type and has a comprehensive sensor suite including a space-borne Global Positioning System (GPS) receiver, star tracker, fibre-optic gyroscopes, magnetometers, and fine and coarse sun sensors. Satellite actuator systems, which include reaction wheels, allow accurate positioning of the satellite. The combinations of high-resolution and large-attitude manoeuvrability allow the RazakSAT to offer a highly customised and configurable imaging system.[244] It is capable of monitoring and tracking the open burning that occurs within or outside Malaysia, and to send direct information to specific departments such as the Fire and Rescue Department.[245] With the launch of the RazakSAT, Malaysia can offer relevant tertiary Geography Information System (GIS) programmes and GPS technology[246] not only locally but also globally, especially to West Asia and the European countries.

The RazakSAT's mission and control operations are carried out by the ATSB's ground station engineers at Hicom-Glenmarie Industrial Park, Shah Alam. It also involves two other ground stations, namely the Malaysian Remote Sensing ground station in Temerloh, Pahang and the ANGKASA's ground station in Banting, Selangor.[247] These stations are equipped with Image Receiving and Processing Systems (IRPS)[248] that are capable of receiving and

[243] MAC is a push-broom camera with five linear detectors (one panchromatic, four multi-spectral) weighing approximately 50 kg. It can produce high-resolution images in one panchromatic (PAN) band and four multi-spectral (MS) bands. At an altitude of 685km, it has a ground sampling distance of 2.5m (PAN) and 5m (MS). See *id*.

[244] The summary details of the RazakSAT specification are: Orbit: Near Equatorial Low Earth Orbit (NEqO) at 685km 9 degrees inclination; Mechanical Configuration: 1200mmxH1200mm hexagon type, 180kg mass; Power Generation: Greater than 300W at end of life; Payload Features: Medium-sized Aperture Camera Panchromatic: 2.5m, Multi-spectral (4-bands): 5.0m; Imaging Capacity: 20km swath by 500km strip for total area of 10 000 km2; Data Down Link Rate: 30 Megabits per second single channel. See *id*. See also http://www.satreci.com/eng/program/program_01.htm, accessed: 10 March 2012; https://www.satreci.com/eng/ds1_1.html?tno=5, accessed: 13 May 2014.

[245] "RazakSAT Mampu Kesan Pembakaran Terbuka", *Berita Harian,* 23 March 2006.

[246] The GIS and GPS technologies are expected to create a new-age economy of futuristic jobs in Malaysia. See Michael Sun, "Geography Information System: Think Geo-Spatial!", http://www.atsb.my/index.php/media/razaksatlsupgrlsupg-in-the-media.html, accessed: 11 June 2011; http://www.malaysiagis.com/index.php/local-gis/news/328-geography-information-system-think-geo-spatial-, accessed: 13 May 2014.

[247] Michael Sun, "Geography Information System: RazakSAT Satellite Opens Doors", *id*.

[248] The IRPS has three subsystems: (1) Antenna and RF subsystem (ARS) which performs the tracking, receiving the RazakSAT X-band downlink signals, demodulation and bit-synchronization the signals; (2) Receiving and archiving subsystem (RAS); (3) Search and Processing Subsystem (SPS). See http://www.atsb.my/index.php/project/space-systems.html, accessed: 24 March 2012;

processing RazakSAT images and other Earth Observation satellite images for post-processing and distribution to users. Apart from IRPS, the ATSB also offers a Mission Control System (MSC) for tele-command, telemetry, and control purposes.[249]

Apart from the TiungSAT and RazakSAT, there are a number of other projects such as CubeSAT and InnoSAT. These are small satellites that were launched together with the RazakSAT. Having experience of dealing with those satellite projects, the ATSB was then appointed as project manager by the Government of Malaysia in the *Program Angkasawan,*[250] especially in handling logistic activities.[251] Other projects expounded by the ATSB are, *inter alia*: Calibration System Development,[252] Spacecraft Attitude Determination & Control Subsystem (ADCS),[253] Space-borne GPS Receiver,[254] National Tsunami Early Warning System,[255] Environment Radiation Monitoring System,[256] Differential Global Navigation Satellite System,[257] Robotic Telescope,[258] Smart Mosque Project,[259] Al-Falak

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http://www.atsb.my/index.php?option=com_content&view=article&id=69:razaksatr-image-receiving-a-processing-station-irps&catid=40:space-systems&Itemid=2, accessed: 13 May 2014.

[249] The IRPS and MSC integrated solution is suitable for customers who need the complete solutions to control their satellite and to process the images received. See *id*.

[250] For details see Chapter 1 of the thesis (1.4.6. *Program Angkasawan Negara*).

[251] Such activities include the logistic aspects of Malaysian astronauts' training in NASA and the Yuri Gagarin Cosmonaut Training Centre in Star City, Russia, the launching at Baikonur Cosmodrome, the Soyuz spacecraft's docking at the ISS 2 days later and the landing. The tasks also cover media coverage, the astronaut's communication with earth, landing activities, the astronaut's inauguration and safe return of the astronaut. See http://www.atsb.my/v2/mediacenter_new_7%20oct.html, accessed: 8 March 2012.

[252] It involves extensive post-processing for raw images collected, and data calibration of the imaging systems of satellites for local application. See http://www.atsb.my/index.php/project/space-systems.html, accessed: 10 March 2012; http://www.atsb.my/index.php?option=com_content&view=article&id=71:calibration-system-development-&catid=40:space-systems&Itemid=2, accessed: 13 May 2014.

[253] The ADCS maintains spacecraft stabilisation and adjusts it to a desired direction when necessary. The ATSB developed the ADCS sensors, actuators, and Flight Control Software. See *id*.

[254] This is a spacecraft orbit determination and timing system designed for cost-effective LEO application. It provides GPS standard time, position, and velocity measurements. See *id*.

[255] In this project, sensors and instruments such as deep ocean buoys, seismic sensors, tidal gauges, and coastal cameras are placed throughout the country. Data from the sensor are transmitted back to the Centre for processing, modelling, and analysis. See http://www.atsb.my/index.php/project/advanced-technology.html, accessed: 10 March 2012.

[256] Specific sensors are placed throughout the country to monitor levels of radiation and provide early warning to safeguard against exposure to potentially hazardous radioactive environments. See *id*.

[257] This has been developed in response to the low resolution of the current GPS system. It encompasses the following networks: firstly, four broadcasting stations at Bagan Datoh (Perak), Melaka (Melaka), Kuantan (Pahang), Kuala Besar (Kelantan); secondly, two remote sensing stations at Port Klang (Selangor), Kuala Terengganu (Terengganu); and thirdly, One National Control Centre at Port Klang, Selangor. See *id*.

[258] This is an application of spin-off technology where the observer can remotely control the telescope and its instruments from convenient places. This robotic observatory is located at Langkawi Island, National Planetarium Kuala Lumpur, and Malacca. See *id*.

[259] This is a project involving installation of SMART Mosque system that disseminates the latest information and knowledge to the mosque community. Al-Jamiul Badawi Mosque at Kuala Batas, Kedah, is the first mosque in the world installed such system. See *id*.

Virtual Reality Solar System,[260] Wind and Runway Visual Range System,[261] and Thermal Infrared Satellite Mission Studies.[262] It also offers products and services such as satellite design and manufacturing. The ATSB has even ventured into exporting satellite components to countries such as South Africa and Germany, with future plans to export a complete satellite.[263] Apart from that, the company offers also various satellite platforms[264] which have been tested and qualified as suitable for educational use. It carries out also work orders for satellite payloads and components including Magnetometer Module, Reaction Wheel, Micro Thrusters, and Digital Fine Sun Sensors. Its other products and services include launch services,[265] Vigilant Ground-Based Imaging Systems[266] and Early Warning Systems, navigation, tracking and communication systems[267].

With all this experience in dealing with satellite technology development, as well as other projects and services, it is believed that the ATSB has the capability to venture further in such technology. Furthermore, Malaysia's efforts to venture into space technology, particularly in the small satellite business,[268] have served as a contribution to and from the developing

[260] Al-Falak Virtual Reality Solar System is a 3D virtual reality application that enables the user to interact with and explore the solar system. It was developed for Falak Al-Khawarizmi Complex (Mufti Department, Malacca). See *id*.

[261] This system is installed at the end of the runways of 16 airports throughout Malaysia. It comprises a set of wind and visibility sensors that will capture the weather data that will be transmitted over the wireless network to the Malaysian Meteorologist Department's station for processing. See *id*.

[262] This is a system for data collection, processing, and dissemination to monitor the harmful impact on the ecology, economy and the general health of population in Malaysia and South East Asia caused by forest, peat fires and smog or haze. See *id*.

[263] See http://www.atsb.my/v2/mediacenter_new_7%20oct.html, accessed: 13 May 2014.

[264] The Platforms include: ATS-1 Platform (125gsm) which is suitable to nurture as elementary level in understanding about space and satellite exploration innovation teaching via miniature educational platform; ATS-10 Platform (10kg) which is ideal for educational and small scientific payloads; ATS-100 Platform (100kg) which is for Earth Observation missions and appropriate for countries that have just embarked on a satellite programme; ATS-500 Platform (500kg) which is perfect for more complex Earth Observation missions. For details see http://www.atsb.my/index.php?option=com_content&view=article&id=58:satellite-systems-design-and-manufacture&catid=37:products&Itemid=60, accessed: 15 May 2014.

[265] The ATSB has developed a Rideshare Adapter, a versatile and smart configurable deployment of electronics that enables multi-payload manifesting with an interface to the launch vehicle. It provides a cost-effective, rapid integration rideshare for science, technology and education payloads for the Falcon 1 Launcher. See *id*.

[266] The ATSB has installed Vigilant telescopes and cameras, the robotic telescopes and cameras that can be remotely programmed and controlled via the internet, in Antarctica and several locations in Malaysia including Langkawi, Kuala Lumpur, Shah Alam and Malacca. These Vigilant series of imaging systems are used by the educational and professional sectors. See *id*.

[267] The ATSB manages high-technology products including the National Tsunami Early Warning System, the National Radiation Monitoring System, and the Runway Visual Range Projects, where sensors are placed at strategic locations and the data are sent back to a control centre for processing, modelling, and decision-making.

[268] Based on the concept of 'faster, cheaper, and better', the small satellite business is considered the most suitable for developing countries with emerging economies as it involves modest development costs. See Mazlan Othman and Ahmad Sabirin Arshad, "Role of Small Satellites for Developing Countries", *TiungSAT-1, From Inception to Inauguration,* Eds., Mazlan Othman and Ahmad Sabirin Arshad, (Kuala Lumpur: Astronautic Technology (M) Sdn Bhd, 2001), at 203. See also Mazlan Othman, "The Small Satellite Business: Contributions

countries. Indeed, such a situation could benefit the country, for instance in communication, navigation, earth observation and international relations. From the above points, it has been established that the ATSB, with all its projects, makes a significant contribution to the Malaysian space-related industry.

(d) Malaysian Remote Sensing Agency (MRSA)

The Malaysian Remote Sensing Agency (MRSA)[269] is also one of the departments under the MOSTI. It was established in August 1988 and became fully operational in January 1990. Its main objective is to develop the remote sensing applications and related technologies in order to apply them in the operational agencies for effective management of agriculture production, natural resources, environment, disaster, security, and land development. Through its vision and missions, the MRSA is aiming to conduct research and development programmes, as well as advising the Malaysian Government on matters related to remote sensing and other related technologies.[270]

MRSA is well equipped with a computer system for satellite data image processing, a geographic information system and global positioning system, a microwave remote sensing laboratory, remote sensing digital photographic laboratory, remote sensing data archiving and retrieval centre, and a satellite ground receiving station. The satellite ground receiving station is known as Remote Sensing Malaysia Ground Receiving Station (MGRS) and was established in March 2000. The station is able to receive data from various remote sensing satellites including the Canadian Radarsat-1, the French SPOT 2, 4 and 5, the American Landsat-7, and others.[271]

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to and from Developing Countries", *TiungSAT-1, From Inception to Inauguration,* Eds., Mazlan Othman and Ahmad Sabirin Arshad, (Kuala Lumpur: Astronautic Technology (M) Sdn Bhd, 2001), at 217.

[269] It was formerly known as Malaysian Centre for Remote Sensing (MACRES). See its official website at http://www.remotesensing.gov.my/portalarsm/start.html, accessed: 15 May 2014.

[270] Its vision is to optimise the use of remote sensing and related technologies for sustainable development of the country. Its mission is to provide solutions in those technologies and to acquire and distribute remote sensing satellite images for Malaysia's needs. Other functions include implementing the National Remote Sensing Programme and acting as the chairman of the national 'Working Group of Remote Sensing', as well as coordinating the implementation of Malaysian remote sensing activities. See http://www.remotesensing.gov.my/, accessed: 10 January 2014.

[271] Other satellites include the USA Terra and Aqua satellites, the Indian IPS-P4 satellite, and the NOAA of USA. The station has been upgraded to also receive data from the RazakSAT. See http://www.remotesensing.gov.my/page.cfm?name=groundstation, accessed: 10 January 2014.

There are four major activities conducted by the MRSA. Firstly, it is related to data services whereby it acts as the sole and centralised remote sensing image satellite provider for all Malaysian Government agencies. It provides data from the Radarsat-1, the Spot 2,4 and 5, the Landsat, the NOAA, the Terra/Aqua (MODIS), the IRS (OCM), the QuickBird, and the IKONOS satellites. In addition, it is also responsible for any negotiation with foreign satellite operators for the procurement of direct reception of satellite images.[272]

Secondly, the main activity of the agency is related to the research and development programme. It was formulated to support various user agencies including those in agricultural production management, natural resources, environment, disasters, security, and land development. The programme focuses mainly on the application and technology developments. In the application development, it stresses the application packages for operation of remote sensing and related technologies in natural resources and environmental, disaster and security management, such as precision farming, rice monitoring and yield prediction system, disaster management and others.[273] For the technology development, it engages with selected remote sensing technology areas such as microwave remote sensing research development.[274]

Thirdly, it deals with training services. The MRSA acts as the main training centre to increase the number of trained remote sensing professionals. This training is conducted by a qualified team of Remote Sensing Malaysia trainers. The trainees are usually given hands-on practice in basic and advanced image processing, such as satellite data integration and image interpretation and classification.[275] Finally, the last major activity of the MRSA is consultancy services. The services offered are applied to various applications for the government and private sectors.

[272] At the end of 2007, the MRSA received 952 requests from various users involved in the processing of 173 Landsat TM scenes, 3039 Spot scenes, 431 Radarsat scenes, 70 Ikonos/QuickBird, and others. There are 3,372 satellite image products distributed to 147 users. See *id*.

[273] Other application packages being developed include integrated geospatial database and planning system, monitoring of environmentally sensitive areas, satellite image maps, satellite image atlas of Malaysia, fish forecasting, environmental health and biodiversity inventory. See *id*.

[274] For details, see http://www.remotesensing.gov.my/page.cfm?name=Microwave; see also http://www.remotesensing.gov.my/page.cfm?name=SIPS, all accessed: 10 January 2014.

[275] See http://www.remotesensing.gov.my/article.cfm?id=198, accessed: 10 January 2014.

The MRSA has conducted a number of major national programmes. These programmes include:[276]

(a) Integrated Geospatial Database and Planning (IGDP) system: A system of comprehensive natural resource and environmental management with geographic analytical capabilities;

(b) Precision Farming: It aims to increase Malaysian crop production using integrated remote sensing, GIS, GPS, and sensor technologies. It stresses the concept of 'The Right Input, The Right Amount, The Right Time, and The Right Place';

(c) Rice Monitoring and Yield Prediction System: This system enables the estimation of the rice yield one month before harvesting, compared to 6-12 months after harvesting by the conventional method;[277]

(d) Monitoring of Environmentally Sensitive Areas: This focuses on observation of development activities that might affect Malaysia's environmentally sensitive areas such as water catchments, highlands, reserved forests, and wetlands;

(e) Disaster Management: This relates to the management of major natural disasters occurring in Malaysia such as forest fires, floods, and landslides. The programme involves processing and analysing satellite images and disseminating value-added data and related information;

(f) Microwave Remote Sensing Research and Development: The programme involves all-weather capability microwave remote sensing that is highly required for a country with persistent cloud cover such as Malaysia. It comprises system development, modelling and application development;[278]

(g) Integrated Remote Sensing and GIS Software Development: This is a package for resource, environmental, and strategic application that consists of, *inter alia*, remote sensing image processing, GIS analysis, and model-based

[276] More information on these programmes is available in Chapter 1 of the thesis (1.4.2. Remote Sensing). See also http://www.remotesensing.gov.my/article.cfm?id=391#, accessed: 10 January 2014.

[277] It is a collaboration project between the MRSA, Malaysia Multimedia University (MMU), and MUDA Agricultural Development Authority (MADA).

[278] Under the system development, the project developed a laboratory equipped with anechoic chamber and a C-band mobile scatter meter. While, the modelling and application development involves laboratory research and field measurement that resulted the development of theoretical and application model for monitoring and yield forecasting of paddy and oil palm crops. It is a collaboration project of MRSA with the Malaysian Multimedia University (MMU).

analysis models. This project was conducted in collaboration with Peking University of China;

(h) Satellite Image Map (SIM): The main activities involved are satellite image processing, spatial data integration and cartography.

In conclusion, the MRSA, through its projects and programmes, has made significant contributions to the development and expansion of Malaysian space-related activities and experiences, particularly in the area of remote sensing technology.

(e) Malaysian Meteorological Department (MMD)

The Malaysian Meteorological Department (MMD)[279] is another department under the Malaysian Ministry of Science, Technology, and Innovation (MOSTI). It was established in 1958 when the Department of the Meteorological Office was formed. In 1965 it was renamed the Malaysian Meteorological Service, formed under the Malaysian Ministry of Transport. In 1984 it was transferred to the Ministry of Science, Technology, and the Environment (MOSTE). The MOSTE was restructured in 2004 and became officially known as MOSTI.[280] The MMD's vision is to become a world-class meteorological centre that affords excellent services both locally and internationally by 2020. However, its mission is to offer effective meteorological, climatological, and geophysical services for national security, societal well-being, and sustainable socio-economic development. It is also to enhance those services for the improved protection of life, property and the environment, and to increase safety on land, at sea and in the air. Its purpose is also to enhance quality of life and help achieve sustainable economic growth.[281] It is to be noted that the MMD uses relatively little space technology; nevertheless, it merits discussion.

The MMD maintains an observation station network for monitoring weather conditions and seismic activities in Malaysia. The MMD has various functions. Among its major tasks is to issue timely meteorological information and forecasts for civil and military aviation, marine activities, and the general public. Other functions are to provide early warnings on weather phenomena and dangerous sea conditions in the Malaysian region, to offer immediate

[279] The MMD official website is available at http://www.met.gov.my/, accessed: 13 May 2014.
[280] For further information, refer to *supra* note 197.
[281] See http://www.met.gov.my/index.php?option=com_content&task=view&id=102&Itemid=327, accessed: 13 May 2014.

information on earthquake events that affect the country, and to provide seismological information to civil engineering and construction industries. Furthermore, it also compiles climatological, atmospheric composition and seismological data, prepares climatological statistics, and monitors atmospheric composition, and also supplies information and technical advice on meteorological aspects of air pollution. Other tasks are to conduct cloud-seeding operations in order to increase water resources for agriculture and other purposes, and to participate in international programmes on research, data collection and exchange in meteorological related matters *etc*.[282]

The MMD supplies a number of major services that are accessible via its official website.[283] Those services are:[284]

(a) Weather forecasting: The MMD provides online access to the general weather forecast as well as forecasts for major towns and tourist destinations in Malaysia;[285]

(b) Seasonal and long-range weather outlook: It provides current El-Nino conditions with the current sea surface temperature, and predictions from the European Centre for Medium-Range Weather Forecast (ECMWF) seasonal forecast model;[286]

(c) Weather warnings: This service supplies warnings of strong winds and rough seas, and warnings of severe weather such as thunderstorms and heavy rain, tropical cyclones and storms;[287]

(d) Marine meteorological forecast: This service is offered particularly for fishermen. It comprises seven-day weather forecasts, winds, waves, and tidal forecasts;[288]

(e) Aviation meteorology: Among the services provided under this category is an aviation briefing terminal that consists of, for example, a pilot briefing

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[282] For more information on other functions, refer to http://www.met.gov.my/index.php?option=com_content&task=view&id=100&Itemid=177, accessed: 13 May 2014.
[283] See *supra* note 279.
[284] For details, see http://www.met.gov.my/index.php?option=com_content&task=view&id=1315&Itemid=1050, accessed: 13 May 2014.
[285] For Malaysia's online current weather forecast, see http://www.met.gov.my/index.php?option=com_weathergeneral&Itemid=960, accessed: 13 May 2014.
[286] For details, see *id*.
[287] For details, see *id*.
[288] For details, see *id*.

package and Kuala Lumpur International Airport (KLIA) radar images. Other services include a weather forecast kiosk which offers a forecast service via world forecasts, local forecasts, satellite, radar, and earthquake info;[289]

(f) Meteorological observation: This is accomplished using images from satellites such as MTSAT, FY-2E, NOAA, and TERRA/AQUA, as well as radar images. The service provides observations on temperatures, humidity, visibility, and rainfall;[290]

(g) Earthquake and tsunami warnings: This service provides current earthquake information and tsunami alerts with the locations where they are taking place. It also provides a list of recent earthquakes;[291]

(h) Weather modification: This service involves information on cloud-seeding operations conducted throughout Malaysia;[292]

(i) Environmental studies: These supply information on solar ultraviolet index, rainfall acidity measurement, ozone monitoring programme, air quality data, summaries of air pollution observations and others;[293]

(j) Climate: This presents details on Malaysia's general climate, Malaysian climate change monitoring information, Malaysian climate data, world city climate information, and others;[294]

(k) Agromet: This supplies a '10-Day Agromet Bulletin' reporting weather review that is useful for agricultural users in Malaysia. It also presents the weather outlook for the next 10 days and the expected weather impact for the coming period. Information provided also includes rainfall, evaporation, solar radiation, temperature, and soil moisture distribution.[295]

The MMD has established a number of forecast offices throughout the country with the responsibility to provide meteorological services. To name but a few, they include the Central Forecast Office, KLIA Forecast Office, Bayan Lepas Forecast Office, Butterworth Forecast Office, and many others.[296] The Central Forecast Office's tasks, among others, are to provide

[289] For details, see *id*.
[290] *Id*.
[291] *Id*.
[292] *Id*.
[293] *Id*.
[294] *Id*.
[295] *Id*.
[296] Other forecast offices include Kuantan Forecast Office, Subang Forecast Office, Gong Kedak Forecast Office, Sarawak Branch and Sabah Branch. See

short-range general weather forecasts for the whole of Malaysia, and also short-range city forecasts for Malaysia's major cities and tourist areas. It is also expected to monitor weather conditions and issue severe-weather advice and warnings when necessary. The main responsibilities of the KLIA Forecast Office are to monitor the weather conditions around KLIA, issue aerodrome warnings when necessary, and provide meteorological information for Air Traffic Management Service, Airport Operation Centre, and Search and Rescue operations. The Bayan Lepas Forecast Office maintains weather monitoring over the states of Kelantan, Terengganu, and Pahang, besides providing meteorological services for civil and military aviation. The Butterworth Forecast Office is more oriented towards providing weather forecasts to the Royal Malaysian Air Force in their daily flight operations.[297]

Based on the above facts, it is evident that the MMD, through its meteorological and seismological services made feasible by space-related technology, has made significant contributions to the country particularly with respect to enhancing the protection of public life, property and the environment, as well as safety on land, at sea and in the air. Such efforts therefore certainly contribute to Malaysia's sustainable development and economic growth.

1.3.2. Non-Governmental Sector

Apart from the Malaysian governmental sector, the non-governmental sector has also contributed to the development and progress of space-related activities in Malaysia. This section is devoted to emphasizing a number of non-governmental sectors that participate in the growth and evolution of the activities. To name but a few, they include MEASAT Satellite System Sdn Bhd, Malaysian Institute of Aero and Space Studies (IKAM), the Space Tourism Society Malaysia Chapter (STS-MC), and Astro All Asia Network Plc. (ASTRO).

(a) MEASAT Satellite System Sdn. Bhd.

MEASAT Satellite System Sdn. Bhd.[298] (hereinafter referred to as the 'MSS') is one of the main private companies directly involved in space activities in Malaysia. It is the only

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http://www.met.gov.my/index.php?option=com_content&task=view&id=92&Itemid=196, accessed: 13 May 2014.

[297] *Id.*

[298] The MEASAT Satellite System Sdn. Bhd. official website is available at http:///www.measat.com, accessed: 13 May 2014.

Malaysian licensed communication satellite operator, and it operates as MEASAT Global Berhad.[299] The MSS was formerly known as Binariang Satellite System Sdn. Bhd. (referred to as 'Binariang').[300] In 1992, in response to the Vision 2020 plan laid out by the former Malaysian Prime Minister, Tun Dr Mahathir Mohamed, specifically with respect to the development of Malaysian communications infrastructure, Binariang started to develop the country's first communication satellite project called 'Malaysia East Asia Satellite' (MEASAT).[301] In 2002, Binariang became a wholly-owned subsidiary of a holding company, MEASAT Global Berhad; in 2004 it was renamed MEASAT Satellite System Sdn. Bhd.[302]

The major vision of MSS is to become a leading emerging-market satellite operator that provides innovative and 'best-in-class' satellite solutions in the Malaysian, Asian and African markets.[303] It is headquartered in Malaysia, with representative offices in India and the Philippines. Since 1996, the MSS has provided reliable satellite solutions to customers across the Asia-Pacific region.

The central operation of MSS mainly involves the MEASAT satellite system which began in May 1994, when Binariang signed a contract with Boeing Satellite Systems International, Inc. (referred to as 'Boeing').[304] Such a satellite system has the capacity to provide digital video and audio broadcasting, telecommunication services, and high-speed internet access. It comprises four communication satellites: MEASAT-1/AFRICASAT-1, MEASAT-2,

[299] On 28 September 1956, MEASAT Global Berhad was incorporated under the name of Malayan Tobacco Company Ltd (MTC), with its main operations focused on manufacturing, importation, and tobacco product sales. In November 1999, MTC disposed of its tobacco manufacturing business, and marketing and distribution operations to become an investment holding company upon the acquisition of MEASAT Satellite Systems Sdn. Bhd. in May 2002. Later, on 23 July 2003, MTC changed its name to MEASAT Global Berhad to reflect its core business as Malaysia's sole licensed regional satellite system. See http://www.measat.com/investor_structure.html, accessed: 13 May 2014.

[300] Binariang Satellite System Sdn. Bhd is a private company established as a result of the Malaysian Government's 1987 privatisation policy, initiated to manage the change from the Government monopoly to privately owned and operated telecommunication services. It is the first cellular operator in Malaysia to offer fully digital services. See http://www.boeing.com/defense-space/space/bss/factsheets/376/measat/measat.html, accessed: 4 April 2012.

[301] MEASAT was a technology breakthrough with its pioneering Director-To-User (DTU) system transmitted via high-powered Ku-band transponder purposely designed for countries with heavy tropical rainfall. Elbert, Bruce R., *The Satellite Communication Applications Handbook*, (Artech House, 2003), at 245.

[302] See MEASAT Global Berhad Annual Report 2008 available at http://www.measat.com/investor_bod_annual.html; and http://www.measat.com/corp_profile_history.html, both accessed: 13 May 2014.

[303] See http://www.measat.com/corp_vision.html, accessed: 13 May 2014.

[304] Boeing Satellite System International, Inc. is a unit of the Boeing Company, the world's leading aerospace company which manufactures commercial communication satellites and is a major provider of space systems, satellites, and payloads for national defence, science, and environmental applications. It is headquartered in Chicago. Its website is available at http://www.boeing.com; See also http://www.answers.com/topic/boeing-satellite-systems-international-inc, all accessed: 13 May 2014.

MEASAT-3, and MEASAT-3a.[305] The first three satellite networks, i.e. MEASAT-1, MEASAT-2, and MEASAT-3, were designed and built by Boeing Satellite Development Center (SDC) through its Hughes Space and Communications Company (HSC).[306] MEASAT-3a was built by Orbital Sciences Corporation.[307] Apart from these, the next MSS satellite will be MEASAT-3b. Its expected launch date is on 29 May 2014. The satellite was constructed by EADS Astrium.[308]

MEASAT-1 and MEASAT-2 were launched in 1996.[309] Both were designed to provide 11 to 12 years of direct-to-user television services in Malaysia, in addition to the general communications service in the region, from Malaysia to the Philippines, and from Beijing to Indonesia. Both satellites are categorised as high-powered Boeing 376HP communication satellites that provide regional C-Band coverage for the Asian region as well as Australia and Hawaii. They also pioneered the use of Ku-Band transponder in the high-rainfall region of South East Asia that covers Malaysia, Indonesia, Eastern Australia, Vietnam, Taiwan, and the

[305] For details of location, background, transponder and performance specification of MEASAT satellites fleet, refer to http://www.measat.com/satellite_91e_measat3.html, accessed: 13 May 2014.

[306] The purchase of Hughes Space and Communication Company by Boeing in 2000 gave Boeing an impressive range of products for design, manufacture, launch, and support of satellites. Boeing Satellite Development Center is a major business unit of Boeing Defense, Space & Security. It is a factory responsible for designing, manufacturing, testing, and shipment of satellites ordered from Boeing, headquartered in El Segundo, California. It also supplied equipment for a satellite control station on Malaysia's Langkawi Island and trained Malaysian spacecraft controllers. See http://www.boeing.com/defense-space/space/bss; See also http://en.wikipedia.org/wiki/Boeing_Satellite_Development_Center, all accessed: 4 April 2012.

[307] Orbital Sciences Corporation is one of the world's leading providers of small-to-medium-class satellites. It is an American company specializing in manufacturing and launching communication, science and technology, imaging and defence satellites. Its headquarters are in Dulles, USA. Its website is available at http://www.orbital.com, accessed: 13 May 2014.

[308] EADS Astrium was an aerospace subsidiary of the European Aeronautic Defence and Space Company (EADS) that provided civil and military space systems and services from 2006 to 2013. Its headquarters are in Paris, France. In late 2013 Astrium was merged with Cassidian, the defence division of EADS and Airbus Military to form Airbus Defence & Space. The EADS itself was reorganised as Airbus Group in January 2014. Its official website is available at http://www.astrium.eads.net/; see also "Satelit 3b Baharu MEASAT dilancarkan 29 Mei", *Utusan Online,* 2 May 2014, http://www.utusan.com.my/utusan/Dalam_Negeri/20140502/dn_42/Satelit-3b-baharu-MEASAT-dilancarkan-29-Mei, accessed: 2 May 2014; see also http://www.measat.com/satellite_91e_measat3b.html; and http://www.satlaunch.net/p/launch-schedule-2013.html; http://en.wikipedia.org/wiki/EADS_Astrium; http://en.wikipedia.org/wiki/EADS, accessed: 4 April 2014.

[309] MEASAT-1 was launched on 12 January 1996 using the Ariane 44L rocket vehicle. Ten months later, on 13 November 1996, MEASAT-2 was launched using the same vehicle. Both were launched from Centre Spatial Guyanais at Kourou in French Guyana. MEASAT-1 has five high-power transponders in Ku-band for the direct-to-user service, powered by a 112-watt travelling-wave tube amplifier. The regional service is provided on 12 transponders in C band, using 12-watt solid state amplifiers. It was located in a geostationary orbit at 91.5 degrees east. Meanwhile, MEASAT-2 has 9 Ku-band and 6 C-band transponders and was located in a geostationary orbit at 148 degrees east. See Elbert, Bruce R., *supra* note 301; http://www.measat.com/satellite_91e_measat3.html, accessed: 13 May 2014.

Philippines.[310] Such launches led, indeed, to a rapid boost in Malaysian infrastructure development, and telecommunications and broadcasting industries, especially Malaysia's first digital Direct-to-Home Multi-Channel Television services.

When the operational life of MEASAT-1 and MEASAT-2 was approaching the end, the MSS developed an operational strategy to extend the satellites' lives. This was done by relocating MEASAT-1 from 91.5 degrees east to a new orbital location at 46.0 degrees east.[311] Since then, MEASAT-1 has continued to offer its services to Africa. With this new role it was renamed AFRICASAT-1. Meanwhile, MEASAT-2 was moved to an inclined orbit at 148.0 degrees east to extend its operational life.[312]

Then, in March 2003, the MSS ordered a Boeing 601HP satellite and designated MEASAT-3 to increase its service capacity. This new satellite will join MEASAT-1 and MEASAT-2 in the MEASAT system. MEASAT-3 was successfully launched on December 11th, 2006, from Baikonur Cosmodrome, Kazakhstan, aboard the Proton Breeze M launch vehicle. It was located at 91.5 degrees East with MEASAT-1.[313] MEASAT-3 was designed for a minimum 15 years' service life.[314] The launch provided back-up capacity in order to meet the increasing market demand for satellite services in the region. Its C-band payload covers Africa, the Middle East, Eastern Europe, Asia, and Australia. However, its Ku-band payload was designed to provide services for the development of data services and Direct-to-Home applications in Malaysia, China and India.

The other MEASAT fleet member is MEASAT-3a. It was launched on the 21st of June 2009 from the Baikonur Cosmodrome in Kazakhstan aboard the Land Launch Zenit-3SLB launch vehicle provided by the Intelsat Corporation. MEASAT-3a was located at the 91.5 degrees

[310] MEASAT-1 and MEASAT-2 are operated from a satellite control facility located 915m above sea level in Gunung Raya, Langkawi Island, and the northwest coast of Peninsular Malaysia. See MEASAT Global Berhad Annual Report 2008, *supra* note 302, at 11; Elbert, Bruce R., *supra* note 301. For details, refer also to http://www.boeing.com/defense-space/space/bss/launch/launched.html, accessed: 4 April 2012.
[311] The relocation of MEASAT-1 was carried out at the end of 2007. See MEASAT Global Berhad Annual Report 2008, *supra* note 302, at 10.
[312] See MEASAT Global Berhad Annual Report 2008, *supra* note 302, at 11.
[313] See Boeing Satellite Chronology of Launches, *id*.
[314] MEASAT-3 employs 24 C-band and 24-Ku band transponders. See http://www.boeing.com/defense-space/space/bss/factsheets/601/601fleet.html, accessed: 13 May 2014.

East orbital location, the same orbital location as MEASAT-3.[315] The satellite has a 15-year mission. It provides an additional 12 C-band transponders to cover Africa and Eastern Europe in the West, and Japan and Australia in the East, beside the 12 Ku-band transponders and high-powered spot beams that concentrate on Malaysia and Indonesia. The aim of building MEASAT-3a is to work in tandem with MEASAT-3 to increase the internet, telecommunication and broadcasting capacity by up to 50 per cent to support the burgeoning plans of their customers. This satellite was also designed to support the continuing growth of the company's Direct-to-Home, broadcasting, and telecommunication services. With this new launch, the MEASAT fleet has a total of 100 transponders across their four satellites.[316] The expectation is that MEASAT-3a will provide a significant boost to the MSS network capacity and simultaneously continue to expand their business in Malaysia, Asia Pacific, and Africa. This became evident when MSS signed an agreement with the MEASAT Broadcast Network Systems Sdn Bhd (MBNS) to supply transponder capacity for the MEASAT-3a satellite for a period of another 15 years.[317]

With respect to facilities, the MSS operation hub known as the MEASAT Teleport and Broadcast Centre (MTBC) accommodates the organization's Corporate Office, Satellite Control Centre and Customer Support Operations. The MTBC houses the telemetry, tracking, and command activities for the MEASAT satellites fleet. It also has two other backup satellite control centres to ensure the efficacy of its services.[318] The MTBC also houses the MEASAT Network Management Centre which offers customer support services by monitoring the satellite communication payloads' status and customer traffic. Apart from that, it also supplies customer teleport facilities.[319]

In brief, there are three core services offered by the MSS. They are: transponder leasing, broadcasting and telecommunication solution. The transponder leasing offers full-time and flexible leasing, and an occasional-usage service. The broadcast services include standard-

[315] MEASAT-3a provides an additional 24 transponders to the 48 transponders provided by MEASAT-3. The satellite, after separation from its launch vehicle, was acquired by the control centres of the Orbital Sciences facility in Dulles, USA and at the MEASAT Teleport and Broadcast Centre (MTBC), CyberJaya, Malaysia.

[316] See "MEASAT-3a enters Commercial Service", 17.07.2009, *MEASAT breaking News*, http://www.measat.com/investor_calendar.html, accessed: 13 May 2014.

[317] MEASAT Broadcast Network Systems Sdn Bhd (MBNS) is a wholly-owned subsidiary of ASTRO All Asia Networks, plc (ASTRO). Discussion on ASTRO is available in Chapter 1 of the thesis (1.3.2(c) Astro Holdings Sdn. Bhd). See also "Supply of Transponder Capacity on MEASAT-3a To ASTRO", 27.05.2009, *MEASAT breaking News*, http://www.measat.com/investor_calendar.html, accessed: 13 May 2014.

[318] The locations are in Langkawi Island (Kedah) and Bukit Jalil (Selangor), Malaysia.

[319] For details, refer to http://www.measat.com/corp_facilities.html, accessed: 13 May 2014.

definition and high-definition video play-out, video up-linking, video turnaround, fibre, and co-location services. The telecommunication services include supplying the co-location services, up-linking, and disaster recovery services.[320] Apart from those services, the MSS also offers programmes such as scholarships and internships for those interested in satellite-related technology.

It is evident that the MSS, being a premium supplier of satellite communication services and with its ability to provide a backbone communication infrastructure to Asia's leading broadcasters, direct to home platforms and telecommunication operators, has contributed to the proliferation and expansion of the Malaysian space industry. Furthermore, its services in regard to satellites capacity are well-known and have been used by over 145 countries across the Asia-Pacific, Middle East, Africa, Europe, and Australia, accounting for 80 per cent of the world's population. Such achievements and reputation, in fact, undoubtedly support the development of Malaysia's communication and broadcasting industries.

(b) Malaysian Institute of Aero and Space Studies (IKAM) and Space Tourism Society Malaysia Chapter (STS-MC)

Space tourism is a new dimension of space exploration. It was intensely discussed after the success of SpaceShipOne. Since then, everyone knows that vacationing in space is a reality. In view of the fact that space tourism will create new business opportunities for the government and the community, a number of countries such as the USA, India, UEA, Sweden and the United Kingdom have shown an interest in space tourism projects. These mainly involve the development of spaceport and suborbital space planes. Responding to this, NASA announced their plan to use 50 million dollars of federal economic stimulus fund to support the development of their commercial space transportation.[321] In this regard, the private sector has also made a great contribution to the growth of the space tourism industry. In Malaysia, the active private sectors participating in space tourism are the Malaysian Institute of Aero and Space Studies (IKAM) and the Space Tourism Society Malaysia Chapter (STS-MC).

[320] For detailed information on the services offered, refer to http://www.measat.com/services_transponder.html, accessed: 13 May 2014.
[321] Sutton, Jane and Phil Stewart (eds.), "NASA Wants Proposals for Space Taxis", 10 August 2009, *Reuters*, http://www.reuters.com/article/newsOne/idUSTRE57944520090810, accessed: 13 May 2014.

IKAM[322] was established in February 2000. It is a voluntary and pioneering private organization dealing with space tourism in Malaysia and is recognised as a non-profit organization. Its main objective is to promote space tourism in Malaysia apart from other aspects of space studies such as space economy, space science, and space technology.[323] Although the establishment of IKAM dates back to 2000, space tourism initiatives in Malaysia can be traced back to as early as July 1999. In this month, the first space tourism public lecture in Malaysia was held at the School of Aerospace Engineering, University of Science, Malaysia.[324] Indeed, a month later, in August 1999, space tourism's popularity was demonstrated by a famous local newspaper's publication of a caricature describing the proposal to develop Kuala Lumpur International Airport to a spaceport by 2020.[325]

IKAM became an internationally recognised institute when, in September 2002, it signed an agreement with Space Future Consulting (SFC)[326] in London on the cooperation and promotion of space tourism in Malaysia. This collaboration has brought the SFC space tourism experts to Malaysia to deliver lectures and conduct research into this field. The first lecture on space tourism under this collaboration was held in February 2004 at the Faculty of Tourism and Hotels, MARA University of Technology (UiTM).[327] Many other series of lectures have since been organized under this collaboration.[328]

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[322] The founder and president of IKAM is Mr. Norul Ridzuan Zakaria.

[323] Norul Ridzuan Zakaria, "IKAM & Space Tourism Society Malaysia Chapter (STS-MC)", email to author, 6 June 2009.

[324] The 'Space Tourism' public lecture was delivered by Norul Ridzuan Zakaria on the 3rd July 1999 at a seminar known as 'Space Studies Seminar'. The seminar was organized by the Terengganu Science Centre, Perak State Economic Planning Unit (UPEN, Perak) and School of Aerospace Engineering, University Science of Malaysia, Tronoh, Perak, and attended by 600 attendees. The seminar was divided into three parts: Space Science, Space Technology, and Space Economic. Space tourism was one of the lectures presented under the space economic part. In this lecture, it was proposed that Kuala Lumpur International Airport (KLIA) could be developed into an international commercial spaceport known as Kuala Lumpur International Spaceport (KLIS). Norul Ridzuan Zakaria, "The First Lecture", Email to author, 3 November 2009. See also "KLIA can be turned into Spaceport", *Sunday Star*, 4 July 1999. Refer also to "A Brief History of Malaysian International Space Tourism Initiative (July 1999 – 2011)," Brochure prepared to commemorate the 5th anniversary of the establishment of Space Tourism Society Malaysia Chapter on July 2011, email to author, 6 July 2011. Available also at http://www.scribd.com/doc/59298184/A-Brief-History-of-International-Malaysian-Space-Tourism-Initiative-July-1999-2011, accessed: 13 May 2014.

[325] See Utusan Malaysia, 24th August 1999. Read also "A Brief History of Malaysian International Space Tourism Initiative (July 1999 – 2011)," *id*.

[326] For more information on the Space Future Consulting, refer to its website at http://www.spacefuture.com/, accessed: 13 May 2014.

[327] The lecture was delivered by Prof. Patrick Collins. He is a Chief EXCO of the Space Tourism Society Malaysia Chapter and one of the senior partners in the editorial and research board of the Space Future Consulting. See http://www.spacefuture.com/masthead.shtml/, accessed: 13 May 2014.

[328] The lectures delivered were entitled, *inter alia*, 'New Opportunities for Malaysia in Space Tourism', held in December 2005 at the Second International Tourism Outlook Conference, Faculty of Tourism & Hotel, UiTM. On February 2006 the British Council organized a public lecture entitled, 'Space Tourism – Fun Things to do in the 21st Century', held at the Faculty of Civil Engineering, UiTM. In November 2006, a lecture on 'Space

In February 2003, IKAM published a book on space commercialisation entitled 'Pengenalan Ekonomi Angkasa' (Introductory Space Economy). It was the first ever space book written in the Malay language and had an illustration of a suborbital space plane with two jets and two rocket engines, known as "Langkasa" (Space Eagle).[329] Next, in November 2004, the space tourism initiative was gradually accepted in Malaysia when the State Government of Perak[330] made an official announcement to allow the Sultan Azlan Shah Airport[331] to be developed as a spaceport for the purpose of Malaysian space tourism. The airport is considered the most suitable and available airport for such purposes as it has a very low flight frequency and is equipped with adequate facilities. Then, in December 2005, the first official meeting between SFC and the Malaysian Department of Civil Aviation was held to discuss the operation of a spaceport and space plane in Malaysia.[332] Following these efforts, in August 2006 IKAM published a second book entitled 'Space Tourism-New Economy and Technology for Developing Countries' which describes ideas such as a space tourism simulator and space tourism observatory.[333]

Then, in July 2006, the Space Tourism Society Malaysia Chapter (STS-MC)[334] was established in conjunction with seven years of space tourism development in Malaysia. This

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Tourism: An Opportunity for Aerospace Engineering Lecturers and Students" was held at the School of Aerospace Engineering, University of Science Malaysia.

[329] The book was written by Norul Ridzuan Zakaria. It is the first book on space tourism published in Malaysia, with a chapter describing suborbital and orbital tourism. The book illustrates the first ever concept of a suborbital space plane published in Malaysia, and with the concept of a twin-boom designed to carry a passenger inside a capsule on each boom. Such a unique capsule design enables the passengers inside to clearly video-photograph the scenery from various angles during the journey. Each capsule is equipped with a small rocket engine, a communication system, and a parachute for safe landing in case of emergency. For details, see Norul Ridzuan Zakaria, *et al.*, "The Symbiotic Relationship between Astronaut Program and Space Tourism Development – A Third World Perspective", *Space Future,* http://www.spacefuture.com/archive/the_symbiotic_relationship_between_astronaut_program_and_space_tourism_development_a_third_world_perspective.shtml, accessed: 13 May 2014. This paper was presented at 2nd IAASS Conference, Chicago, 14 May 2007.

[330] Perak is one of the thirteen states of Malaysia. It is the second largest state located in Peninsula Malaysia, bordering Kedah and Thailand to the north. Sultan Azlan Shah Airport is one of the domestic airports in Malaysia. It is Perak's main airport situated in Ipoh, the state capital of Perak. For further details, see http://en.wikipedia.org/wiki/Perak, accessed: 13 May 2014.

[331] The facilities available include a terminal and runway for medium-sized passenger jets including Boeing 737 and Airbus A320. Furthermore its location is close to Kuala Lumpur, the capital city of Malaysia. Norul Ridzuan Zakaria, *et al*., "The Symbiotic Relationship between Astronaut Program and Space Tourism Development – A Third World Perspective", *supra* note 329.

[332] However, the research noted that there has been no new progress on this matter. Norul Ridzuan Zakaria, *et al*., "The Symbiotic Relationship between Astronaut Program and Space Tourism Development – A Third World Perspective", *supra* note 329.

[333] The authors of the book are Norul Ridzuan Zakaria, Ramli Zahari, Abd. Azis Abd. Majid, and Jamaludin Othman.

[334] The founder and president of STS-MC is Norul Ridzuan Zakaria.

was realized due to the offer made by the Space Tourism Society[335] to IKAM in June 2006 to sponsor and establish a chapter of the Society in Malaysia. As a result, the Space Tourism Division under IKAM, which was responsible for space tourism activities, was converted into STS-MC in July 2006. Thus, IKAM and Space Future Consulting remain the major sponsors of the Chapter.[336] It is noted that the STS-MC is the 5th international Chapter of the Space Tourism Society in the world and the second Chapter in Asia.[337]

Among activities conducted by the STS-MC are presentations on space tourism at international conferences organized by major world space agencies such as the European Space Agency (ESA). Among the presented papers are the following titles: 'The Symbiotic Relationship Between Astronaut Program and Space Tourism Development – A Third World Perspective',[338] 'Human Factors Engineering in Designing the Passengers' Cockpit of the Malaysian Commercial Suborbital Spaceplane', 'Spherical Meal Container Food and Beverage Management System for Space Hotel',[339] 'Safety and Trend Considerations in Designing the Costumes for the Passengers of Commercial Suborbital Spaceplane', 'The Advantages, Potentials and Safety of VTOL Suborbital Space Tourism Operations', and 'Internet TV aboard Commercial Suborbital Spaceplanes and at Spaceports for Safety and Commercialization'.[340] Apart from this, at the national level, the STS-MC, in collaboration with Perak State Government, has also undertaken a project on the first space tourism commercial product which involves the development of a spherical meal container made of

[335] Space Tourism Society is a non-profit society specifically focused on space tourism. It is based in the USA. Its mission is to encourage as many people as possible to travel into the Earth's orbit. It has Chapters in countries such as Japan, Norway, and the United Kingdom. Its Founder/President is John Spencer (an award-winning NASA space architect). Its website is available at http://spacetourismsociety.org/; see also http://en.wikipedia.org/wiki/Space_Tourism_Society, accessed: 13 May 2014.

[336] Norul Ridzuan Zakaria, "IKAM & Space Tourism Society Malaysia Chapter (STS-MC)", email to author, 6 June 2009.

[337] Norul Ridzuan Zakaria, *et al*., "The Symbiotic Relationship between Astronaut Program and Space Tourism Development – A Third World Perspective", *supra* note 329. See also Mohd Roshdi Hassan, "Membina Pesawat Angkasa Suborbital Sendiri", *Utusan Online,* 3 April 2008, http://www.utusan.com.my/utusan/info.asp?y=2008&dt=0403&pub=Utusan_Malaysia&sec=Rencana&pg=re_08.htm, accessed: 13 May 2014.

[338] The paper was presented at the 2nd International Association for the Advancement of Space Safety (IAASS) Conference, Chicago, on 14 May 2007. See *supra* note 329.

[339] Both papers were presented at the 4th IAASS Conference, Huntsville, USA, 19-21 May 2010. See http://www.congrex.nl/10a06/, accessed: 11 April 2012; http://www.scribd.com/doc/50159913/Human-Factors-Engineering-in-Designing-the-Passengers-Cockpit-of-the-Malaysian-Commercial-Suborbital-Space-Plane, accessed: 13 May 2014.

[340] Papers were presented at the 5th IAASS Conference, Paris, France, 17-19 October 2011. See http://www.congrex.nl/11a03/, accessed: 11 April 2012; http://eprints.usm.my/25130/1/Paris.The_Advantages,_Potentials_and_Safety_of_VTOL_Suborbital_Space_Tourism_Operations.pdf, accessed: 13 May 2014

high-quality plastic; it was called 'Labu Sayong'.[341] It was purposely designed for the astronaut and space tourist. The project was officially launched in November 2006 and, in fact, originated in the Malaysian Astronaut Program.[342] Aside from those activities, the STS-MC has also produced and distributed various posters to the public. The posters included the 'Labu Sayong' poster distributed in July 2007 and the 'Perak-Pioneering Space Tourism into the 50th Anniversary of Independence' poster distributed in August 2007. However, in conjunction with the celebration of 'One Decade of Space Tourism in Malaysia', they also circulated a high-resolution poster entitled, 'Commercial Suborbital Spaceflight as a Tool to Promote Interest of Space Travel in Developing Countries'.[343]

In respect of the STS-MC core missions, two core projects have gained attention. The first is the M-R2D2 (Malaysian Research for Rocket Plane Design & Development) project. This is a project that aims to design and develop a prototype suborbital space plane through a partnership with Swiss Propulsion Laboratory (SPL) and Project Enterprise.[344] The second project is the development of a Malaysian commercial spaceport. This project involves building, for instance, a spaceflight terminal/mall, suborbital space plane, zero gravity squadron, astronaut hall of fame, visitor transit centre, space resort, international aeronautics and astronautics academy, and many others.[345] These two projects will be discussed further in the approaching section.[346]

In relation to international affiliation, besides SFC, STS-MC has also successfully developed international relationships with various other international space actors. This became evident when, in February 2008, STS-MC signed an agreement with SPL on the development of a

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[341] 'Labu Sayong' is a Malay word that refers to a traditional earthenware water container that was used by an individual to carry drinking water and to keep it cool for a long journey. It originated in Perak, a state on the north-west coast of peninsular Malaysia. For details on this project, see Norul Ridzuan Zakaria, *et al*., "The Symbiotic Relationship between Astronaut Program and Space Tourism Development – A Third World Perspective", *supra* note 329.

[342] *Ibid*.

[343] The poster was presented by the STS-MC at the 12th Annual International Symposium held at the International Space University, France, in February 2008. It consists of an illustration of the Ascender suborbital space plane and an explanation about the practicality of developing such a plane for the developing countries. See http://www.klia.com.my/poster3.jpg; Norul Ridzuan Zakaria, "POSTER ISU 2008", email to author, 6 July 2008.

[344] Norul Ridzuan Zakaria, "An Aviation Approach to Space Transportation", email to author, 24 August 2009. See *id*., "IKAM & Space Tourism Society Malaysia Chapter (STS-MC)", email to author, 6 June 2009.

[345] For details, visit http://spaceportmalaysia.com/invest.html, accessed: 13 May 2014.

[346] More discussion of the M-R2D2 project is available in Chapter 1 of the thesis (1.4.8. Suborbital Space Plane). However, for the Malaysian spaceport it is available in Chapter 1 of the thesis (1.4.9. Commercial Spaceport).

carbon-neutral rocket propulsion system. Furthermore, in May 2009, STS-MC signed a memorandum of understanding with SPL and the Talis Institute, owner of the Project Enterprise for cooperation as partners in the M-R2D2 project. This arrangement attracted the attention of various parties in space travel including California Spaceport Authority and IAASS.[347] Thus, it marks the consciousness of the international space community regarding the emergence of the STS-MC in the related industry. Responding to its active involvement in the related industry, in May 2010 STS-MC was entrusted as a Board Member of IAASS.[348] And, during the 4th and 5th IAASS Conferences held from 19-21 May 2010 and 17-19 October 2011, STS-MC was also appointed a Program Committee Member and Conference Abstract Reviewer. Then, in April 2011, the STS-MC was assigned to the IAASS Technical Committee for Suborbital Spaceflight Safety.[349] Next, in May 2011, the Space Tourism Society entrusted the STS-MC to represent the Society at the future IAASS Conferences, starting with the 5th IAASS Conference.[350]

Moreover, STS-MC made a great effort to promote the initiative of suborbital space tourism to Malaysian society, particularly when they successfully organized a suborbital space plane design competition among secondary schools in Malaysia.[351] This effort could be regarded as a successful one since the idea of suborbital space tourism was effectively conveyed to the public through various competition advertisements in local newspapers.[352] As a result, five hundred pupils participated in the competition and one hundred were short-listed. In the competition, the participants were required to produce 3D-perspective drawings and scale models of their designs of suborbital space planes for judging by international suborbital space plane and space tourism experts.[353] Apart from that, STS-MC has pioneered the

[347] This was proved when both parties reported the news of the joint development agreement in their bulletins of Spot beam California, and IAASS Newsletter. See "A Brief History of Malaysian International Space Tourism Initiative (July 1999 – 2011)," *supra* notes 324 at 4. For more details, refer to www.californiaspaceauthority.org/html/spotbeams/spot090526.pdf, accessed: 2 May 2012.
[348] Norul Ridzuan Zakaria, "STS-MC Nominated to be the Board Member of IAASS", email forwarded to author, 22 May 2010.
[349] Norul Ridzuan Zakaria, "STS-MC now a Member of Suborbital Space Safety Technical Committee of IAASS", email forwarded to author, 21 April 2011.
[350] See "A Brief History of Malaysian International Space Tourism Initiative (July 1999 – 2011)," *supra* note 324, at 5.
[351] The competition started in February 2011 and lasted for 18 months.
[352] Norul Ridzuan Zakaria, "Competition Co-organized with Utusan Malaysia", email forwarded to author, 3 January 2011. See also "Menangi Penyertaan di Kem Angkasa Eropah: Pertandingan Mereka Bentuk Kapal Angkasa Kebangsaan", *Utusan Malaysia,* 3 January 2011, at 24.
[353] See "Lima Sekolah Terbaik ke Perancis", *Utusan Malaysia,* 23 May 2011, at 25; Norul Ridzuan Zakaria, "5 Winners of Design Competition Announced by Utusan Malaysia Today", email forwarded to author, 23 May 2011.

production of an animated movie on orbital space tourism called, 'Re-Entry'. It consists of animated orbital space planes, space resorts, and lifestyles.[354]

The STS-MC, indeed, strongly believes that space tourism will be of significant benefit to a third-world country such as Malaysia, especially through its space plane technology transfer programme as well as by creating new economic opportunities. They also claim that space tourism will win the hearts of people since the space plane prototype can be built at the same cost of sending an astronaut to the International Space Station or perhaps less.[355] In fact, they further claim that, in comparison to the Astronaut Program, the space tourism programme was seen as an alternative to the continuation of the Malaysian space programme, especially with regard to the limited budget of the Malaysian Government.[356] As a matter of fact, it is contended that the third-world astronaut programmes were indeed intended to promote the country's international image and to instil confidence and pride in its people; this is different from the astronaut programmes of first-world countries which really contribute to science and technology via their continuous experiments conducted on board the International Space Station. For these reasons, the STS-MC then proposes that space tourism is the most suitable programme for the continuation of the Malaysian Astronaut Program.[357] The Government of Malaysia has been urged to openly support space tourism development, particularly with respect to the development of a reusable launch vehicle, as it will not commit itself to maintaining expendable launch vehicles, as experienced in the first- and second-world countries.[358]

Relying on the aforementioned reasons, the STS-MC had made several efforts to convince the Malaysian Government about their space tourism projects. These included the submission of the IAASS White Paper hard copies to selected Malaysian Government bodies such as Malaysian National Space Agency (ANGKASA), Ministry of Science, Technology and

[354] The original script and characters of the movie were written by Prof. Patrick Collins. See "A Brief History of Malaysian International Space Tourism Initiative (July 1999 – 2011)," *supra* note 324, at 5 and note 325.
[355] Norul Ridzuan Zakaria, "Discussion Topic: Role of Government Agencies in Space", email to Space Travel Bureau and forwarded to author, 10 October 2009.
[356] It is claimed that the Malaysian Astronaut Program has given a momentous boost to the space tourism promoted by the STS-MC when it disseminates the idea of having an opportunity to travel into outer space like an astronaut. It was foreseen that there would be no other Malaysian astronauts after the first due to the expensive cost involved. See Norul Ridzuan Zakaria, *et al*., "The Symbiotic Relationship between Astronaut Program and Space Tourism Development – A Third World Perspective", *supra* note 329.
[357] By adopting such a strategy, the Astronaut Program would not be considered an economic burden and would therefore no longer be detested by the third-world countries.
[358] Norul Ridzuan Zakaria, et al., "The Symbiotic Relationship between Astronaut Program and Space Tourism Development – A Third World Perspective", *supra* note 329.

Innovation (MOSTI), Ministry of Transportation and the Ministry of Tourism.[359] The Paper mentions, among other things, the growth of space tourism activities in Malaysia. Such effort was made in order to make the Malaysian Governmental bodies aware of the emergence and potential of space tourism-related activities in Malaysia. Besides that, the STS-MC also conducted discussions with the MOSTI and ANGKASA on their M-R2D2 project. This resulted in the MOSTI showing interest in two areas, namely the suborbital space plane as a microgravity research platform,[360] and the development of local capability and expertise in space-related areas.[361]

Meanwhile, at the international level, the STS-MC is becoming one of the most established space tourism organizations in the developing countries. In addition, it has been verified that the STS-MC is the most active Chapter of the Space Tourism Society. As the STS-MC is actively involved in space tourism activities, the Chapter has received a lot of moral and technical support from their technology partners such as SPL, Projects Enterprise, Space Future & Bristol Spaceplanes, as well as the Space Tourism Society. Apart from that, the Chapter also receives strong moral support from IAASS, the world-famous non-profit organization of space safety. Such circumstances, in fact, have been significant for the growth of the space-related activities of the STS-MC, both nationally and internationally.

In sum, it has been established that IKAM and the STS-MC are the active private sectors in Malaysia involved directly with Malaysian and international space-related activities. Based on the preceding discussion, it is also evident that the Chapter's involvement and participation in the related activities have been recognised worldwide. It is foreseen that the STS-MC will further develop their activities and continue promoting their ideas and projects for the growth of space tourism activities.

[359] The paper entitled "AN ICAO for space?".
[360] The tourism suborbital space vehicle is the most effective platform for microgravity research. See http://www.parabolicarc.com/2009/05/30/overview-nasas-commercial-suborbital-research-program/, accessed: 6 April 2012.
[361] The discussion was held on 15 June 2009. See Norul Ridzuan Zakaria, "FW: Perbincangan M-R2D2 pada 15 Jun 2009", Email to ANGKASA and Ministry Of Science Technology and Innovation (MOSTI) and forwarded to the author, 17 June 2009.

(c) Astro Holdings Sdn. Bhd.

Satellite technology is an element of space technology that provides services to people. Satellites are mainly used as a means of accessing information that leads to decision-making and transmission of information. One of the major types of satellite is communication satellites which are used to transmit information from one point to another. They provide a worldwide linkup of radio, telephones, and television broadcasting. Based on this development, satellite television was introduced. This is a broadcasting service technology that allows subscribers to receive television signals, which have been uploaded to a satellite, through a receiver unit or satellite dish.[362] Currently, there are a number of satellite television providers around the world offering subscription-based services such as Sky Digital marketed by British Sky Broadcasting in the United Kingdom, Bell TV and Shaw Direct in Canada, and Dish Network and DirecTV in the United States of America. In Malaysia, the sole provider of Direct-To-Home (DTH) satellite pay-multi-channel services and the leading commercial radio broadcaster and TV programming in the country is known as Astro Holdings Sdn. Bhd. (previously known as ASTRO All Asia Networks Plc).[363]

Astro Holdings Sdn Bhd operates its Malaysian business through its subsidiary company called Astro Malaysia Holdings Sdn Bhd.[364] As a holding company; it has become an integrated electronic media enterprise that offers wide-ranging multimedia broadcasting services.[365] It initially introduced its satellite pay-television subscription services in 1996 under the brand name 'Astro', the first Malaysian direct broadcast satellite pay-tv service.[366] At present, Astro Holdings, under its subsidiary Astro Malaysia, has a 52 per cent penetration of TV-owning homes in Malaysia or 3.5 million customers, making it a key pay-tv operator

[362] For further reading on satellite communication and satellite television technologies, refer to Maral, Gerard, Michel Bousquet and Zhili, *Satellite Communications Systems: Systems, Techniques and Technologies,* (United Kingdom: John Wiley & Sons Ltd, 2009); Ross, John A., *Howard W. Sams Guide to Satellite TV Technology,* (Indianapolis: Prompt, 1999); Long, Mark E., *The Digital Satellite TV Handbook,* (USA: Newness, 1999).

[363] The name was changed after ASTRO All Asia Networks Plc was de-listed from the main market of Bursa Malaysia Securities Berhad on 14 June 2010, and thus taken over by the Usaha Tegas Group Holdings Bhd. which is now the parent company of Astro Holdings Sdn Bhd. See http://en.wikipedia.org/wiki/Astro_Malaysia_Holdings, accessed: 14 May 2014.

[364] The website for Astro Malaysia Holdings Sdn. Bhd. is available at http://www.astromalaysia.com.my/; See http://www.astromalaysia.com.my/AboutUs.aspx, accessed: 14 May 2014.

[365] Elbert, Bruce R., *The Satellite Communication Applications Handbook*, (Artech House, 2003) at 245; http://www.astromalaysia.com.my/AboutUs.aspx; http://www.astro.com.my/byond/home.aspx; http://en.wikipedia.org/wiki/Astro_Holdings_Sdn_Bhd#Holdings; all accessed: 14 May 2014.

[366] Astro is an acronym for 'All-Asian Satellite Television and Radio Operator'. The service initially started with 22 television and 8 radio channels. See official website of Astro, http://www.astro.com.my; see also http://en.wikipedia.org/wiki/Astro_(Malaysian_satellite_television), all accessed: 14 May 2014.

in Southeast Asia.[367] It is also regarded as Malaysia's top multimedia broadcaster and producer of Malay, Chinese, Indian and English language programming content with access to some 12 million viewers.[368] It also operates nine Malaysian radio stations including the top-ranking stations in four major languages - Malay, Chinese, Indian, and English - through which cumulatively the stations reach over 13 million radio listeners a week.[369]

As a subsidiary of Astro Holdings, Astro Malaysia is pioneering the Direct-to-U (DtU)[370] digital satellite broadcasting services in Malaysia, as well as in the South and East Asian regions. With its commitment to providing subscribers with high-quality broadcasting services, the company has invested in state-of-the-art technology in all its operation areas. As Malaysia is in a heavy rainfall region, Astro Malaysia has employed the digital Ku-band satellite technology, using the high-powered Ku-band payload of the MEASAT (Malaysia East Asia Satellite)[371] system. Using a small satellite dish of 60cm in diameter, the company manages to provide satellite services direct to its users with a 99.7 per cent service availability rate.[372] With this high payload capacity, it also has the ability to decrease the outage incidence.[373] In December 2011, Astro Malaysia, in collaboration with the Government of Malaysia, launched Malaysia's first free satellite TV, called NJOI , as part of its aspiration to make long-life learning, information, and entertainment available to all in Malaysia free of charge.[374]

Cognisant of the fact that the highest quality of broadcasting services requires an excellent broadcast centre, the company has developed its own broadcast centre, known as the All Asia

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[367] See http://www.astro.com.my/portal/about-astro/index.html, accessed: 14 May 2014.
[368] See "MEASAT-3a Satellite Successfully Launched", 22.06.2009, *MEASAT breaking News*, http://www.measat.com/investor_calendar.html, accessed: 14 May 2014.
[369] See http://www.astro.com.my/portal/about-astro/index.html, accessed: 13 May 2014.
[370] Direct-to-U (DTU) is a brand of direct-to-home (DTH) service which relates to broadcasting that involves high-power Ku-band transmissions utilizing the transponders of the MEASAT satellite system. See http://www.astro.com.my/portal/about-astro, accessed: 25 April 2012; http://www.astro.com.my/portal/about-astro/index.html, accessed: 13 May 2014.
[371] For more information on MEASAT, see Chapter 1 of the thesis (1.3.2 (a): MEASAT Satellite System Sdn Bhd); see also Elbert, Bruce R., *supra* note 365*,* at 245.
[372] When a subscriber subscribes to Astro, a satellite dish is installed at the subscriber's home or office. The satellite dish will receive the down-linked signals and transmit them to a Digital Multimedia Terminal (DMT) which is connected to a television set. The DMT extracts, decompresses and decodes the audio, video and data signals relayed by the satellite dish. See http://en.wikipedia.org/wiki/Astro_(Malaysian_satellite_television); http://www.astro.com.my/portal/about-astro/index.html, accessed: 13 May 2014.
[373] Outage incidence means signal interference or loss in reception due to rain fade. See *id*.
[374] http://www.astro.com.my/portal/about-astro/index.html; http://www.astro.com.my/njoi/index.html, accessed: 13 May 2014.

Broadcast Centre (ABC).[375] This is the nerve centre of the company's operation in Malaysia and other markets. ABC is one of the world's largest and most advanced all-digital broadcast and production complexes. It is a 24-hour broadcast production centre that supports the company's operations including broadcasting and transmission, production and an on-line subscriber management call centre. The Centre is well equipped with all-digital facilities accommodating the latest broadcasting equipment and systems. The facilities include uplink and downlink systems, programme production studios, multiple audio and video editing suites, and electronic graphic facilities.[376] The Broadcast Control Centre at the ABC works closely with the MEASAT Satellite Control Centre located in Langkawi Island[377] to monitor the broadcast system and to ensure the excellent quality of its broadcasting service.

With regard to its products and services, the company has designed a programme that functions as a 'touch button' entry into the world of entertainment and information with the best selection of local, regional and international programming. It provides the subscribers with access to the 24-hour multi-channel digital television and radio services. Its television services also offer a wide range of programmes including dramas, movies, entertainment shows, global news, documentaries, and educational programmes. Currently it broadcasts over 170 pay-television channels in four major languages - Malay, Chinese, Indian, and English - and also packages 20 digital radio channels over the DTH platform.[378] Apart from that, ASTRO is expanding several interactive multimedia services by aggregating and distributing multimedia content to subscribers through many communication and mobile devices. These available interactive application services include monitoring the Kuala Lumpur Stock Exchange, distance learning, home shopping, home banking, ordering programmes, playing interactive games, and software download capacity. They are also planning more interactive services concentrating on communications, entertainment, information and convenience in the future. It is hoped that these efforts will position Malaysia in the forefront of multimedia technology.[379]

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[375] The All Asia Broadcast Centre (ABC) is located in the Multimedia Super Corridor (MSC) on a 29 acre site at Technology Park Malaysia, Bukit Jalil, Kuala Lumpur, Malaysia.
[376] See *id*.
[377] Langkawi Island is an island under the state of Kedah, a state adjacent to the Thailand border.
[378] See http://www.astro.com.my/portal/about-astro/index.html; http://www.astromalaysia.com.my/AboutUs.aspx, accessed: 13 May 2014.
[379] See http://www.astro.com.my/aboutastro/products.asp, accessed: 30 October 2009; http://www.astro.com.my/portal/about-astro/index.html, accessed: 13 May 2014. See also Elbert, Bruce R., *supra* note 365, at 245.

Furthermore Astro Holdings, along with its strategy to work with regional partners and in line with its objective to expand its business in the overseas market, has produced and aggregated local content for distribution not only within Malaysia and Indonesia, but also to other regional and international markets such as Singapore, Vietnam, and the Middle East.[380] In fact, it has entered successfully into a shareholders' agreement with the Saudi Telecommunications Company (STC), a leading telecommunications service provider in the Middle East, to aggregate digital content in various formats.[381] Apart from that, its service is also available in Brunei.[382] It has also invested in pay-television and radio broadcasting in India,[383] and launched an airtime marketing venture in China.[384]

In a nutshell, even though the company did not contribute directly to the development of space technology in Malaysia, it is worth discussing since the company is one of the major users of satellite technology in Malaysia and has an essential connection with the MEASAT (Malaysia East Asia Satellite) system. Its contribution to Malaysia as the sole provider of satellite pay-television services, especially in the area of broadcasting and telecommunication technology, cannot be neglected. Its excellent services have indeed contributed to the sustainable development of the country.

1.3.3. Higher Educational Institutions

In this section, the higher educational institutions specifically referred to are universities. The public and private universities in Malaysia are playing important roles in the growth of space activities, particularly with regard to space technological development and research. In fact, such institutions supply the country with manpower and experts in the field. The excellence of the education strategy in a higher educational institution will no doubt produce excellent professionals for the country.

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[380] See http://en.wikipedia.org/wiki/Astro_(Malaysian_satellite_television)#International_operations_and_joint_venture ; http://en.wikipedia.org/wiki/Astro_Holdings_Sdn_Bhd#Astro_Overseas_Ltd, accessed: 13 May 2014.

[381] See The Astro All Asia Networks Plc. Making Difference Annual Report 2009, at 15, available at http://www.astroplc.com/09/pdf/AnnualReport2009.pdf; http://www.docstoc.com/docs/18274167/Annual-Report-ASTRO, accessed: 13 May 2014.

[382] In Brunei, the service is available under the 'Kristal-Astro' brand which was launched on 24 January 2000. http://en.wikipedia.org/wiki/Astro_(Malaysian_satellite_television)#International_operations_and_joint_venture , accessed: 13 May 2014.

[383] In April 2007, ASTRO All Asia announced a joint venture with the Sun Group in India, one of the country's leading media groups. It also owns 20 per cent of South Asia FM Ltd which has licences to own and operate 23 FM radio stations in India. See The Astro All Asia Networks Plc., Imagine Annual Report 2007.

[384] Refer to The Astro All Asia Networks Plc., Imagine Annual Report 2007, *id*.

In Malaysia, space education is offered mainly by the public universities in various undergraduate and postgraduate programmes.[385] In most cases, at undergraduate level, the course normally takes about 3–4 years. For postgraduates, the Master's programme requires 1-2 years full-time or 2-4 years for part-time study. However, the doctorate programme (Ph.D.) normally takes 3–4 years on a full-time basis and 4-7 years part-time. This section presents a description of space-related education, including both technological and legal aspects, offered by the higher educational institutions in Malaysia.

(a) Technology Education

Space technology education has been considered a necessary subject area in a number of countries. It is offered by various higher educational institutions around the world. Among the universities ranked as top-class aerospace universities, to name but a few, are the Massachusetts Institute of Technology School of Engineering (USA)[386], Stanford University School of Engineering (USA),[387] Cranfield University School of Engineering (United Kingdom),[388] University of Manchester School of Mechanical Aerospace and Civil Engineering (United Kingdom),[389] and Institut Supérieur de I'Aéronautique et de I'Espace (France).[390] Space technology education in Malaysian universities is presented chronologically as follows:

(i) University of Malaya (UM):[391]

In the University of Malaya (UM), the Faculty of Arts and Social Sciences' Department of Geography[392] offers a programme that reflects the multidisciplinary nature of Geography at

[385] In Malaysia, there are 20 public and 634 private higher educational institutions altogether whose programmes have been recognised by the Malaysian Government. See http://jpt.mohe.gov.my/IPT%20MALAYSIA/SENARAI%20IPTA.php; and also http://jpt.mohe.gov.my/eng/menudirektori.php, accessed: 13 May 2014.
[386] For details, refer to http://engineering.mit.edu/; see also http://www.infozee.com/channels/ms/usa/top-rankings.htm, accessed: 13 May 2013.
[387] For more information, see http://engineering.stanford.edu/, accessed: 13 May 2014.
[388] For details, see http://www.cranfield.ac.uk/soe/departments/aerospaceengineering/index.html, accessed: 13 May 2014.
[389] For details, see http://www.mace.manchester.ac.uk/, accessed: 13 May 2014.
[390] For details, see http://www.isae.fr/en/index.html; see also, http://theknowledgeworld.com/world-of-aerospace/Best-Aerospace-University-World.htm, both accessed: 13 May 2014.
[391] UM official website is at http://www.um.edu.my/, accessed: 13 May 2014.

both undergraduate and postgraduate levels. At the undergraduate level, the Department offers a Bachelor of Arts degree, in which the space-related subjects taught include Geographic Information Systems (GIS), Advanced Remote Sensing, Interpretation of Aerial Photographs and Remote Sensing, Application and Implementation of GIS, and Advanced GIS. The Master of Arts course is available by dissertation, and Doctor of Philosophy requires a thesis. The Department focuses on several research areas related to space applications including Geographic Information Systems (GIS), Environmental Management, and Remote Sensing.[393]

(ii) University of Technology Mara (UiTM):[394]

In the University of Technology Mara (UiTM) there are three faculties involved in space technological education. The first faculty is the Faculty of Mechanical Engineering.[395] It offers a programme called Diploma in Mechanical Engineering. This is a 3-year programme in which, in the final year, the students are given an optional module to specialize in areas of interest such as automotive and aerospace engineering.[396] Another faculty dealing with space technological education is the Faculty of Electrical Engineering.[397] At the postgraduate level, the faculty offers a Master of Science in Electrical Engineering, and also a Master of Science in Telecommunications and Information Engineering. Among the space related courses offered are mobile and satellite communication networks, internet protocol networks, and broadband networks. For a Doctor of Philosophy, the research is in electrical engineering.[398] The third faculty is the Faculty of Communication and Media Studies.[399] It offers a programme called Diploma in Communication and Media and also a Bachelor of Mass

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[392] Department of Geography was established in 1959. Its official website is at http://geografi.um.edu.my/, accessed: 13 May 2014.

[393] See http://geografi.um.edu.my/research-thrusts.php, accessed: 20 June 2012; see also http://geografi.um.edu.my/undergraduate-overview.php, accessed: 13 May 2014.

[394] UiTM official website is at http://www.uitm.edu.my, accessed: 13 May 2014.

[395] The Faculty of Mechanical Engineering (UiTM) was established in 1996. Its website is at http://fkm.uitm.edu.my/v1/, accessed: 13 May 2014.

[396] See http://fkm.uitm.edu.my/v1/programmes/overview, accessed: 14 May 2014.

[397] The Faculty of Electrical Engineering (UiTM) was established in 1968 initially under the name of the Department. It was then upgraded to a Faculty in 1996. Its official website is at http://fke.uitm.edu.my/v1/, accessed: 13 May 2014.

[398] The PhD research areas focussing in communication engineering deal with matters like mobile satellite, antennas, and wireless networks. For more information, see http://fke.uitm.edu.my/v1/programmes/postgraduate/msc-in-telecommunications-and-information-engineering-ee770.html; http://fke.uitm.edu.my/v1/programmes/postgraduate/phd-in-electrical-engineering-ee990.html, accessed: 14 May 2014.

[399] The Faculty of Communication and Media Studies was established in 1972. Its official website is available at http://masscomm.uitm.edu.my/v1/, accessed: 14 May 2014.

Communications with Honours in Broadcasting. The space-related courses offered include introduction to broadcasting and multimedia, comparative broadcast systems, radio broadcasting, and radio and TV presentation. With respect to postgraduate study, two types of Master's programmes are offered: Master of Mass Communications by research and the same programme by coursework.[400] The Doctor of Philosophy is also made available by thesis.

(iii) National University of Malaysia (UKM):[401]

The University's Faculty of Engineering and the Built Environment[402] offers, through its Department of Electrical, Electronic and Systems Engineering,[403] a Bachelor of Engineering in Communication and Computer Engineering. The programme includes courses such as control system analysis, power systems, digital signal processing, and multimedia signals. The Faculty also offers a Master of Engineering for Communications and Computer Engineering by coursework in which space-related courses such as satellite communications, telecommunication networks, multimedia communication, communication systems, and mobile and personal radio communication are taught.[404] The Doctor of Philosophy programme offered by the Faculty is by research especially in areas such as telecommunication engineering, space science and communication, and signal processing.[405]

[400] The courses offered include new communication technologies, telecommunication media management, and international communication. http://masscomm.uitm.edu.my/v1/programmes/undergraduate/37-diploma/55-mc110-diploma-in-communication-and-media; http://masscomm.uitm.edu.my/v1/programmes/undergraduate/38-degree/120-mc243-bach-of-mass-comm-hons-broadcasting; http://masscomm.uitm.edu.my/v1/programmes/postgraduate/39-master; http://masscomm.uitm.edu.my/v1/programmes/postgraduate/40-phd/58-mc990-phd-in-mass-communication-by-research, accessed: 14 May 2014.

[401] UKM official website is at http://www.ukm.my/, accessed: 13 May 2014.

[402] The Faculty of Engineering and Built Environment's official website is at http://www.ukm.my/jurutera/index.php/en/, accessed: 13 May 2014.

[403] The Department of Electrical, Electronic, and Systems Engineering was formed in 1984. Its official website is at http://www.ukm.my/jkees/index.php/en/, accessed: 13 May 2014.

[404] See http://www.ukm.my/jkees/index.php/en/academic-programmes/undergraduate-programmes; http://www.ukm.my/jkees/index.php/en/postgraduate-academic-program/postgraduate-coursework, http://www.ukm.my/jurutera/index.php/ms/postgraduates-4/pgcoursework/mengcom, accessed: 20 June 2012; http://www.ukm.my/jkees/index.php/en/postgraduate-academic-program/postgraduate-coursework, accessed: 13 May 2014.

[405] http://www.ukm.my/jkees/index.php/en/postgraduate-academic-program/postgraduate-research, accessed: 13 May 2014.

(iv) University of Technology Malaysia (UTM):[406]

The University of Technology Malaysia (UTM) offers a programme in space applications. Its Faculty of Geoinformation and Real Estate[407] offers Bachelor of Science (Remote Sensing), Bachelor of Engineering (Geomatics), and Bachelor of Science (Geoinformatics).[408] This faculty has conducted space courses such as GIS and remote sensing since the late 1990s. Specifically, the Bachelor of Science (Remote Sensing) offers courses such as introduction to space science, remote sensing technology, satellite systems and data delivery, microwave remote sensing, remote sensing for terrestrial applications, digital image processing, satellite technology and earth stations, GPS surveying, and sensor and satellite design, while the Bachelor of Engineering (Geomatics) offers space-related subjects such as satellite surveys, introduction to remote sensing, satellite navigation, advanced satellite surveys, and field astronomy. For the Bachelor of Science (Geoinformatics), among the space-related subjects taught are remote sensing and environmental studies, as well as GPS surveys.

There are three Master's programmes in which the space-related subjects taught: (1) Master of Science in Remote Sensing; (2) Master of Science in Geomatic Engineering; (3) Master of Science in Geoinformatics. The first Master's programme teaches space-related courses such as principles of remote sensing, digital image processing, microwave remote sensing, satellite orbit and instrumentation, GPS surveying, and application of remote sensing.[409] The second Master's programmes offered courses such as GPS surveying, GPS navigation, and navigation system. However, the last Master's programme offered deals with subjects such as principles of geographical information systems and spatial databases.[410] Apart from these Master's programmes, the Faculty also offers a PhD in these related fields.[411]

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[406] UTM official website is at http://www.utm.my/, accessed: 13 May 2014.
[407] Its official website is at http://www.fksg.utm.my/, accessed: 13 May 2014.
[408] See http://www.fksg.utm.my/academic_programs/undergraduates/remotesensing.php; http://www.fksg.utm.my/academic_programs/undergraduates/geomatic.php; http://www.fksg.utm.my/academic_programs/undergraduates/geoinformatics.php, all accessed: 13 May 2014.
[409] See http://www.fksg.utm.my/postgraduate/remote_sensing.php, accessed: 13 May 2014.
[410] See http://www.fksg.utm.my/postgraduate/Geomatic.php; http://www.fksg.utm.my/postgraduate/Geoinformatics.php, all accessed: 13 May 2014.
[411] See http://www.fksg.utm.my/postgraduate/remote_sensing.php; http://www.fksg.utm.my/postgraduate/Geoinformatics.php; http://www.fksg.utm.my/postgraduate/Geomatic.php; all accessed: 13 May 2014.

(v) International Islamic University of Malaysia (IIUM):[412]

Space education has been offered at the International Islamic University Malaysia (IIUM) by the Kulliyyah of Engineering.[413] The Kulliyyah's vision is to be a 'world-class centre of engineering education and research with values and ethics'.[414] The Department of Mechanical Engineering[415] of the Kulliyyah offers undergraduate programmes such as a Bachelor of Engineering with Honours in Aerospace in which the courses include spacecraft dynamics and control, spacecraft systems engineering, launch vehicle technology, aerospace propulsion, aircraft design, aircraft structures, flight mechanics, automatic control propulsion, aerospace engineering laboratory, and control systems.[416]

Another Department of the same Kulliyyah offering space-related subjects is the Department of Electrical and Computer Engineering.[417] It offers an undergraduate programme for a Bachelor of Engineering with Honours in Communications Engineering. This programme was designed for specialisation in areas of telecommunications, satellite and microwave telecommunication systems, optical communication and signal processing. The courses taught, to name but a few, include satellite communication systems, multimedia communications, wireless communications, digital communications, and antennas and wave propagation.[418] With respect to postgraduate study, the Department offers a Master of Science in Communication Engineering, and a Doctor of Philosophy in Engineering. The Master's programme is either by research or by both the coursework and research, whereas the Doctorate programme is offered only by research. The Master's coursework offers subjects

[412] IIUM's official website is available at http://www.iium.edu.my/, accessed: 13 May 2014.
[413] The Kulliyyah of Engineering (IIUM) was established in 1994. Its website is at http://www.iium.edu.my/engineering, accessed: 13 May 2014.
[414] The faculty started with three departments and three undergraduate engineering programmes, while it currently has six departments that offer eight undergraduate and various postgraduate programmes. See *id*.
[415] The Department's website is available at http://iium.edu.my/mec/, accessed: 3 May 2012.
[416] Another degree offered is Bachelor of Engineering with Honours in Mechanical-Automotive. See http://www.iium.edu.my/engineering/programmes-courses/undergraduate-programmes/curriculum-structure; http://www.iium.edu.my/sites/default/files/AERO.pdf; http://www.iium.edu.my/sites/default/files/AUTO.pdf, accessed: 13 May 2014.
[417] The Department's website is available at http://www.iium.edu.my/engineering/departments/electrical-computer-engineering/, accessed: 13 May 2014.
[418] See http://eng.iium.edu.my/~kskkk/commu, accessed: 3 May 2012. The current research shows that the degree of Bachelor of Engineering with Honours in Communications Engineering is not mentioned anymore in the Faculty's website. See http://www.iium.edu.my/engineering/programmes-courses/undergraduate-programmes/curriculum-structure, accessed: 14 May 2014.

on satellite communications, microwave communications systems, image processing, and digital communication.[419]

(vi) University of Putra Malaysia (UPM):[420]

The University of Putra Malaysia's (UPM) Faculty of Engineering[421] has offered space education since 1996. The course is conducted by the Department of Aerospace Engineering which was established in the same year.[422] The Department offers a Bachelor of Engineering in Aerospace with an emphasis on aeronautics and astronautics engineering courses with specialization in aircraft and spacecraft vehicles.[423] The programme is designed to concentrate on knowledge and skills in aeronautical, mechanical, electrical and electronics engineering, material and structural engineering, and computer and industrial studies.[424] Upon completion, the students are recommended to complete a 10-week industrial placement offered by the aerospace industries. The aerospace courses offered in this programme include aerospace material and process, satellite technology, space mechanics, control systems, measurement and sensors, aerospace laboratory, management of aerospace and agriculture industry, launcher technology, failure analysis, aerospace software engineering, spacecraft dynamics and control, space environment and mission, aircraft structures, aircraft stability and control, and aircraft design.[425]

With respect to postgraduate study, the Department offers a Doctor of Philosophy (PhD) and Master of Science (M.Sc.). These programmes stress research and courses connected with aircraft and spacecraft engineering. This includes topics such as aircraft design and structure, aerodynamics, aircraft engines, satellites, orbital analysis, control systems and flight technology, space trajectory, spacecraft systems, space stations, and spacecraft attitude

[419] See http://www.iium.edu.my/sites/default/files/msc%20automotive.pdf, accessed: 2 April 2014.
[420] UPM's official website is available at http://www.upm.edu.my/, accessed: 13 May 2014.
[421] The faculty website is available at http://www.eng.upm.edu.my/html/en, accessed: 13 May 2014.
[422] The department was initiated to support the development of the national aerospace industry as announced in the Malaysia National Blueprint for the Development of Malaysian Aerospace Industry. See http://www.eng.upm.edu.my/introductionkaa, accessed: 13 May 2014.
[423] Aeronautics engineering involves knowledge and applications related to aerodynamics, aerospace material, structure, propulsion, flight mechanics, aircraft stability and control. Astronautics engineering deals with orbit mechanics, estimation and control of height, telecommunications, aerospace structure, and rocket propulsion. See http://www.eng.upm.edu.my/html/en/undergraduate-aerospace, accessed: 3 May 2012; http://www.eng.upm.edu.my/dokumen/FKJUR1_KAA.pdf, accessed: 13 May 2014.
[424] See *id*.
[425] *Id*.; see also Mohd Ibrahim Seeni, Mazlan Hashim and Samsudin Ahmad, "Space Education in Malaysian Universities", *Joint Malaysia-China Seminar on Space for Sustainable Development, Kuala Lumpur, Malaysia, September 2-4, 2004*, at 2.

control.[426] The Department has also assigned an on-going research work group among the Department staff members that focuses on conducting research in areas such as aerospace materials and structures, space vehicle guidance and control, and aerospace vehicle design.

(vii) University of Science Malaysia (USM):[427]

University of Science Malaysia (USM) is another Malaysian higher educational institution involved in space technology education. It was introduced through its School of Aerospace Engineering.[428] The School acts as the University's centre of aeronautics and astronautics to deliver aerospace knowledge and conduct research and development. It offers a Bachelor of Engineering with Honours in Aerospace Engineering.[429] The students are required to undergo 10 weeks of practical or industrial training in government or private aerospace agencies before graduating, as a continuation of the practical engineering course conducted by the School. The space courses offered include spacecraft subsystem elements, spacecraft subsystem design, spacecraft design, aerospace structural design, aerospace policy and management, and orbital mechanics.[430]

The School also offers a Master of Science and Doctor of Philosophy degree by research in the aeronautic and astronautic fields, as well as in satellite technology. Currently, the School is focusing on areas related to aerospace structures, aerospace control, aerospace composites and propulsion, astronautics, and others.[431]

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[426] See Aerospace Engineering Postgraduate brochure, Department of Aerospace Engineering, UPM, available at http://www.eng.upm.edu.my/html/en/postgraduate-aerospace, accessed: 5 May 2012; http://www.eng.upm.edu.my/dokumen/90801_Kejuruteraan_Aeroangkasa.pdf, 13 May 2014.

[427] USM's official website is available at http://www.usm.my/, accessed: 13 May 2014.

[428] The School was established in 1999 and is located at one of the University's branch campuses at Seberang Perai Selatan, Pulau Penang, Malaysia. Prior to the School's establishment, it operated under the name of Aerospace Engineering Unit from 13 May 1998 until 28 February 1999. Its official website is at http://aerospace.eng.usm.my/, accessed: 13 May 2014.

[429] This programme emphasizes multidisciplinary engineering concepts such as mechanical, electrical, and electronic engineering, and non-technical subjects such as management, languages, computers etc. See *id*.

[430] Kamarul Arifin bin Ahmad, Programme Chairman for the Aerospace Engineering, "Courses offered for undergraduates", Email to author, 4 November 2009.

[431] See http://aerospace.eng.usm.my/index.php?option=com_content&task=view&id=29&Itemid=59, accessed: 5 May 2012; http://aerospace.eng.usm.my/index.php?option=com_content&task=view&id=23&Itemid=53, accessed: 13 May 2014.

(viii) University of Technical Malaysia (UTeM):[432]

The Faculty of Electronics and Computer Engineering[433] of the University of Technical Malaysia (UTeM) offers a Bachelor of Electronics Engineering with Honours in Wireless Communication. This programme covers areas such as broadcasting equipment and receivers, satellite and radar, and radio communication. The courses offered include telecommunications technology, wireless communication systems, radio navigation systems, and wireless data networks.[434] Another programme offered by the Faculty is a Bachelor of Electronic Engineering with Honours in Telecommunication Electronics. It relates to areas of microwave systems, satellite systems, radar systems, mobile radio systems, and digital and multimedia communication systems.[435] For postgraduate, the Faculty offers a Master of Electronic Engineering by research, Master of Electronic Engineering in Telecommunication Systems by coursework, and a Doctor of Philosophy in Electronic Engineering by research.[436]

(b) Legal Education

Apart from space technological education, space legal education is also a necessity for a country venturing into space technology and its advancement. However, in Malaysia, due to a shortage of legal experts in space legal education, only two public universities are currently able to offer space legal courses.

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[432] UTeM's official website is at http://www.utem.edu.my/, accessed: 13 May 2014.

[433] The Faculty was established in 2001. Its official website is at http://www.utem.edu.my/fkekk/, accessed: 13 May 2014.

[434] See http://www.utem.edu.my/fkekk/index.php?option=com_content&task=view&id=74&Itemid=83, accessed: 5 May 2012; The latest research shows the degree of Bachelor of Electronics Engineering with Honours in Wireless Communication is not mention anymore in the Faculty's website, however it states a degree of Bachelor of Electronics Engineering with Honour only. Refer http://www.utem.edu.my/fkekk/index.php?option=com_content&task=view&id=100&Itemid=124, accessed: 13 May 2014.

[435] See http://www.utem.edu.my/fkekk/index.php?option=com_content&task=view&id=73&Itemid=82, accessed: 5 May 2012. The latest research however shows the degree of Bachelor of Electronic Engineering with Honours in Telecommunication Electronics is not stated anymore in the Faculty's website. However it mentions a Diploma in Electronics Engineering. Refer http://www.utem.edu.my/fkekk/index.php?option=com_content&task=view&id=100&Itemid=124, accessed: 13 May 2014.

[436] For more information, see http://www.utem.edu.my/fkekk/index.php?option=com_content&task=view&id=128&Itemid=139, accessed: 5 May 2012; http://www.utem.edu.my/fkekk/index.php?option=com_content&task=view&id=126&Itemid=139, accessed: 13 May 2014.

(i) University of Malaya (UM):[437]

The University of Malaya's (UM) Faculty of Law,[438] one of the earliest law faculties in Malaysia, offers a number of undergraduate and postgraduate law programmes. For the undergraduate programme, the Faculty offers Bachelor of Law (LL.B) and Bachelor of Jurisprudence (External).[439] For postgraduate study, it offers Master of Law (LLM), Master of Criminal Justice, and Doctor of Philosophy. The LLM can be attained either by coursework or by a combination of coursework and dissertation.[440] The Doctor of Philosophy is a full research programme that involves writing a thesis over a period of between 2 and 6 years.

At this Faculty, the space law course was offered initially in 1996 and continued until 1998. It was introduced under the course title 'Air and Space Law'.[441] This course was offered only at the postgraduate level as one of the courses approved for obtaining a Master of Law (LLM). As its name suggests, the contents of the subject are mainly divided into two major parts: air law and space law. This was the first Faculty of Law in the country to offer both areas of law to law students. In respect of the course contents, the air law part discusses the concept of delimitation of airspace and outer space, contracts between passengers and airlines, liability of airlines for injury caused to passengers, issues of flight delays, aircraft financing, cabotage, and others. However, in the space law part the discussion touches on, for example, space exploration and the legal implications, the concept of common heritage of mankind, satellite communications and ITU procedure, space tourism, liability issues, space debris and others. At present, even though the course is still listed as one of the Faculty's subjects, it has been

[437] See *supra* note 391.
[438] The Faculty of Law (UM) was established in 1972. Its official website is available at http://law.um.edu.my/, accessed: 13 May 2014.
[439] These programmes entitle the holder to be an advocate and solicitor of the High Court of Malaya after undergoing a 9-month period of pupillage. The duration of the programme is 4 years. *Id*.
[440] This LLM degree consists of three programmes: by full dissertation, or dissertation and coursework, or by coursework only. See http://ips.um.edu.my/?modul=Programmes_Offered&pilihan=Faculties&subpilihan=Master_of_Laws_(LLM), accessed: 20 June 2012; http://law.um.edu.my/?modul=Academic_Programmes&pilihan=MCJ_and_LLM, accessed: 13 May 2014.
[441] Abu Bakar Munir, "Air and Space Law Subject, Faculty of Law (UM)", email to author, 16 December 2009.

observed that it is no longer offered to students.[442] In terms of research supervision, there is only one professor of law at the Faculty whose research interest is in air and space law.[443]

(ii) National University of Malaysia (UKM):[444]

The Faculty of Law[445] of the National University of Malaysia (UKM) designed its academic programmes based on a combination of three laws: civil law, *syariah*,[446] and customary law. The Faculty offers a Bachelor of Law (LLB) with Honours. With respect to postgraduate study, the Faculty offers Master of Law (LLM), Master of Intellectual Property (MIP), Master of Business Law (MBL), and Doctor of Philosophy.[447] Space law, as it was named, is one of the optional subjects offered in the undergraduate programme. Nevertheless, the subject is offered depending on the availability of the teaching staff of the Faculty. It was first offered in the year 2000 as an elective paper. The course contents include introduction to space law and policy, international space law and the United Nations, legal principles of space law, legal status of space objects, legal status of astronauts, space aircraft, space objects, telecommunications, dispute settlement in space law and others.[448]

Based on the foregoing presentation, it is concluded that space technological education is becoming more common and gaining more attention in the public higher educational institutions in Malaysia than space legal education. This remark is made based on the current practices of the Malaysian public universities in that only two public universities offer space legal courses. Moreover, it is noticed that space legal education has been provided with a very limited scope. Therefore, such a situation indeed demonstrates how space legal

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[442] See *id*, and http://ips.um.edu.my/?modul=Programmes_Offered&pilihan=Faculties&subpilihan=Master_of_Laws_%28LLM%29, accessed: 13 May 2014.

[443] The academic staff member referred to is Professor Abu Bakar Munir. See http://law.um.edu.my/?modul=Staff&pilihan=Academic_Staff, accessed: 13 May 2014.

[444] See *supra* note 401.

[445] The Faculty of Law (UKM) was established in 1984. Its official website is at http://www.ukm.my/fuu/, accessed: 13 May 2014.

[446] *Sharia* is an Arabic word literally meaning 'way' or 'path' or 'way to the water'. It is the law of Islam based on the teachings of the *Quran* and *Sunna* (practices of Prophet Muhammad). As Islam makes no distinction between religion and life, the Islamic law covers not only ritual but all aspects of life. See also http://www.answers.com.topic/sharia, accessed: 13 May 2014.

[447] For Master of Law (LLM), the Faculty offers three types of programme: by thesis only, coursework and thesis, and coursework only. Doctor of philosophy is attained by thesis only. See http://www.ukm.my/fuu/, accessed: 13 May 2014.

[448] See Aishah Bidin, "Space Law Subject, Faculty of Law (UKM)", email to author, 17 December 2009; Professor Dr Aishah Bidin is a Dean of Faculty of Law, UKM. See also http://www.ukm.my/fuu/, accessed: 13 May 2014.

education contrasts with space technological education in that it is viewed as still being in the infancy stage in Malaysia.

1.4. APPLICATIONS AND ACTIVITIES

At present, the space sector is one of the emerging sectors in Malaysia that holds considerable promise for those wishing to venture therein. In fact, the application of space technology in Malaysia dates back to the 1960s. Currently, there are a variety of space-related applications and activities in Malaysia. This part will discuss the space applications and activities in Malaysia. Those applications and activities are as follows: telecommunications and broadcasting, remote sensing, meteorology, navigation, satellite manufacturing and launching, the *Angkasawan* Programme, scientific research, suborbital space planes, and also commercial spaceport projects.

1.4.1. Telecommunications and Broadcasting

Telecommunications and broadcasting are among the most significant space applications in Malaysia. Such applications were among the earliest space applications to gain the attention of the Government of Malaysia over the past 52 years. This was evidenced in 1960 when *Jabatan Penyiaran Malaysia* (Malaysian Broadcasting Department) constructed its first earth satellite station in Kuantan, Pahang.[449] The station functioned as a ground receiving station for the communication satellite *Palapa-B*.[450]

In respect of communication satellites, Malaysia might be deemed an active player in launching such satellites. Over the past 16 years, four communication satellites have been successfully launched into orbit, with the expected launch of a new satellite called MEASAT 3B by the end of 2014.[451] The first communication satellite, namely MEASAT-1, was launched in January 1996. This opened up investment in the communication and multimedia

[449] Kuantan is the state capital of Pahang, one of the states on the east coast of Peninsular Malaysia.
[450] *Palapa-B* is one of the Indonesian PALAPA communication systems, the first regional telecommunication system in ASEAN countries. The system was first introduced in 1976 by Indonesia and was used by its neighbouring countries, including Malaysia, the Philippines, Cambodia, Vietnam, and Australia. For further details, read Kantaatmadja, Mieke Komar, "Development of Broadcasting Laws Related to Satellite Television in the ASEAN Countries", (1997) 39 *IISL Colloquium on the Law of Outer Space* 194.
[451] For more details, read Chapter 1 of the thesis (1.3.2(a) MEASAT Satellite System Sdn Bhd.). Refer also http://www.measat.com/satellite_91e_measat3b.html; and http://www.satlaunch.net/p/launch-schedule-2013.html, all accessed: 13 May 2014.

technologies in Malaysia. The second Malaysian communication satellite, MEASAT-2, was put into orbit ten months later in November 1996. In this regard, whilst MEASAT-1 provides coverage over the Asian Pacific Regions, Malaysia, the Philippines and India, MEASAT-2 has a wider coverage to include Australia, Hawaii, Vietnam, Indo-China, and Taiwan.[452] With such launches the communication and multimedia industries in Malaysia have burgeoned. This led to the formulation of the Malaysian Communications and Multimedia Act 1998.[453] In December 2006, the third Malaysian communication satellite, namely MEASAT-3, was launched to back up those earlier satellites, and its coverage extended to Africa, the Middle East and Eastern Europe. Next, in June 2009, a fourth satellite, namely MEASAT-3a, was launched to increase the capacity of internet, direct-to-home, broadcasting, and telecommunication services for the coverage areas.

Utilizing the MEASAT satellite fleet, space applications in Malaysia are employed in two major services: telecommunications services and broadcasting services. A number of telecommunications services have resulted from the space application of the MEASAT fleet. To name but a few, they include the very small aperture terminal (VSAT) service, remote telephony, and disaster recovery.[454] Such telecommunications services are provided by companies such as Celcom, Telekom Malaysia, DiGi, and Maxis.[455] The service remains the largest satellite-related business activity in Malaysia.[456] As for the broadcasting services, they include direct-to-home (DTH) television, satellite news gathering (SNG), and video playout/uplink.[457] The broadcasting service, which includes direct-to-home service, is offered by ASTRO, Malaysia's leading broadcaster.[458]

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[452] N.N. Mahmood, "Report on the Development of Space Technology and Applications in Malaysia", http://aprsaf.nasda.go.jp/members/updated/malaysia/macres/main.html, accessed: 28 March 2013.

[453] For more information, read Chapter 1 of the thesis (1.2.3. The Malaysian Communications and Multimedia Act 1998 (Act 588).

[454] VSAT service is a two-way satellite ground station with a small dish antenna (mostly ranging from 75 cm to 1.2 metres). It is commonly used to transmit narrowband data, such as point-of-sale transactions with credit cards, or broadband data for satellite internet access to remote areas; Remote telephony service is a service to provide communication services to remote areas for basic voice and data services, in which the connectivity is provided based on local, national or regional scales; Disaster recovery service is a service which includes equipment co-location, up-linking, satellite transponder and fibre connectivity, and it can be pre-arranged at short notice when necessary. See http://en.wikipedia.org/wiki/Very_small_aperture_terminal; The MEASAT Global Berhad Annual Report 2008 and 2009 are available at http://www.measat.com/investor_bod_annual.html, accessed: 13 May 2014.

[455] Besides MEASAT, the companies also subscribe to other satellite systems such as Palapa, Iridium, InMarsat and Intelsat. See Ahmad Sabirin Arshad, "Satellite Technology Potentials in Malaysia", *International Conference on Information Technology*, Kuala Lumpur, September 8-10, 1999, Vol.1, Paper 4.

[456] *Id*.

[457] Direct-to-home (DTH) television service is a service that allows viewers to receive a wide selection of local and international television programming via a small satellite dish on the roof. The satellite news gathering

Since communication satellites are capable of transmitting information from one point to another without connecting to any ground network, Malaysia utilises her satellite communication services extensively, especially to the remote villages,[459] to ships on the high seas, and to places where the ground infrastructure areas have been damaged by natural disasters such as monsoon floods and landslides. With the communication satellites application, valuable information can be passed on and decision-making can be executed faster and more effectively for the public, especially when it involves tsunami warnings, earthquakes, storm, typhoons, haze and other natural disaster warnings. The Malaysian Meteorological Department (MMD), for instance, has installed a video conferencing system to conduct face-to-face communications among weather forecasters in different places. Through this system, they are able to communicate, discuss, and share their experience, knowledge and understanding effectively.[460] Government-linked companies, such as Telekom Malaysia, have introduced a Fixed-line Alert System (FLAS) or Disaster Alert System (DAS) for the dissemination of disaster alerts which enable the messages to be communicated and disseminated in a timely manner, quickly and effectively.[461] The space applications of Malaysian telecommunication and broadcasting services have undoubtedly contributed to the sustainable development of the country by improving the education, health services and standard of living of the nation.

1.4.2. Remote Sensing

Remote sensing is another important area of space application in Malaysia. Remote sensing satellites are used to monitor the changes in land surfaces, the ocean, and even the atmosphere. These satellites view the same area over a long period of time, thus enabling the observer to detect, observe, and monitor the environmental changes. Such circumstances

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(SNG) service is a service that allows broadcasters to connect remote news-gathering television crews directly to their television studios without any terrestrial networks. Video play-out/uplink service is a service to provide a complete play-out solution including advertisement insertion, subtitling, dubbing, encryption, up-linking and satellite distribution. See *id*.

[458] For more information, read Chapter 1 of the thesis (1.3.2(c) Astro Holdings Sdn Bhd.).

[459] 58.2 per cent of the geographical area of Malaysia is still covered by forest. See http://en.wikipedia.org/wiki/Geography_of_Malaysia#Forests, accessed: 13 May 2014.

[460] See also Malaysian Meteorological Department, Report for Typhoon Committee, 40th Session, Macao, China, 21-26 November 2007, http://severe.worldweather.org/tcc/creport.htm, accessed: 13 May 2014.

[461] Mohd Najib Tun Abdul Razak, speech delivered during the *Third Asian Ministerial Conference on Disaster Risk Reduction,* Putra World Trade Centre, Kuala Lumpur, 2nd December 2008, http://www.pmo.gov.my/?menu=speech&page=1677&news_id=87&speech_cat=11, accessed: 13 May 2014. See also Malaysian Meteorological Department, Report for Typhoon Committee, *id.*

became feasible since the collection of data occurred in a mode of consistency. Furthermore, the satellites can provide data rapidly in urgent cases as the images can assist the rescue efforts by providing updated landscape and infrastructure views that have been affected by the disaster, such as in the Haiti earthquake.[462] These types of satellites are essential for the Malaysian earth observation programme, such as in marine exploration, water and ocean monitoring and forecasting, seismic activity and tsunami monitoring, meteorology-oceanographic interaction, and sun-earth relationship.[463]

The current active Malaysian Earth observation or remote sensing satellite launched into orbit is the RazakSAT satellite.[464] It is operated and controlled through the Malaysian National Space Agency's Ground Stations in Banting, and also in Shah Alam, Selangor; these consist of a Mission Control Station (MCS) and Image Receiving and Processing Station (IRPS).Those stations will receive and archive images for post-processing and distribution to the users. Their main role is to provide higher imaging opportunities for Malaysia by alleviating the constraint of cloud and lack of timeliness of satellite imagery provided by other Satellite Operating Agencies (SOAs) upon which Malaysia has been dependent. The imaging opportunity increases when the satellite is placed into a Low Earth Near Equatorial Orbit (NEqO).[465]

The Government agency responsible for Malaysian remote sensing activities is the Malaysian Remote Sensing Agency (MRSA)[466]. Its ground station, namely the Remote Sensing

[462] On 12 January 2010, a major 7.0 magnitude earthquake struck the Haitian capital of Port-au-Prince which caused major casualties and damage. Through the International Charter on Space Major Disasters, a free of charge satellite data was acquired from various satellites after the event and the satellite imageries are used to generate emergency maps to provide rescue services. By using this technology, the rescuers can overview the current state of the area and able to identify the major ground changes caused by the disaster. These can further help them to identify possible routes for relief and rescue workers as well as identify areas that are suitable for setting up aid camps. See http://www.spacemart.com/reports/First_Satellite_Map_Of_Haiti_Earthquake_999.html, accessed: 13 May 2014.

[463] Mustafa Din Subari, "MALAYSIA REPORT TO GEOSS AP SYMPOSIUM: Working Together towards a Secure and Prosperous Society", at 2, http://www.restec.or.jp/geoss_ap1/materials/PDF/plenary/11_Malaysia_Subari.pdf, accessed: 13 May 2014.

[464] It was launched on July 2009. More information on RazakSAT is available in Chapter 1 of the thesis (1.3.1(c) Astronautic Technology (M) Sdn Bhd (ATSB) and (1.4.5. Satellite Manufacturing and Launching).

[465] Norhan Mat Yusoff and Norhizam Hamzah, "The Role of RazakSAT in Remote Sensing", *The Geospatial Resource Portal,* http://www.gisdevelopment.net/magazine/malaysia/2006/apr-jun/26_1.htm, accessed: 7 May 2012.

[466] Information on MRSA is available in Chapter 1 of the thesis (1.3.1(d) Malaysian Remote Sensing Agency (MRSA). Its official website is available at, http://www.remotesensing.gov.my/, accessed: 13 May 2014.

Malaysia Ground Receiving Station (MGRS), is located in Temerloh, Pahang.[467] Apart from the Malaysian National Space Agency's Ground Stations, the MGRS is also capable of receiving data from the RazakSAT satellite and other remote sensing satellites such as Spot 2, 4 and 5 (France), Radarsat-1 (Canada), IPS-P4 (India), NOAA, Langsat-7, and Terra/Aqua Satellites (USA).[468] Pursuing the Malaysian National Remote Sensing Programme, the objectives of which are to strengthen national capability, coordinate development activities and operationalize the use of remote sensing and related technology for development, the MRSA focuses on at least seven space application developments. These include agriculture and food production, disaster management, environment, forestry, health, geosciences and mapping.

The first is agriculture and food production. It is observed that the remote sensing technology has been applied significantly in this sector. For example, the rice monitoring and yield prediction system is based on the model of linear correlation between rice yield and radar backscattering coefficient of the remote sensing technology of RADARSAT satellite data.[469] Rice monitoring and yield prediction is vital to determine the total areas of rice plantation, estimate the yield, and verify the environmental impact of rice production. The estimation of advanced rice production is crucial, especially for Malaysia, a country where rice is an essential food staple, as it can provide an early warning of production shortfall. It has been found that the remote sensing technology makes it easier to identify paddy rice than other crops because of the way in which it is planted.[470] In Malaysia, this system, which has been verified as having up to 95 per cent accuracy, was developed by the MRSA with the collaboration of Multimedia University (MMU) and MUDA Agricultural Development

[467] Temerloh is one of towns in Pahang, a state that located in the east coast of Peninsular Malaysia. Pahang is the third largest state in Malaysia after Sarawak and Sabah.
[468] See http://www.remotesensing.gov.my/page.cfm?name=groundstation, accessed: 10 March 2014
[469] RADARSAT is Canada's earth observation satellite. RADARSAT-1 was launched in November 1995 and RADARSAT-2 in December 2007. The satellite provides images of the earth for both scientific and commercial applications. Its microwave technology can penetrate heavy clouds, snow, fog, haze, dust, and rain, even during the monsoon season, to record detailed land and water features. It is in exactly the same location and can take the same image every 24 days which is useful for detecting changes at that location. See http://en.wikipedia.org/wiki/Radarsat-2; also http://en.wikipedia.org/wiki/Radarsat-1, all accessed: 14 May 2014.
[470] The paddies are first planted under water, where the SAR (synthetic aperture radar) images appear very dark as the water generates no direct backscatters, or no microwave energy to the satellite's antenna. This image then becomes brighter as the rice grows, getting darker when it matures. For more details, see Twitchell, Karen, "Monitoring Rice Crops from Space", (09.01.1998), *The International Development Research Centre,* http://www.idrc.ca/en/ev-5530-201-1-DO_TOPIC.html, accessed: 28 December 2009; http://idl-bnc.idrc.ca/dspace/handle/10625/22471, accessed: 14 May 2014.

Authority (MADA).[471] Utilising the space technology in this system is a proven time-saving measure as it makes it possible to estimate the rice yield one month before harvest, compared to the conventional Malaysian method of a crop-cutting survey which was normally undertaken 6-12 months after harvest. Apart from that, the system has effectively assisted in reducing the cost and human resources needed for rice yield estimation.[472] In fact, this system is critical for the rice-exporting countries to estimate the production surplus for decision-making on distribution, storage, and price-setting.

In a similar sector, space technology is also utilised in precision farming. This is a farm management system that integrates remote sensing, geographic information system (GIS), global positioning system (GPS), and sensor technologies. The remote sensing technology of precision farming in Malaysia is currently applied to paddy fields and oil palms only. Such technology is applied mainly to increase the crop production. The system stresses the concept of 'the right input, the right amount, the right time, and the right place'.[473] By employing technology such as remote sensing satellite navigation systems, GIS, automatic yield recording system, automatic soil sensor, and an integrated database, the concept of the right input of fertilizers, pesticides, and water, in the right amount, at the right time and place is feasible for boosting Malaysian crop production. Apart from the involvement of Remote Sensing Malaysia, other agencies are engaged such as Malaysian Agricultural Research and Development Institute (MARDI) and Universiti Putra Malaysia (UPM).[474]

The next example is a system to identify fishing zones. This space technology application is vital for Malaysian fishermen, since a large portion of Malaysia is surrounded by water.[475]

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[471] MMU website is available at, http://www.mmu.edu.my/, and MADA is at http://www.mada.gov.my/, accessed: 14 May 2014.

[472] Malaysian Remote Sensing Agency, Annual Report 2007, at 17; see also http://www.remotesensing.gov.my/articlePrint.cfm?id=389, accessed: 14 May 2014.

[473] http://www.remotesensing.gov.my/article.cfm?id=348, accessed: 7 December 2009.

[474] MARDI is a Malaysian statutory body that has been mandated to conduct research in agriculture, food, and agro-based industries. Its official website is at http://www.mardi.gov.my/; UPM is a Malaysian public university that initially started as an agricultural-based university and is currently expanding in various disciplines such as engineering, medical sciences, pure sciences, economics, education, language and others. Its official website is at http://www.upm.edu.my/, all accessed: 14 May 2014.

[475] Malaysia has a total coastline of 4,675km, the 29th longest coastline in the world. It is surrounded by the South China Sea, the largest body of water around Malaysia (in between Peninsular Malaysia and East Malaysia), the Straits of Malacca (facing the western coast of Peninsular Malaysia towards the south), Andaman Sea (towards the north), Gulf of Thailand (a small area in the north of Peninsular Malaysia), Straits of Johor (south of Peninsular Malaysia, acting as maritime border between Malaysia and Singapore), Sulu Sea (north coast of Sabah, East Malaysia), and Celebes Sea (southeast coast of Sabah, East Malaysia). See http://en.wikipedia.org/wiki/Geography_of_Malaysia, accessed: 14 May 2014.

Furthermore, fishing activity, besides agriculture and forestry, forms the basis of the Malaysian economy. Such technology was developed under a collaborative project between Remote Sensing Malaysia, Department of Fisheries Malaysia (DOF), National Fishermen Association (NEKMAT), Fisheries Development Authority of Malaysia (LKIM) and Malaysian Institute of Microelectronic Systems (MIMOS Berhad).[476] The first targeted area of the project is the east coast of Peninsular Malaysia. The project, which began in 2007, involves a first phase called 'now casting' which was successfully completed in 2009. The fishing location is identified using the extracted remote sensing satellite images from MODIS satellites, OCM and NOAA, based on sea surface temperature and phytoplankton parameters. The warmer temperature of the sea surface detected indicates the possibility of high fish volume in the surrounding areas. The higher chlorophyll concentration indicates a higher amount of algal blooms, the nutrient needed by the fish.[477] When the potential fishing zone map was produced, it was then distributed to the fishermen through their association office either by fax, e-mail, SMS, internet, or satellite phone. Such fishing locations are valid for one to three days. It has been reported that the accuracy of the locations is quite high. When the Fishing Zone Identification System is fully completed, it will be capable of producing a potential fishing zone map that is valid for one to two weeks.[478]

The second space application development is the natural disaster management application. Even though Malaysia is geographically located outside the 'Pacific Rim of Fire' and is relatively free of the severe destruction caused by natural disasters such as earthquakes, typhoons and volcanic eruptions, the country has nevertheless experienced other types of natural disaster that are not catastrophic in nature, such as monsoon or seasonal floods, landslides, forest fires and severe haze.[479] Natural disaster monitoring was introduced in the disaster management programme under the name of 'detection and monitoring' components.[480] It was carried out using data taken from the remote sensing satellites. For

[476] The DOF official website is available at www.dof.gov.my/; The NEKMAT, http://nekmat.com/; The LKIM, http://lkim.gov.my/; The MIMOS Berhad, http://www.mimos.my/, all accessed: 14 May 2014.
[477] The sea surface temperature is determined through the conversion of infrared emissions from the ocean detected by the USA Terra (MODIS) satellite. See "Outlook of Fish Forecasting in Malaysia Based on Sea-Surface Temperature (SST) and Chlorophyll Concentration (Period: 22-28 December 2009)", http://www.met.gov.my/pdf/agromet/sst_cc.pdf, accessed: 14 May 2014.
[478] http://www.remotesensing.gov.my/article.cfm?id=783, accessed: 14 May 2012.
[479] Mohd Najib Tun Abdul Razak, *supra* note 461; see also Country Report 2003: Malaysia, "The Malaysian Experience and Future Direction on Disaster Management", http://www.adrc.asia/countryreport/MYS/2003/page2.html, accessed: 13 May 2014.
[480] On 11th May 1997, the Government issued the National Security Council (NSC) Directive No.20 on "Policy and Mechanism on National Disaster and Relief Management" which aims to outline the policy on Disaster and

instance, detection of forest fire or hotspots occurrence is performed using the lower-resolution remote sensing satellites such as NOAA and MODIS, whereas the higher-resolution satellite images from SPOT and IKONOS are used to detect the exact locations where disasters happen.[481] At this juncture, space technology is significantly applied as it is capable of providing real-time data, which is a major key to the effectiveness of the disaster management programme. The data collection then leads to data processing; thus, the information gathered will be disseminated to the various users for various purposes. For instance, the MRSA disseminates the information on hotspots, open burning, and forest fire to the Malaysian National Security Council, Department of Environment, Fire and Rescue Department, Malaysian Meteorological Department and Forestry Department to assist them in their mission-planning for cloud-seeding, open burning and forest fire-monitoring, and fire suppression.

The third is the environmental management application. This involves monitoring environmentally sensitive areas. In this programme, the space technology of remote sensing is applied for the purpose of monitoring and observing any kind of activity that might possibly affect Malaysia's environmentally sensitive areas. These areas include the highlands, reserved forests, wetlands, and water catchments. It was reported that some of Malaysia's reserved forests have already been cleared for rubber plantations and other activities, and up to 80 per cent of the remaining forest is at risk.[482] The clear-cutting process, moreover, will cause soil erosion and increase the risk of fire. In view of the fact that the permanent forest reserves are classified as Environmentally Sensitive Areas Rank Two in the Malaysian National Physical Plan,[483] in which no development or agriculture is allowed, such

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Relief Management based on the level of complexity of disaster, and to establish a management mechanism to determine the roles and responsibilities of various agencies in handling the disaster. See Country Report 2003, *id.* Che Moin Umar, "Policy and Mechanism on National Disaster and Relief Management", National Security Council, Putra Jaya, at http://spm.um.edu.my/news/disaster_management_23072008/talk02.pdf, accessed: 14 May 2014.

[481] Other components of the Disaster Management Programme are: early warning, and mitigation and relief. The early warning component involves producing a risk map that indicates areas vulnerable to disaster. Mitigation and relief involves the inter-agency activities performed under the coordination of the Malaysian National Security Council. See Malaysian Remote Sensing Agency's website, *id.*; see also Siti Atikah Mohamed Hashim, "National Disaster and Remote Sensing in Malaysia", 2nd JPTM Meeting, Bangkok, Thailand, http://www.aprsaf.org/data/jptm2_pdf/JPTM200606_12.pdf, accessed: 14 May 2014.

[482] Even though conversion of natural forest to plantations is not illegal under Malaysian law such replacement has significant ecological implications, such as reducing the number of plant and animal species; furthermore, the plantations store less carbon than natural forests.

[483] The National Physical Plan is a statement of strategic policies, approved on April 2006, on the physical development and conservation throughout Peninsular Malaysia. It was prepared based on the requirement of the Malaysian Town and Country Planning Act 1976. Among its themes is conservation of wildlife and natural

conversion therefore should not be allowed, for the sake of environmental security.[484] Under the aforesaid programme, the Malaysian Government assigns the MRSA to continuously monitor the development activities around these areas, and reports are submitted to the related authority on a regular basis. Conserving and monitoring these environmentally sensitive areas, especially the highlands, which are vital for the country's water-catchment areas, were also given special attention in the Malaysian East Coast Economic Region (ECER) master plan.[485]

At this point, the water catchments mapping and monitoring also became part of the MRSA's collaborative project with the Department of Irrigation and Drainage (DID).[486] Using high-resolution satellite images, the task was to map new proposed catchment areas and also monitor dam constructions and encroachment areas. The encroachment images and reports would be sent to the relevant authority for further action. Another space technology application is the islands development monitoring. Utilising the remote sensing and GIS technologies, a study was conducted on the status of islands development in Malaysia, and the impact on its environment.[487] Such technologies were used to provide the latest map of the land use and changes in the islands. This information is crucial to monitor the activities performed on the islands as it is important for their sustainable development.

The fourth is the forestry application. Realising the importance of remote sensing technology for forest management, the MRSA collaborated with the Forestry Department of Peninsular Malaysia (FDPM)[488] to develop the 'Logging Activity Monitoring System'. The aim of the system is to monitor and detect any illegal logging activities in selected logged areas such as Malaysian permanent forest reserve. There are a number of declared illegal activities such as

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resources. See Department of Town and Country Planning, Peninsular Malaysia, http://www.townplan.gov.my/english/service_dev_npp.php, accessed: 25 June 2013.

[484] Tan Cheng Li, "Malaysia's Rainforests Being Insidiously Replaced with Plantations of Clones", *The Malaysian Star,* 7 July 2009, also published in mongabay.com, 20 July 2009, http://news.mongabay.com/2009/0719-rubber_malaysia.html, accessed: 14 May 2014.

[485] ECER covers the Malaysian east coast states such as Kelantan, Terengganu, Pahang, and district of Mersing in Johor. The main objective of the master plan is to accelerate the growth of the ECER in a viable, equitable and sustainable manner, undertaken via projects and programmes to raise income and reduce poverty in order to achieve developed status by the year 2020. See Consulate General of Malaysia Karachi, The Ministry of Foreign Affairs Wisma Putra, "East Coast Economic Region (ECER)-Part ½", http://www.kln.gov.my/perwakilan/karachi/event/1260, accessed: 25 June 2012.

[486] The Malaysian Department of Irrigation and Drainage website is available at http://www.water.gov.my/, accessed: 14 May 2014.

[487] Malaysian Remote Sensing Agency, Annual Report 2007, at 26.

[488] The Forestry Department of Peninsular Malaysia official website is available at www.forestry.gov.my/, accessed: 14 May 2014.

felling outside licensed areas, felling within protected areas, illegal road construction, and felling prohibited trees such as special species of trees that need to be monitored and observed.[489] Using the remote sensing technology, all these activities can be easily detected by the authority by monitoring the forest changes in their areas; thus, further enforcement mechanisms could be carried out effectively by the relevant authority.

The fifth is the environmental health application. In this sector, the space technology was used to identify the environmental factor that caused the dengue outbreak[490] in Malaysia. The MRSA developed a system called 'Dengue Out-Break Risk Area Mapping System' where the observation was performed from the remote sensing data derived from the Landsat TM image. It was discovered that the land surface temperature is highly correlated with the distribution of dengue cases in Malaysia. The finding was that most dengue cases occurred in the high land surface temperature areas, compared to the low land surface temperature areas. Such a discovery is useful to the Malaysian Ministry of Health to identify and control the dispersion of dengue outbreaks in the country. Under the same application, the MRSA worked in partnership with the University Science of Malaysia (USM) for the mapping of risk areas for children with malnutrition. Again the remote sensing data were used to obtain information needed to develop a GIS model for the risk mapping. The finding will be helpful to the Malaysian Ministry of Health to implement the food supplementary programme efficiently.[491]

The sixth is the geosciences application. Utilization of the remote sensing application in this area, which involves the collaboration of MRSA and Minerals and Geosciences Department, relates to the study of land subsidence due to non-sustainable groundwater extraction in selected areas. Such technology was applied to identify peat lands and map the land use changes. The peat lands are recognised, using the Landsat TM satellite image, by their smooth texture, homogeny and reduced structure compared to other surrounding lands. The project finding could be used by policy-makers to create better groundwater extraction plans. Apart from that, the application of the technology is essential to detect potential mineral areas in Malaysia by developing a potential mineral area detection system.

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[489] Malaysian Remote Sensing Agency, Annual Report 2007, at 29.

[490] Dengue, also known as dengue fever, is an acute mosquito-born viral illness of sudden onset that usually produces headache, fever, prostration, severe joint and muscle pain, swollen glands and rash. It is transmitted to humans by aedes mosquito. It occurs widely in tropical countries. "Definition of Dengue", *MedicineNet.com*, http://www.medterms.com/script/main/art.asp?articlekey=6625, accessed: 14 May 2014.

[491] Malaysian Remote Sensing Agency, Annual Report 2007, at 28.

The seventh is the basic mapping application. Satellite Image Map (SIM), is another remote sensing application project that was developed by MRSA in a joint venture with Department of Surveying and Mapping Malaysia (JUPEM).[492] SIM consists of ortho-rectified satellite remote sensing images overlaid with topographic data, transportation and hydrological network, and administrative details. The project aims to furnish updated topographical features and complement the topographic maps produced by JUPEM, which consist of spatial information on roads, rivers, contours, and boundaries. Using the Landsat TM satellite data as a base layer, 177 map sheets on the scale of 1:50 000 were completed for the whole of Peninsular Malaysia; they will be updated using the higher-resolution SPOT data. These maps are stored in the SIM database and are available through the MRSA Data Service Section.[493]

Apart from the aforementioned space applications, the Integrated Geospatial Database and Planning System (IGDP system), formerly known as National Resources and Environmental Management (NAREM) System,[494] also utilised the remote sensing technology to produce data and geospatial information, geographic information system (GIS) analytical capabilities and global positioning system. The system was built to overcome the constraint of the absence of an integrated geospatial database experienced by agencies in planning and monitoring projects such as agricultural production management, natural resources, environment, disaster, security and land development in Malaysia. Using the remote sensing technology, the system provides an integrated database with standardized data concerning the format, scale and level of mapping accuracies; this was previously unavailable and only obtainable in different environments of various agencies.[495] Such application packages were developed for the agriculture sector, forestry, geology, marine environment, environmental management, hydrology, coastal areas, topography, and socio-economic areas.[496]

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[492] JUPEM is a Malaysian Government agency that provides survey and mapping services as well as managing geospatial data. Its official website is at http://www.jupem.gov.my/, accessed: 14 May 2014.

[493] See Malaysian Remote Sensing Agency, Annual Report 2007, at 35. See also http://www.remotesensing.gov.my/articlePrint.cfm?id=454, accessed: 25 June 2012.

[494] Its objective is to establish and operate a system of integrated spatial database on national resources and the environment to support national development planning.

[495] The system comprises three major components: NaSAT, where an integrated database is developed using remote sensing as the main source of data input; NaMOS, where application packages employing a model-based technique are developed; NaDES, where a decision support system is developed by incorporating data and application query capabilities.

[496] http://www.remotesensing.gov.my/articlePrint.cfm?id=391, accessed: 7 December 2009.

1.4.3. Meteorology

Meteorology is another sphere that involves space technology application in Malaysia. It normally deals with the scientific study of the atmosphere and focuses on weather processes and forecasting. In Malaysia, the Malaysian Meteorological Department (MMD) was given the task of providing effective meteorological and seismological services.[497] A number of activities performed in Malaysia involve direct and indirect applications of meteorological satellite technology. They include weather observing and monitoring, forecasting, warnings, aviation meteorology, marine meteorological forecasting, and seasonal and long-range weather outlook.[498]

In weather observing and monitoring, the meteorological observation was executed via images from satellites such as MTSAT (Japan), FY-2E (China), NOAA (USA) and TERRA/AQUA (USA), as well as images from the radar. The high-resolution data from those satellites were received and processed by the meteorological ground station equipped with sophisticated multifunctional instruments. In this observation and monitoring process, the observers monitor, among others, the daily rainfall, the minimum and maximum temperature, the horizontal visibility, and the humidity of the major towns in Malaysia. Apart from that, the meteorological satellites are also used to collect other environmental information such as fires, effects of pollution, auroras, sand and dust storms, snow cover, ice mapping, boundaries of ocean currents, energy flows, city lights, and many others.[499]

In weather forecasting, the meteorological satellites are treated as the major source for daily weather forecasts. The data from those satellites are collected and used by trained observers to forecast the weather. Data on the current state of the atmosphere coupled with scientific understanding of atmospheric processes will produce predictions of the future atmosphere. In fact, the advantage of using these satellites is that they are more global and consistent in coverage. By utilising the visible light satellite images from MTSAT and FY-2E, the forecasters are able to see the development of clouds, particularly in South East Asian Countries and Asia. Moreover, the infra-red images are useful for providing information on the surface temperature and cloud tops. Individual clouds can also be traced by the forecaster

[497] Discussion on the MMD is available in Chapter 1 of the thesis (1.3.1(e) Malaysian Meteorological Department (MMD).
[498] See N.N. Mahmood, *supra* note 452, at 2.
[499] See http://en.wikipedia.org/wiki/Weather_satellite, accessed: 14 May 2014.

from time to time to access information on wind direction and cloud steering level.[500] The MMD provides an online general weather forecast service as well as forecasts for the major towns and tourist destinations in Malaysia.

One of the outcomes of weather forecasts is weather warnings. This service is crucial as it enables the protection of people and property. In Malaysia, the weather warning system is capable of providing early warnings to the public. These warnings include, for instance, notice of tropical cyclones, severe storms, strong winds, rough seas, heavy rain, and extreme temperatures. The system is also vital for the agriculture sector which is among the major income sources for Malaysia. The warning information and other guidance and advice from the authorities are updated daily in the MMD official portal. There are three stages in the severe weather warning system in Malaysia. They are categorised as yellow, orange, and red stages.[501] The rough seas warning involve three stages: the first category warning, second, and third.[502] Such weather warnings have proved to be very useful for the public to make appropriate preparations to deal with such situations.

Weather modification is another activity performed in Malaysia. It is worth mentioning as it is another outcome of space application of weather forecasts. In Malaysia, a cloud-seeding operation is a popular type of weather modification. It is conducted throughout the haze seasons. The haze seasons occasionally occur between July and October, Malaysia's dry season. Cloud-seeding is conducted in order to increase water levels in Malaysian dams. It is also an essential step to reduce the number of public health problems caused by haze. Apart from this, by utilising the space weather forecast technology, reports on seasonal and long-range weather outlooks are prepared. The latest updated seasonal predictions, long-range

[500] The current satellite images from MTSAT, FY-2E, NOAA and TERRA/AQUA are provided at http://www.met.gov.my/index.php?option=com_weatherimages&Itemid=866, accessed: 14 May 2014.

[501] The yellow warning refers to the possibility of monsoon rain occurring in the next 24 to 48 hours. The orange warning alerts that moderate monsoon rain is currently happening or will happen with an expected impact of flooding over low-lying areas and river banks. The red stage is the dangerous stage, when the heavy monsoon rain occurs with strong winds, and it warns that the water current is dangerous for children playing on the river banks. For details, see http://www.met.gov.my/index.php?option=com_content&task=view&id=739&Itemid=1129, accessed: 14 May 2014.

[502] The first warning category refers to strong winds detected at speeds of 40-50 km/h and wave height up to 3.5 metres. This warns that it is dangerous for small craft and recreational sea activities. The second category refers to the stage where there are winds with speeds of 50-60 km/h and the wave height is up to 4.5 metres. This is dangerous for all shipping activities and ferry services. The third category indicates winds with speeds of more than 60 km/h with waves higher than 5.5 metres. This warns that it is dangerous for all shipping activities, including workers on oil platforms. See *id*.

weather outlook for Malaysian states, the current el-Nino condition, and the sea surface temperature are also issued.[503]

Another application of meteorological satellite technology is marine meteorological forecasting. This is designed purposely for Malaysian fishermen. The forecast provides seven-day weather, wind, and wave forecasting, including tidal forecasts, for Malaysian territorial waters. Such forecasts are of tremendous help to fishermen in making decisions about their fishing activities. This is crucial as it involves the safety of life and property. In fact, Malaysian fishermen are highly dependent on this technology, especially during the monsoon season which occurs between November and January.

Aviation meteorology is another main field that utilises space meteorological technology. Such technology is useful since it involves aviation safety, especially during landing and take-off. The Kuala Lumpur International Airport (KLIA) weather forecast kiosk was designed to provide global and local forecast services via satellite images and radar. In this sector, the aviation briefing terminal, which consists of the KLIA pilot briefing package, was also introduced.[504]

Since the meteorological services play a vital role in contributing towards the improvement in the quality of public life, Malaysia chose to become a member of the World Meteorological Organization (WMO) in May 1958. It was noted that meteorological observation in Malaysia had inadvertently shifted towards a dependency on data derived from space-based platforms, as experienced by the Global Observation System of the World Weather Watch Programme, WMO.[505] It was alleged that shifting to such a strategy is a solution to the difficulties faced by conventional ground-based observation. Furthermore, it was motivated by the rapid changes in the related technology itself.[506]

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[503] See http://www.met.gov.my/index.php?option=com_content&task=view&id=1590&Itemid=123, accessed: 26 June 2013.
[504] See http://www.met.gov.my/index.php?option=com_content&task=view&id=1381&Itemid=1147, accessed: 26 June 2013.
[505] World Weather Watch is a unique system linking institutions around the world, and collects, processes and transmits information on the weather. See United Nations Office at Vienna for Outer Space Affairs, *Space Solutions for the World's Problems: How the United Nations Family is Using Space Technology For Sustainable Development*, (Vienna: United Nations).
[506] *Id*.

1.4.4. Navigation

Navigation is another area of space utilisation that has successfully reached an operational level. The space technology of navigation is capable of accurately determining the location of people, vehicles, ships, planes, goods, and animals. In Malaysia, this is a new-ventured area compared to other areas mentioned earlier. The Global Navigation Satellite System (GNSS),[507] originally developed for military purposes, has become a global utility with increasing benefits and is used in various applications. With extremely high accuracy, global coverage, and all-weather operation, the system is becoming well-known in areas including aviation, maritime, land transportation, mapping and surveying, precision agriculture, power and telecommunications networks, disaster warning and emergency response.[508] There are four main GNSS: the United States' Global Positioning System (GPS), the Russian Global Navigation Satellite System (GLONASS), the European Galileo positioning system (Galileo), and the Chinese global BeiDou Compass navigation system (Compass). At present, the United States' GPS and Russian GLONASS are fully operational. However, the European Galileo and the China Compass are still under development and construction.[509] The United States' GPS has been in operation since 1978 and has been available globally since 1994. It is currently the world's most utilised satellite navigation system.[510] Meanwhile, the Russian GLONASS was recovered and restored in 2011.[511] As for the European Union's Galileo, it is the first satellite positioning and navigation system built for civil purposes. It is expected to become operational in 2014 but is unlikely to be in full service until at least 2020.[512] The Republic of China's global Compass navigation system is scheduled to be offering service

[507] The Global Navigation Satellite Systems (GNSS) is a standard generic term for satellite navigation systems which provide geo-spatial positioning with global coverage. They allow small electronic receivers to determine the location in terms of longitude, latitude, and altitude using time signals transmitted along a line-of-sight by radio from satellites. Refer http://en.wikipedia.org/wiki/Satellite_navigation, accessed: 14 May 2014.
[508] United Nations Office for Outer Space Affairs, *supra* note 505, at 1.
[509] See http://en.wikipedia.org/wiki/Satellite_navigation, accessed: 14 May 2014.
[510] See http://en.wikipedia.org/wiki/Satellite_navigation, accessed: 14 May 2014.
[511] GLONASS was, in fact, a fully functional navigation constellation from 1995, but it fell into disrepair with the collapse of the Russian economy. Beginning in 2001, the Russian Federation was committed to restoring the system to full global availability, introducing the Indian Government as a partner. Discussion on GPS and GLONASS is available in Liebig, Volker and Kai-Uwe Schrogl, *Space Applications and Policies for the New Century,* (Frankfurt: Peter Lang GmbH, Europäischer Verlag der Wissenschaften, 2000), at 95-100; see also http://en.wikipedia.org/wiki/GLONASS, accessed: 14 May 2014.
[512] For more details, refer to Wilson, Andrew, ed., *Galileo The European Programme for Global Navigation Services,* (Noordwijk: European Space Agency, 2005); see also http://en.wikipedia.org/wiki/Satellite_navigation#GPS, accessed: 14 May 2014.

globally by 2020. However, the service for the Asia Pacific region is expected to be available by the end of 2012.[513]

In general, the GNSS has been applied in Malaysia in three main sectors, namely the marine, aviation, and land navigation sectors. In the marine sector, the technology is crucial for safety reasons, particularly to determine the exact location and position of a vessel in order to avoid a collision. Dealing with the marine navigation sector, Marine Department Malaysia[514] provides a Differential Global Positioning System (DGPS) service called SISPELSAT (*Sistem Pelayaran Satelit*) [515] to all vessels navigating in Malaysian waters. It is a primary navigational aid for vessels navigating along the shore of Peninsular Malaysia. It has been operated and managed by the Marine Department Malaysia since April 2003. By utilising the DGPS technology, it increases the accuracy of positions derived from the GPS receivers to better than 5 metres at a 95 per cent reliability level.[516] This system has proved to be very useful to vessels navigate within the busiest Malaysian waters such as the Straits of Malacca as it is able to detect the location and movement of other vessels around them. Moreover, it manages to provide other information such as the names, sizes, lengths and type of the vessels and also receives warning alarms whenever a dangerous situation, such as a tsunami, is detected.[517]

The space technology of the GNSS is also vital in the aviation sector in that it can be used in various phases of flight including the en-route navigation, airport approach, landing, and

[513] Regional Beidou navigation system is a regional navigation system of the Republic of China. It covers the Republic of China and neighbouring regions. Other regional navigation systems include: DORIS (France), IRNSS (India), QZSS (Japan). See http://www.bbc.co.uk/worldservice/business/2010/01/100107_galileo_satellite_biz.shtml, accessed: 29 June 2012; http://en.wikipedia.org/wiki/Beidou_Navigation_Satellite_System, accessed: 14 May 2014.

[514] Marine Department Malaysia official website is available at http://www.marine.gov.my/, accessed: 14 May 2014.

[515] The SISPELSAT system consists of two beacon stations, the Lumut Reference Station (Lumut Integrity Monitoring Station/LRSIM) and the Kuantan Reference Station (Kuantan Integrity Monitoring Station/KRSIM). Those stations transmit the GPS differential corrections to the targeted area service, within a 250km radius of the Malacca Straits on the west coast and the South China Sea on the east coast. See Mustafa Din Subari and M. Saupi Che Awang, "GNSS Radio beacon Service Availability Study: The SISPELSAT", 3rd FIG Regional Conference, Jakarta, Indonesia, October 3-7, 2004, http://www.fig.net/pub/jakarta/papers/ts_15/ts_15_3_subari_chewang.pdf, accessed: 14 May 2014.

[516] See *id*.

[517] Azmi Hassan, "Faedah Pasang GPS di Batuan Tengah", *Utusan Online,* 19 June 2008, http://utusan.com.my/utusan/info.asp?y=2008&dt=0619&pub=Utusan_Malaysia&sec=Rencana&pg=re_05.htm, accessed: 2 October 2012; Mustafa Din Subari, M. Saupi Che Awang, *id*.; Mustafa Din Subari, "Update on Malaysian GNSS Infrastructure", *Third Meeting of the International Committee on Global Navigation Satellite System (ICG), Pasadena, California, United States of America, December 8-12, 2008,* http://www.oosa.unvienna.org/pdf/icg/2008/icg3/13.pdf, accessed: 14 May 2014.

ground guidance. The Malaysia Department of Civil Aviation is fully committed to complying with the timeline set by the International Civil Aviation Organization (ICAO) for the implementation of the GNSS application or Performance Based Navigation (PBN) Programme to enhance the capacity and efficiency of Malaysian airspace.[518] To this end, Malaysia has implemented Area Navigation (RNAV)[519] over the Bay of Bengal and South China Sea for the en-route segment. The RNAV Standard Instruments Departure (SIDs) and Standard Terminal Arrival Routes (STARs) together with GNSS RNAV Non-Precision Approach (NPA) will be completed soon at the Kuala Lumpur International Airport (KLIA). Apart from that, the Malaysia Department of Civil Aviation also plans to install additional infrastructure for the Ground-Based Augmentation System (GBAS)[520] at other major Malaysian international airports.[521]

In the land navigation sector, the GNSS technology is becoming popular among vehicle users in Malaysia. This is because satellite navigation is treated as a means of safely guiding a vehicle to its destination as well for tracking purposes. The benefit of using GNSS technology for taxi services, for instance, has been proved, especially in fast dispatching, as the GPS system helps to pinpoint the location of the taxi and the customer. The application of such technology will also cut the fuel consumption and decrease air pollution since it limits the taxi to the shortest route. Furthermore, it also involves safety features as the taxi can be tracked easily should it experience any problems or emergencies.[522] Regarding the consumer

[518] ICAO is the United Nations main agency that codifies the international air navigation principles and techniques, as well as fostering the planning and development of international air transport to ensure safety and orderly growth. Its programme, called the Performance Based Navigation (PBN) Programme, involves a concept representing a shift from sensor-based to performance-based navigation. Its website is available at http://www.icao.int; see also http://www2.icao.int/en/pbn/Pages/Introduction.aspx, accessed: 29 June 2012; and http://en.wikipedia.org/wiki/International_Civil_Aviation_Organization, accessed: 14 May 2014.

[519] RNAV is a method of navigation that permits an aircraft to choose any course within the coverage of station-referenced navigation signals or within the limits of self-contained system capability. This can conserve flight distance, reduce congestion and flight delay, decrease fuel consumption, and allow flights into airports without beacons. See http://en.wikipedia.org/wiki/Area_navigation, accessed: 14 May 2014.

[520] Ground-Based Augmentation System (GBAS) is a safety-critical system that augments the GPS standard positioning service and provides enhance level of service which supports all flight phases of approach landing, departure, and surface operation within its area of coverage. See http://www.eurocontrol.fr/Newsletter/2002/November/GBAS/GBASv0.32.htm, accessed: 14 May 2014.

[521] "Final Report of the Global Navigation Satellite System (GNSS) Implementation Team (GIT)", *The 13th Meeting of the Asia-Pacific Economic Cooperation (APEC), 27-19 July 2009, Singapore,* http://www.apec-tptwg.org.cn/new/Archives/tpt-wg32/Intermodal/GIT%20Final%20Report.pdf, accessed: 14 May 2014.

[522] Arellano, Vanessa, "Why GPS Navigators are Necessary for Todays Taxis", http://www.streetdirectory.com/travel_guide/52315/car_parts/why_gps_navigators_are_necessary_for_todays_taxis.html, accessed: 14 May 2014.

product application of GPS navigation devices,[523] a variety of devices offer GPS services is available in the market. Among the famous navigational devices on sale in Malaysia is the Garmin product.[524] Indeed, GPS navigation products have various purposes and designs, such as automotive, handheld, motorcycle, and cycling. The most widely used device in Malaysia is the automotive navigation system. This involves a satellite navigation system designed for automobiles. In such circumstances, the system uses a GPS navigational device to acquire positional data to locate the user on a road in a unit's map database. By using the road database, the unit can give directions to the other locations.[525] Such a system is, however, exposed to controversy especially in cases of misdirection, and it was reported that a number of accidents have occurred due to misdirection by the system. For instance, a man was reported to have driven down a steep mountain path after allegedly being misdirected by his GPS portable system.[526]

The space technology of GNSS also has potential for increasing the quality of agricultural production. It was confirmed by the Malaysian Agricultural Research and Development Institute (MARDI) that such technology was applied in Malaysian rice precision farming.[527] The GNNS technology is utilised to provide geographic references for yield data. An accurate topographic map can be produced since it is useful for interpreting yield and weed maps as well as for planning grassed waterways and field divisions. Field boundaries, roads, yards, tree stands and others can all be accurately mapped to aid the farm planning.[528] With satellite navigation technology, it is possible to apply fertilizers and pesticides according to the fertility of a particular part of the field.[529] Therefore, the plan stresses that the correct input of fertilizers, pesticides, and water, in the right amounts, at the right time and place can be carried out efficiently.

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[523] GPS navigation device means a device that receives GPS signals for the purpose of determining the current location.

[524] Garmin products are produced by Garmin (Asia) Corporation, a subsidiary of Garmin Ltd. This is a company that develops consumer, aviation and maritime technologies for the GPS. Its website is at http://www.garmin.com/; see also http://en.wikipedia.org/wiki/Garmin, all accessed: 14 May 2014.

[525] See http://en.wikipedia.org/wiki/Automotive_navigation_system, accessed: 14 May 2014.

[526] See http://www.asylum.com/2009/03/26/gps-leads-driver-to-cliffs-edge/, accessed: 14 May 2014.

[527] For more information, read Chapter 1 of the thesis (1.4.2. Remote Sensing).

[528] Goddard, Tom, "What is Precision Farming?", *Proceedings of Precision Farming Conference, January 20-12, 1997, Taber, Alberta, Canada,* http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/sag1951, accessed: 14 May 2014.

[529] Liebig, Volker and Kai-Uwe Schrogl, *supra* note, 511, at 92.

Besides the Marine Department Malaysia and Malaysia Department of Civil Aviation, the Department Survey and Mapping Malaysia (JUPEM)[530] is another governmental agency that is directly involved with the GNSS technology. Since mapping and surveying are increasingly dependent on GPS coordinates, Malaysia has consequently applied such technology in these areas since 1989. In order to ensure full coverage of GNSS services throughout the country, JUPEM made an effort to develop a domestic GNSS infrastructure called Malaysia Real-Time Kinematic Network System (MyRTKnet). This is Malaysia's first and only nationwide GPS network developed for GPS users to provide DGPS services with accuracy and coverage for surveying and positioning applications throughout the country.[531] Its whole network consists of 50 reference stations in Peninsular Malaysia and 28 stations in Sabah and Sarawak. The network is available to users for static and real-time operations in Malaysia.

1.4.5. Satellite Manufacturing and Launching

Satellite manufacturing in a way leads to various space applications in Malaysia. It is among the Malaysian space-related activities that are predicted to earn profits for the country when they become profit-making businesses. Thus, at this juncture, it is worth briefly discussing this point in its own right. In general, the development of the space technological programme in Malaysia, particularly, in Research and Development (R&D) which stressed the indigenous design and development of systems and satellite subsystems, has intensified since the 1990s.[532] The technology of satellite manufacturing was acquired through a Malaysian wholly governmental-owned company called Astronautic Technology (M) Sdn Bhd (ATSB).[533] Such technology was indeed gained through the first ATSB first project, namely the TiungSAT-1 technology transfer programme.

Specifically, this technology transfer programme started in 1997, when the ATSB began a technical collaboration with Surrey Satellite Technology Ltd (SSTL)[534], a British satellite provider; this venture allowed the ATSB engineers to jointly develop a satellite with the

[530] JUPEM official website is at http://www.jupem.gov.my/, accessed: 14 May 2014.
[531] For more information on MyRTKnet see http://www.jupem.gov.my/index.php?action=geodetik_data_rinex, accessed: 29 June 2012.
[532] Ahmad Sabirin Arshad, "Satellite Technology Potentials in Malaysia", *supra* note 455.
[533] More discussion on ATSB is available in Chapter 1 of the thesis (1.3.1 (c): Astronautic Technology (M) Sdn Bhd).
[534] Read also *supra* note 232.

British engineers. In this programme, the technology partners shared advanced technology and expertise mainly in the construction, testing, launch, and orbital operations of the micro-satellite and its operation. The ATSB sent a team of seven Malaysian engineers to the SSTL from June 1997 until March 1998 to acquire knowledge and skill in the related technology. During the training, the engineers were exposed to direct first-hand practical experience and skills, and worked on an actual satellite fabrication project. They were also directly involved in the whole satellite life-cycle process including mission analysis, subsystem and payload design review, satellite manufacture, assembly, integration and testing, environmental testing, launch campaign and launch, and in-orbit commissioning and operation.[535]

The second major project of ATSB in satellite manufacturing was the development of RazakSAT, the second Malaysian remote sensing satellite.[536] In the RazakSAT satellite development programme, the ATSB worked on a bilateral collaborative development with a South Korean company, Satrec Initiative Co. Ltd. In this collaboration, the ATSB worked on upgrading the resolution of the satellite from the 78m spatial resolution of TiungSAT-1 to a higher resolution of 2.5m of RazakSAT.[537] The development of the satellite started in 2000 and was completed in 2004[538] and it was indeed designed and built by Malaysian local engineers with the joint cooperation of Satrec Initiative Co. Ltd, while its satellite bus was jointly developed by both.[539]

Besides the aforementioned programmes, there have also been a number of other small satellite projects jointly conducted with the Malaysian local universities. These programmes include CubeSAT, InnoSAT, and CanSAT. The CubeSAT and InnoSAT are small satellites that were built for educational and research purposes. They also function to stabilise

[535] Ahmad Sabirin Arshad, "TiungSAT-1 Technology Transfer Programme", *TiungSAT-1, From Inception to Inauguration,* Eds., Mazlan Othman and Ahmad Sabirin Arshad, (Kuala Lumpur: Astronautic Technology (M) Sdn Bhd, 2001), at 8.
[536] More information on RazakSAT is available in Chapter 1 of the thesis (1.3.1(c): Astronautic Technology (M) Sdn Bhd).
[537] See Norhan Mat Yusoff, "RazakSAT-Technology Advent in High Resolution Imaging System for Small Satellite", http://www.a-a-r-s.org/acrs/proceeding/ACRS2005/Papers/ANS-5.pdf, accessed: 5 July 2012; http://www.researchgate.net/publication/228978232_RazakSATTechnology_Advent_in_High_Resolution_Imaging_System_for_Small_Satellite, accessed: 14 May 2014; read also Chapter 1 of the thesis (1.3.1(c): Astronautic Technology (M) Sdn Bhd).
[538] Amree Ahmad, Norhayati Yahya, "RazakSAT Sensitif Suhu", *Kosmo Online*, 19 April 2009, http://www.kosmo.com.my/kosmo/content.asp?y=2009&dt=0419&pub=Kosmo&sec=Rencana_Utama&pg=ru_05.htm, accessed: 14 May 2014.
[539] Satellite bus is a general model on which multiple-production satellite spacecraft are often based. The RazakSAT satellite bus was marketed as 'SI-200'. See http://www.satreci.com/eng/products/products_01.htm, accessed: 21 January 2010; http://en.wikipedia.org/wiki/Satellite_bus, accessed: 14 May 2014.

RazakSAT's position in orbit. The CubeSAT was developed by the ATSB, while the InnoSAT was built by three Malaysian public local universities, namely Universiti Sains Malaysia (USM), Universiti Teknologi Malaysia (UTM) and Universiti Malaysia Perlis (UniMAP). The project was carried out with a research grant funded by the MOSTI.[540] The CanSAT, it is a nano-scale satellite model. It provides excellent training opportunities for those who wish to pursue careers in satellite design, fabrication, and operation. In regard to this project, the Malaysian National Space Agency (ANGKASA),[541] among others, organized the CanSAT competition in order to encourage the Malaysian higher education institutions to actively participate in space activities and to expose the students to the satellite development process.[542]

In respect of satellite launch activities, it is observed that Malaysia performs such activities through other countries' facilities. At present, Malaysia does not have her own launch facility to launch her satellites from her territory into orbit. Thus, Malaysia takes the initiative to launch her satellites through other countries' launch sites and facilities. For instance, TiungSAT-1 was successfully launched from Kazakhstan. It was launched into orbit on 26 September 2000 from Tyuratam, Baikonur Cosmodrome Launching Centre.[543] The launch vehicle used to carry TiungSAT-1 was a Russian-Ukrainian launch vehicle called the Dnepr rocket.[544] However, the RazakSAT satellite was successfully launched from Omelek Island[545] in the Republic of the Marshall Islands. After several delays, the RazakSAT was finally launched on 14 July 2009[546] from a launch site called the U.S. Army Kwajalein Atoll

[540] See ATSB official website, *supra* note 226.
[541] Information on ANGKASA is available in Chapter 1 of the thesis (1.3.1(b): Malaysian National Space Agency (ANGKASA).
[542] Malaysia National Space Agency (ANGKASA), "CanSAT- Malaysian Plan", http://www.angkasa.gov.my/siswasat/document/ICW-16)MSA.pdf, accessed: 7 July 2012.
[543] TiungSAT-1 was launched together with two micro-satellites from Italy, MegSAT-1, and UniSAT, and two from Saudi Arabia, SaudiSAT-A, and SaudiSAT-B. See *infra* note 544
[544] The Dnepr launch vehicle was initially designed as an Intercontinental Guided Ballistic Missile (ICBM SS-18) which had been modified as an Expendable Launch Vehicle (EL) for use in space missions. For details on the TiungSAT-1 pre-launch activities, read Norhizam Hamzah and Mohd Fadhil Sayuti, "TiungSAT-1 Pre-Launch Activities", *TiungSAT-1, From Inception to Inauguration,* Eds., Mazlan Othman and Ahmad Sabirin Arshad, (Kuala Lumpur: Astronautic Technology (M) Sdn Bhd, 2001), at 93. See also Mohamed Haikal Isa, "Malaysia's First Micro-Satellite, TiungSAT-1 Launched", *Bernama,* 26 September 2000*,* http://www.zdnetasia.com/news/hardware/0,39042972,13029638,00.htm, accessed: 14 May 2014.
[545] The Omelek Island is part of Kwajalein Atoll in the Republic of the Marshall Islands. It is controlled by the United States military under a long-term lease. See http://en.wikipedia.org/wiki/Omelek_Island, accessed: 14 May 2014.
[546] On 21 March 2009, the RazakSAT was sent to the United States military base, Bucholz Army Airfield, using the Royal Malaysian Air Force (RMAF) C-130 aircraft. It was then sent to a launch site on Omelek Island by Great Bridge, a transport craft of the United States Navy.

(USAKA).[547] The launch vehicle used for the RazakSAT satellite was the United States launch vehicle Falcon-1.[548] It is owned by Space Exploration Technologies Corporation (SpaceX)[549]. CubeSAT and InnoSAT were launched together with the RazakSAT satellite on 14 July 2009 using the Falcon-1 vehicle; their function, apart from their research purpose, is to stabilise the position of the RazakSAT in its orbit.

In respect of Malaysia's current project to build a new satellite, a special budget for the earth observation programme has already been requested from the Malaysian Government.[550] This has been done in order to ensure further growth of the country's satellite manufacturing industry. This new programme involves building another new operational remote sensing satellite called RazakSAT-2. It is expected to produce a better quality of image acquisition compared to RazakSAT. The project was started in 2011 and is expected to be completed in 2014. It is presumed that the satellite will be ready to launch in late 2015, and its operational life is expected to be three to four years.[551]

Relying on the successful development of these earlier satellite programmes, Malaysia is believed to have the capacity to venture further into satellite development technology, especially with regard to the satellite manufacturing industry. In fact, trust was placed in Malaysia by another country, South Africa, when one of its companies asked the Malaysian Government- owned company ATSB, to develop a satellite component as well to collaborate in the satellite technology area.[552] Furthermore, the satellite technology business can be

[547] The U.S. Army Kwajalein Atoll (USAKA) is the Space Exploration Technologies Corporation's (SpaceX) launch site on Omelek Island.
[548] The Falcon 1 is a small, partially reusable rocket capable of placing several hundred kilograms into low earth orbit. See http://en.wikipedia.org/wiki/SpaceX, accessed: 30 March 2012.
[549] SpaceX is an American space-transportation company which is developing a partially reusable launch vehicle, namely Falcon 1 and Falcon 9 and a series of space capsules. It operates from its headquarters at Hawthorne, California. On 28 September 2008, SpaceX made history when its Falcon 1 Flight 4 became the first privately-developed liquid fuel rocket to orbit the Earth. See SPACEX website at http://www.spacex.com/, accessed: 14 May 2014.
[550] Interview with Mr Maszlan Ismail, ANGKASA, held on October 2009, http://www.aprsaf.org/interview/interview_37.html, accessed: 21 January 2010.
[551] See Statement by Colonel Nazari Abd Hadi, Representative of Malaysia, on Agenda Item 51: International Cooperation in the Peaceful Uses of Outer Space, at the Fourth Committee of the 67th Session of the United Nations General Assembly, New York, 18 October 2012, http://www.un.int/malaysia/GA/67/2012-10-18%20Outer%20Space.pdf; and also, Mustafa Din Subari, "Malaysia Space Related Activities 2011: Country Report", http://www.aprsaf.org/annual_meetings/aprsaf18/pdf/program/day3/11_Malaysia%20Country%20Report.pdf, accessed: 14 May 2014.
[552] Laupa Junus, "ATSB Peneraju Teknologi Satelit", *Estidotmy*, January 2007, http://www.akademisains.gov.my/download/estidotmy/2007/JAN%202007/estipg04.pdf, accessed: 14 May 2014.

considered a good opportunity to create business in Malaysia based on its considerable future profitability. However, the main challenge faced by Malaysia in this area is obtaining certification for the products manufactured, since it requires high degrees of reliability and efficiency.[553] It was reported that Malaysia is poised to become the hub for satellite manufacturing service provider for Southeast Asian region with the completion of its Assembly, Integration and Testing (AIT) facility located at Malaysia Space Centre.[554]

In respect of the non-governmental sector, Malaysia has 'Malaysia East Asia Satellite' (MEASAT), the country's first communication satellite project owned and operated by MEASAT Satellite System Sdn. Bhd. It comprises four communication satellites: (1) MEASAT-1/AFRICASAT-1 (launched: 12 January 1996); (2) MEASAT-2 (launched: 13 November 1996); (3) MEASAT-3 (launched: 11 December 2006); and (4) MEASAT-3a (launched: 21 June 2009). These satellites were launched through other countries' launch sites and facilities: MEASAT-1/AFRICASAT-1 and MEASAT-2 were launched from Centre Spatial Guyanais at Kourou in French Guyana, using the Ariane 44L rocket vehicle; MEASAT-3 was launched from Baikonur Cosmodrome, Kazakhstan, aboard the Proton Breeze M launch vehicle; and MEASAT-3a was launched from Baikonur Cosmodrome, Kazakhstan also, aboard the Land Launch Zenit-3SLB launch vehicle.

MEASAT-1/AFRICASAT-1, MEASAT-2, and MEASAT-3 were designed and built by Boeing Satellite Development Centre through its Hughes Space and Communications Company (HSC). However, MEASAT-3a was built by Orbital Sciences Corporation. The next satellite will be MEASAT-3b. It was constructed by EADS Astrium and its expected launch date is on 29 May 2014. The information regarding MEASAT satellites fleet has been further discussed in: 1.3.2 (a) MEASAT Satellite System Sdn Bhd, of the thesis.

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[553] Ahmad Sabirin Arshad, "Satellite Technology Potentials in Malaysia", *supra* note 455, at 7.

[554] The 20 million USD of AIT facility building was recently completed, but the installation of its equipment is in progress. It is expected to be fully operational by end of 2013. Upon the completion of the facility, Malaysia would be able to provide the regional and global space community the services of: (a) vibration test system; (b) thermal vacuum chamber; (c) mass property measurement system; (d) electromagnetic compatibility chamber; (e) reverberation acoustic test facility, and; (f) alignment measurement system. More information on other facilities available at Malaysia Space Centre, read Chapter 1 of the thesis (1.3.1(b) Malaysian National Space Agency (ANGKASA). Refer also Statement by Colonel Nazari Abd Hadi, Representative of Malaysia, on Agenda Item 51: International Cooperation in the Peaceful Uses of Outer Space, at the Fourth Committee of the 67th Session of the United Nations General Assembly, New York, 18 October 2012, http://www.un.int/malaysia/GA/67/2012-10-18%20Outer%20Space.pdf; and also Malaysia Space Centre Brochure, "A Passage to Space", http://www.angkasa.gov.my/sites/default/files/artikel/Bahasa%20Melayu/Menu/Mengenai%20Kami/Kampus/Pusat%20Angkasa%20Negara/pusat%2520angkasa%2520cover%2520BI.jpg, both accessed: 21 April 2013.

1.4.6. *Program Angkasawan Negara*

Program Angkasawan Negara is an essential programme introduced by the Malaysian National Space Agency (ANGKASA). It is an initiative by the Malaysian Government to send a Malaysian into outer space. The idea of sending a Malaysian into outer space was, in fact, raised by the Malaysian Government in early 2003. Later, the Government declared that it would send an astronaut to the International Space Station by the end of 2007.[555] This was then officially announced by the former Prime Minister of Malaysia, Tun Dr Mahathir Mohamad, as a joint programme with the Russian Federation. It was a project identified as an offset agreement between Malaysia and Russia through the purchase of Sukhoi SU-30MKM fighter jets for the Royal Malaysian Air Force. Through this package, the Russian Government bore the cost of training and sending a Malaysian astronaut to the International Space Station, inclusive of a backup candidate, to conduct scientific research, life sciences, physical science, earth observation, education, and technology.[556] This programme was named after a Malay word *angkasawan* which means astronaut.

Program Angkasawan Negara has its own philosophy, vision, and objective. Its philosophy is education which is the core mission enabling ANGKASA to explore the frontiers of education in science, technology, and engineering, in ways never before envisaged by Malaysians. Since this programme is designed for Malaysian people, it thus aims to involve Malaysian scientists, educationists, parents, the general public, and students. This is done in multiple and inspirational ways particularly during the phases of selecting the astronaut, training, and flight process.[557] The programme's visions and objectives are, among others, to inspire Malaysians to strive for excellence and a unity of purpose. It also aims to instil a sense of identity that will promote national resolve and enrich their lives. The programme is, in fact, designed to stimulate the interest of young Malaysians to explore new areas of science

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[555] Norul Ridzuan Zakaria, *et al.*, "The Symbiotic Relationship between Astronaut Program and Space Tourism Development – A Third World Perspective", 2nd IAASS Conference, Chicago, 14 May 2007, *Space Future,* http://www.spacefuture.com/archive/the_symbiotic_relationship_between_astronaut_program_and_space_tourism_development_a_third_world_perspective.shtml, accessed: 14 May 2014.

[556] See National Space Agency official website at http://www.angkasa.gov.my; see also http://en.wikipedia.org/wiki/Angkasawan, both accessed: 14 May 2014.

[557] See http://www.angkasa.gov.my/index.php?option=com_content&task=view&id=191&Itemid=259, accessed: 9 July 2012.

and technology which are crucial for sustaining a long-term national competitiveness in the globalization era.[558]

In the selection of *angkasawan*, the Malaysian Government gave trust and responsibility to the ANGKASA and the Ministry of Science, Technology and Innovations (MOSTI) to commission the process of selecting the national *angkasawan*. The registration for selection of the national *angkasawan* began in October 2003 when about 10,000 applicants registered online. The general criteria for such application were as follows: the applicants had to be over 21 years of age, degree holders, or professional pilots. To be selected as *angkasawan*, the candidates had to undergo various levels of screening process inclusive of physical fitness screening. Of 435 candidates who were screened at the early stage, only two candidates qualified at the final stage after passing through various levels of screening.[559] Those candidates were Dr. Sheikh Muszaphar Shukor[560] and Dr. Faiz Khaleed.[561] They were

[558] See *id.*

[559] In the screening for physical fitness, 435 candidates took part in the 3.5 km run that had to be completed within 20 minutes. From the above test, 199 participants qualified for the screening II which involved basic medical screening including gross physical abnormalities, pulse, ear, heart, chest, lungs, limbs, nervous system examination, and urine test. From the above, 59 qualified for the screening III in which the participants had to undergo other specific tests such as urine test for drugs, and blood test for full blood count, for serum biochemistry, for HIV/Hep B, physical body measurement, i.e. to fit into cockpit configuration. From this test, 27 candidates qualified for the screening IV which involved stool sample test, full blood picture, abdomen ultrasound, human centrifuge test, bone densitometry balance test etc. From here, 18 participants qualified for the screening V which was called the survival test. The test included psychiatric evaluation, and general health questionnaire, psychological group work, sea and land survival tests, Russian language class and test, technical competency including medical research competency and communication skills. From the above, 10 were short-listed for screening VI (in-depth medical tests). These tests included CT scan brain, mammogram, blood test haemoglobin analysis, and liver function. From these, 8 candidates were short-listed. From the 8, four were selected: Dr. Sheikh Muszaphar Shukor (34 years old, an Orthopaedic Surgeon), Vanarajah Siva (35, a Senior Quality Engineer), Dr. Faiz Khaleed (26, an Armed Forces Dental Surgeon), Mohammed Faiz Kamaludin (34, Malaysia Airlines Pilot). The ANGKASA website*, id.*; See also International Astronautical Federation: Connecting People to Space, http://www.iafastro.com/, accessed: 14 May 2014.

[560] Sheikh Muszaphar is an orthopaedic surgeon and a university lecturer in medicine at the Universiti Kebangsaan Malaysia. Since he blasted off to the International Space Station during the month of Ramadhan, the Muslim fasting month, he was declared the first Muslim to perform fasting in space and the ninth Muslim to cross the 100-km boundary above the earth. As a result, the Malaysian Islamic National Fatwa Council made an initiative drawing up the first comprehensive guidebook for Muslims in space. The 18-page book entitled "Guidelines for Performing Islamic Rites at the International Space Station" details issues such as how to pray in a low-gravity environment, determination of *qiblah* (direction a Muslim takes during prayers) determination of prayer times, and issues surrounding fasting. For his personal details, see ANGKASA website*, id.*; See "Malaysian Guide for Muslim Astronauts", 1 May 2007, IslamOnline.net & Newspapers, http://staging.onislam.net/english/index.php, accessed: 1 October 2012; "Malaysian Guide for Muslim Astronauts", *Turks.US Daily World EU News,* 2 May 2007, http://www.turks.us/article.php?story=20070502064845245; "Malaysia Mulls Prayer Guidelines for Muslim Astronauts", 25 April 2006, TMCnet, http://pgoh13.com/muslim_astronauts.php; http://en.wikipedia.org/wiki/Sheikh_Muszaphar_Shukor, accessed: 14 May 2014.

[561] Dr. Faiz Khaleed is a dental surgeon in the Royal Malaysian Armed Forces. See http://www.angkasa.gov.my/index.php?option=com_content&task=view&id=189&Itemid=257, accessed: 10 July 2012; http://en.wikipedia.org/wiki/Faiz_Khaleed, accessed: 14 May 2014.

selected after completing an initial training course in Russia. Next, they had to undergo an 18-month astronaut training programme at the Cosmonaut Training Programme in Star City, Russia. Finally, on 4 September 2006, the Malaysian Government unveiled its first astronaut: Dr. Sheikh Muszaphar Shukor, as the prime crew member, will blast off in a Russian Soyuz spacecraft, while Dr. Faiz Khaleed will serve as backup.[562]

On 10th October 2007, Dr Sheikh Muszaphar Shukor made his way to the International Space Station on board Soyuz TMA-II. He was, in fact, launched to the International Space Station in the company of the Expedition 16 crew.[563] This event thus resulted in Dr Sheikh Muszaphar Shukor becoming the first Malaysian in space. After nine days on board the International Space Station, Dr Sheikh Muzaphar then returned to Earth on 21 October 2007, aboard Soyuz TMA-10. This time he returned with the Expedition 15 crew members.[564] It was remarked that, as well as becoming the first Malaysian in space, Dr Sheikh Muszaphar was accepted as a fully-fledge cosmonaut[565].

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[562] M. Jegathesan, "Malaysia Unveils Two Final Male Astronaut Candidates", 4 September 2006, *Space Daily Your Portal to Space,* http://www.spacedaily.com/reports/Malaysia_Unveils_Two_Final_Male_Astronaut_Candidates_999.html, accessed: 14 May 2014.

[563] Dr Sheikh Muszaphar, along with the Russian cosmonaut Yury Malenchenko and the American Peggy Whitson, the space station's new commander, blasted off into space from the launch site Baikonur Cosmodrome in Kazakhstan and circled the earth before docking at the International Space Station. Mrs Whitson and Mr Malenchenko will remain on the station for six months, replacing two astronauts with whom Sheikh Muszaphar will return. It was a historic journey which Malaysia celebrated on Thursday (10 October 2007) as he hurtled through space in a landmark for the nation which is marking 50 years of independence. See **"**Malaysia Astronaut Set to Launch", *BBC News,* 10 October 2007, http://news.bbc.co.uk/2/hi/asia-pacific/7036933.stm, accessed: 14 May 2014.

[564] Sheikh Muszaphar returned to Earth with the Expedition 15 crew: Commander Fyodor Yurchikhin and Soyuz Commander and Flight Engineer, Oleg Kotov. See International Astronautical Federation: Connecting People to Space website, *id.*; see also "NASA TV Coverage Set For Space Station Crew Exchange", *NASA News Releases,* 24 September 2007, http://www.nasa.gov/home/hqnews/2007/sep/HQ_M07122_Exp_15_and_16_crew_exchange_prt.htm, accessed*:* 14 May 2014.

[565] The Russian ambassador to Malaysia, Alexander Karchava, and a former American Shuttle astronaut, Captain Robert Hoot Gibson, said that the Malaysian *angkasawan*, Dr Sheikh Muszaphar, is no passenger or tourist but a fully-fledged cosmonaut. Russia does not see him as a mere passenger to the International Space Station but a researcher who carried out the experiments that were discussed between Russia and Malaysia. A cosmonaut or an astronaut is a person trained by a human spaceflight programme to command, pilot, or serve as a crew member of a spacecraft. While generally reserved for professional space travellers, the term is sometimes applied to anyone who travels into space, including scientists, politicians, journalists, and tourists. See Ritikos, Jane, "Russian Envoy Confirms That Malaysian Is Not A 'Mere Passenger", *The Star Online,* 4 October 2007, http://thestar.com.my/news/story.asp?file=/2007/10/4/nation/19072942&sec=nation; "Malaysian a Full-Fledged Cosmonaut, Says Ex-Astronaut", *The Star Online,* 11 October 2007, http://thestar.com.my/news/story.asp?file=/2007/10/11/nation/19142225&sec=nation, all accessed: 14 May 2014; see also NASA, *Astronaut Fact Book (Information Summaries),* (U.S: National Aeronautics and Space Administration, January 2005).

Program Angkasawan Negara is regarded as a pioneering programme for the country to cater for the next generation for the purpose of exploring new technologies in outer space. In fact, this Programme offers various benefits, especially in the field of science and technology, including space medicine, aviation medicine, life science, environmental science, and physics.[566] Indeed, the programme is regarded as significant since it has increased the Malaysian public interest and awareness of the importance of space science and technology, as well as cultivating a sense of pride in all Malaysians.[567] Apart from that, all the space scientific research has demonstrated inspiring outcomes. However, most importantly of all, the Programme has successfully proved that it is not a dream to send a Malaysian into outer space. Thus, there is a strong prospect of it happening again in the future. This assertion is indeed supported by the Malaysian Government's contention that the Government has agreed to proceed with the Second National *Angkasawan* Programme as a continuation of the first programme. This initiative is regarded as vital for the country since it can ensure the continuity and development of national capability in the space sector and other related fields.[568]

1.4.7. Scientific Research

Conducting scientific research in space is another Malaysian space-related activity worth mentioning. Space scientific research is an area that has the potential to develop in the future. Corresponding to the objective of the *Program Angkasawan Negara*,[569] which is to inspire and stimulate the interest of the Malaysian young generation to explore new areas of science and technology,[570] conducting space scientific research can be viewed as an appropriate step towards fulfilling those objectives.

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[566] The discussion on the experiments done by the Malaysian *angkasawan* is available in Chapter 1 of the thesis (1.4.7. Scientific Research).

[567] See http://www.angkasa.gov.my/index.php?option=com_content&task=view&id=469&Itemid=103&lang=english, accessed: 11 July 2012; Azmy Mohamed, "Teruskan Program Angkasawan Negara", *Utusan Online,* 6 February 2012, refer http://www.utusan.com.my/utusan/info.asp?y=2012&dt=0206&pub=Utusan_Malaysia&sec=Pendidikan&pg=pe_01.htm, accessed: 14 May 2014.

[568] See http://www.angkasa.gov.my/index.php?option=com_content&task=view&id=469&Itemid=103, accessed: 11 July 2012; "Program Angkasawan Negara Kedua Diteruskan", *Utusan Online,* 4 January 2012, http://www.utusan.com.my/utusan/info.asp?y=2012&dt=0104&pub=Utusan_Malaysia&sec=Terkini&pg=bt_19.htm, accessed: 14 May 2014.

[569] Discussion on this Programme is available in Chapter 1 of the thesis (1.4.6. *Program Angkasawan Negara*).

[570] See http://www.angkasa.gov.my/index.php?option=com_content&task=view&id=192&Itemid=260, accessed: 10 July 2012.

Thus, the Malaysian Government, through its *Angkasawan* programme, commenced a number of scientific researches in space. Various steps were taken to ensure that a number of experiments would be conducted in outer space through this programme. Those experiments were carried out by a Malaysian *angkasawan,* namely Dr Sheikh Muszaphar. These were conducted during his mission to the International Space Station that took place for 11 days from 10 to 21 October 2007. A number of experiments were performed in the International Space Station including work on liver cancer and leukaemia cells, microbes in space, and crystallisation of protein in space. The experiments conducted on liver cancer and leukaemia cells, as well as microbes, will indeed benefit general science and medical research. However, the research on protein crystallisation and lipases will directly benefit the local industry. [571]

Among the aforementioned research and experiments carried out in space, one in particular is related to cells. This experiment involves a study of the effects of microgravity and space radiation on cancer cells; it concentrates on structural changes and functions at the cellular and molecular level. This experiment also aims to reveal more about the cell behaviour, activity, and tissue repair. Another experiment is related to microbes in space. This experiment is intended to discover the effects of microgravity and space radiation on motility of bacteria, drug resistances, and the genetic mechanisms controlling them. It was done using the microarray approach. Another experiment is on protein crystallisation in space. In this experiment, the aim is to crystallise two proteins and study their molecular structures, compare the crystal growth of lipases on Earth with that grown in microgravity. In this experiment, several test conditions will be tested to improve the protein crystallisation process on Earth as well as in space for the sake of future industrial applications.[572] Another experiment involves the study of spinning motions in a microgravity environment. This experiment is a physics demonstration to show the effect of microgravity on the motions of a spinning object using a top.[573]

It was reported that the above research programme was then continuously performed by a team of researchers from various Malaysian public universities including National University

[571] Sim Leoi Leoi, "Tapping into Space Research", *The Star Online,* 22 September 2007, http://thestar.com.my/news/story.asp?file=/2007/9/22/nation/18514133&sec=nation; see also http://en.wikipedia.org/wiki/Sheikh_Muszaphar_Shukor#Space_experiments, all accessed: 14 May 2014.
[572] "Mission in Space", *The Star Online,* 11 October 2007, http://thestar.com.my/news/story.asp?file=/2007/10/11/nation/19136025&sec=nation, accessed: 10 July 2012.
[573] See http://en.wikipedia.org/wiki/Angkasawan_program, accessed: 14 May 2014.

of Malaysia (UKM),[574] University of Malaya (UM),[575] Universiti Putra Malaysia (UPM),[576] and University of Technology Mara (UiTM),[577] and by research institutes such as the Malaysian Agricultural Research and Development Institute (MARDI).[578] It is testified that the results from those microgravity science research programmes are impressive and some of the findings are reported to have produced a number of patent applications that have been filed in Europe, the United States, and Japan. It was also affirmed that at least one spin-off technology will be further commercialised.[579] It seems that the research conducted in space by the Malaysian *angkasawan* has received international recognition. This is a consequence of the request by the international space agencies such as JAXA and ESA for him to conduct some scientific experiments.[580]

Since the space scientific research can generate a good return for the country, the Malaysian Government stresses that the content of the Second National *Angkasawan* Programme should be well-designed to provide further returns to the country, especially in the area of scientific discovery. Apart from that, the Programme will be designed to generate new knowledge and contribute to the nation's economy.[581] Therefore, to meet such targets, it is suggested that a longer scientific mission at the international space station is required for the next Programme.

1.4.8. Suborbital Space Plane

Apart from the various space-related activities accomplished by the Malaysian public sector, some activities have also been performed by the Malaysian private sector.[582] The first activity to gain attention was the development of a suborbital space plane. The suborbital space plane

[574] For UKM official website, see *supra* note 401.
[575] For UM official website, see *supra* note 391.
[576] For UPM official website, see *supra* note 420.
[577] For UiTM official website, see *supra* note 394.
[578] MARDI is a Malaysian Government research and development institute under the Malaysian Ministry of Agriculture & Agro-Based Industry which focuses on development and research in the areas of food, agriculture and biology-based industry. Its official website is available at http://www.mardi.gov.my/, accessed: 14 May 2014.
[579] See http://www.angkasa.gov.my/index.php?option=com_content&task=view&id=469&Itemid=103&lang=english, accessed: 2 October 2012.
[580] *Id*.
[581] See http://www.angkasa.gov.my/index.php?option=com_content&task=view&id=469&Itemid=103, accessed: 2 October 2012.
[582] It was reported that there was an illustration of the Malaysian suborbital space plane on a published and exhibited poster of 5th IAASS Conference in Versailles, Paris. Norul Ridzuan Zakaria, "Malaysian Spaceplane and Spaceport at 5th IAASS", email to author, 23 October 2011.

project was introduced by a Malaysian private organization called Space Tourism Society Malaysia Chapter (STS-MC),[583] a Chapter of the Space Tourism Society[584] that was established in Malaysia. The project is known as Malaysian Research for Rocket Plane Design & Development or 'M-R2D2'.

The M-R2D2 project was launched in October 2008. It aims to design and develop a prototype of a suborbital space plane. The project was, in fact, designed to meet the NASA requirement of developing a suborbital space plane.[585] This project is treated as an independent project of the STS-MC.[586] Specifically, the M-R2D2 project is being conducted in partnership with the Swiss Propulsion Laboratory (SPL), as the major partner, and also with Project Enterprise.[587] Apart from this, prior to the launch of this project, it was established that the STS-MC had already signed an agreement with the SPL. This earlier agreement is related to the development of the carbon-neutral rocket propulsion system for the suborbital space plane prototype. This agreement was executed in February 2008, which is seven months before the launch of the M-R2D2 project.

For the purpose of cooperation as partners in the M-R2D2 project, the STS-MC signed a memorandum of understanding in May 2009 with SPL, and the Talis Institute, which is owner of the Project Enterprise**.** This took place in Langenthal, Switzerland, seven months after the M-R2D2 project launch date.[588] Then in July 2009, that is two months after signing the memorandum of understanding, the STS-MC succeeded in publishing its own conceptual design of a suborbital space plane. This design is completed by a propulsion system, designed by the SPL, consisting of a hybrid system of jet and rocket propulsion. The space plane is in fact intended to carry two passengers for zero-gravity experience, earth viewing, and to

[583] For more information on STS-MC, read Chapter 1 of the thesis (1.3.2 (b): Malaysian Institute of Aero and Space Studies (IKAM) and Space Tourism Society Malaysian Chapter (STS-MC).
[584] Read also *supra* note 335
[585] Norul Ridzuan Zakaria, "Vehicle Capability by NASA", email to author, 14 June 2009. See also http://suborbitalex.arc.nasa.gov/node/31, accessed: 11 July 2012.
[586] At the time when the facts were received, it was reported that the STS-MC did not receive any kind of assistance from the Government of Malaysia in terms of financial and technical support. Norul Ridzuan Zakaria, "IKAM & Space Tourism Society Malaysia Chapter (STS-MC)", email to author, 10 October 2009.
[587] Norul Ridzuan Zakaria, "An Aviation Approach to Space Transportation", email to author, 24 August 2009. See *id*., "IKAM & Space Tourism Society Malaysia Chapter (STS-MC)", email to author, 6 June 2009.
[588] See http://web.mac.com/spacemansam//STS_Events/2009-04-24_STS_Malaysia_signs_rocketplane_agreement.html, accessed: 26 October 2009.

conduct zero-gravity experiments at 120km above sea level. This was called the 'Prototype 10'.[589]

In the same month, July 2009, the STS-MC launched the M-R2D2 subprogram for a suborbital hidro-space plane project called Suborbital Water-Aero N'Spaceplane (SWANS). This project aims to study, design and develop a prototype suborbital space plane capable of taking off from and landing on water.[590]

Apart from the above, another conceptual design for a suborbital space plane that is worth mentioning is *Langkasa* (Space Eagle). This was the first conceptual design for a suborbital space plane and was produced and published in Malaysia as early as 2003. It is a unique twin-boom design with a passenger's cockpit in each boom.[591] In 2008, the STS-MC published a conceptual suborbital space plane design called MX (M-10). It carries a pilot and two passengers who sit side by side behind the pilot. It is powered by a jet engine and 3 rocket engines. This commemorated the 10th anniversary of the establishment of the STS-MC.[592]

Next, in February 2010, the STS-MC produced another conceptual design for a suborbital space plane called MXI (M-11). It was also designed to carry two passengers, or three if unpiloted, to over 100km above sea level. There are two types of MXI: types R and V. Type R is a rocket plane powered by a set of four liquid rocket engines for horizontal take-off, flight orientation, and vertical ascent into space. Its dimensions are 16.2m in length and 3.6m in height, with a wingspan of 8.6m. It is a low-cost small suborbital space plane. However, type V is a type of vertical take-off and landing (VTOL) craft but with the same dimensions as type R. It does not require a complex liquid rocket propulsion system as it uses its turbo shaft and turbo fan for take-off, flight orientation, and landing. It uses its solid rocket engine only for a short time during vertical ascent into space. This VTOL small suborbital space

[589] It is called 'Prototype 10' to commemorate the 10th anniversary of STS-MC's establishment. See Space Tourism Society Malaysia Chapter, "A Brief History of Malaysian International Space Tourism Initiative (July 1999 – 2011)," *supra* note 324, at 3.
[590] Norul Ridzuan Zakaria, "Chronology of Important Events in 10 Years", email to author, 3 August 2009.
[591] Norul Ridzuan Zakaria, "MXI 1st Brochure (New & Improved)", email to author, 19 July 2010. See also Norul Ridzuan Zakaria, et al., "Human Factors Engineering In Designing the Passengers' Cockpit of the Malaysian Commercial Suborbital SpacePlane", 4th International Association for the Advancement of Space Safety Conference, Huntsville, USA, 19-21 May 2010, http://www.re-entry.com.my/pdf/PAPERHUNTSVILL%202010.pdf, accessed: 14 May 2014.
[592] *Id.*

plane has since become known as Langkasa 2.[593] In October 2011, the Langkasa 2 programme was reported in the New Space Global.[594] It was noted as one of the world's first suborbital tourism space plane conceptual designs capable of vertical take-off and landing.[595] The V type is expected to revolutionize the space tourism industry as it can operate from exotic locations without runways and luxury ocean liners. Both MX and MXI rocket propulsion systems were designed and developed by the SPL. Their conceptual designs maintain the application of jet propulsion besides rocket propulsion. Having jet propulsion as well as rocket propulsion is more useful and safer for landing. Indeed, it is projected that the future suborbital space plane concept will explore the use of a bio-fuel-powered rocket engine and electric propulsion powering a retractable propeller for safe horizontal landing.[596] All those developments, in fact, are certainly significant not only for the space tourism industry but also for effective zero-gravity research, atmospheric research, high-altitude observation, photography, and astronaut training.[597]

1.4.9. Commercial Spaceport

Another project that is gaining attention is the building of a Malaysian spaceport.[598] This is also a private sector project. The idea of developing Spaceport Malaysia is not a recent one as it was first highlighted 13 years ago. The notion of building Spaceport Malaysia was indeed initially reported in one of the Malaysian local newspapers, the *Sunday Star*, on 4 July 1999.[599] It described the possibility of turning the Kuala Lumpur International Airport (KLIA) into a Malaysian spaceport. A month later, on 24 August 1999, this idea was then transformed into a caricature which again stressed the prospect of KLIA becoming the first spaceport in Asia by 2020.[600] Then, five years later, in November 2004, there was another

[593]Norul Ridzuan Zakaria, "Langkasa 2 Malaysian 53rd Independence Day Edition", email to author, 30 August 2010.
[594] See http://www.newspaceglobal.com/Pages/aboutus.aspx, accessed: 1 November 2011. Norul Ridzuan Zakaria, "Spaceport S.E.A & Langkasa 2 Reported by New Space Global", email to author, 1 November 2011.
[595] See http://www.newspaceglobal.com/Pages/aboutus.aspx, accessed: 1 November 2011.
[596] Norul Ridzuan Zakaria, "New Idea for Suborbital Spaceplane Propulsion", email to author, 5 November 2011.
[597] Norul Ridzuan Zakaria, "MXI 1st Brochure (New & Improved)", email to author, 19 July 2010. See also Norul Ridzuan Zakaria, et al., "Human Factors Engineering in Designing the Passengers' Cockpit of the Malaysian Commercial Suborbital SpacePlane", *supra* note 591.
[598] See official website of Malaysia spaceport project at http://spaceportmalaysia.com/v2/, accessed: 14 May 2014.
[599]"KLIA can be turned into Space Port", *Sunday Star*, 4 July 1999.
[600] "Senyum Kambing" Column, *Utusan Malaysia,* 24 August 1999.

proposal for the development of a spaceport at Sultan Azlan Shah Airport in Ipoh.[601] Unfortunately, there was not much support for this as most people regarded the idea of developing Malaysian airports into spaceports as impractical.[602]

In July 2011, a programme to develop a commercial spaceport for tourism in South East Asia (SEA) was proposed by the STS-MC. Hence, the proposed project was called 'SpaceportSEA'. This programme was then transformed into an international programme owned by the Space Tourism Society, in which the STS-MC is the programme manager.[603] Indeed, the idea of developing spaceport Malaysia was gaining in currency when, during the fifth IAASS Conference held in Paris on 17-19 October 2011, the IAASS published and exhibited a poster for the 'Suborbital Safety Technical Committee'. This poster featured an illustration of Spaceport Malaysia.[604] Thus, the poster had indirectly promoted and recognised Malaysia as one of the world's major players in spaceport development, especially since Spaceport Malaysia was illustrated together with Spaceport America.[605]

On 3 December 2011, the STS-MC signed a Memorandum of Understanding (MOU) with Perbadanan Kemajuan Negeri Selangor (PKNS) or Selangor State Development Corporation.[606] This MOU is concerned with the planning, designing, development, and operation of Spaceport Malaysia.[607] The first location suggested for the development of the spaceport was Bernam Jaya, a new Malaysian township built by the PKNS in Northern Selangor.[608] Several meetings later, the final location suggested for Spaceport Malaysia was

[601] Malaysia has 58 airports. Sultan Azlan Shah Airport is a public national airport located in Ipoh. Ipoh is the capital city of Perak, one of the states of Malaysia. See http://en.wikipedia.org/wiki/List_of_airports_in_Malaysia, accessed: 14 May 2014.
[602] Norul Ridzuan Zakaria, "Caribbean Spaceport", email to author, 12 July 2010.
[603] See Space Tourism Society Malaysia Chapter, "A Brief History of Malaysian International Space Tourism Initiative (July 1999 – 2011)," *supra* note 324, at 4.
[604] Apart from the Malaysian spaceport, there was also an illustration of a Malaysian suborbital space plane. This illustration was also provided in the Space Safety magazines (Issue 1, Fall Edition, 2011) on page 17, which were distributed to the Board Members of IAASS. See IAASS poster on 'Suborbital Safety Technical Committee' at 5th IAASS Conference in Paris on 17-19 October 2011. See also Norul Ridzuan Zakaria, "Malaysian Spaceplane & Spaceport at 5th IAASS", email to author, 23 October 2011. See also, http://www.spacesafetymagazine.com/wp-content/uploads/2011/10/Space_Safety_Magazine_-_Issue_1_-_Fall_2011.pdf, accessed: 14 May 2014.
[605] See *id*.
[606] PKNS is a state development corporation in Selangor, Malaysia.
[607] There was a suggestion that the name 'SpaceportSEA' be changed to 'MARS' or Malaysian Asian Regional Spaceport after the PKNS General Manager proposed that the spaceport should be indicative of Asia, rather than just South East Asia. See Norul Ridzuan Zakaria, "Signing of MOU with PKNS & ASEA", email to author, 3 December 2011.
[608] Langkawi Island in the state of Kedah was one of the locations mentioned earlier as suitable for development as a Spacepark Langkawi. See N Laupa Junus, "Melancong ke Angkasa Melalui Malaysia", *Utusan Online,* 31

Bandar Jasin Bestari[609] in the state of Malacca.[610] There are several unique reasons for selecting the state of Malacca as the location for the development of Spaceport Malaysia. Primarily, the state of Malacca is the most famous historic tourist destination in Malaysia and has always been called 'the historic state of Malacca'. The town of Malacca was listed as a UNESCO World Heritage Site on 7 July 2008. Malacca had become an empire that had occupied the whole of Peninsular Malaysia and most of Sumatra, Indonesia, by the end of the fifteenth century. This period was followed by many other historical episodes.[611] Indeed, these historical facts will form part of the philosophy in the project planning and design of Spaceport Malaysia.[612]

The development project of Spaceport Malaysia occupies an area of 150 acres. This project consists of two geographical areas: Malacca Space Centre and Spaceflight Terminal. The Malacca Space Centre comprises, among others, a university, a space plane and astronaut hall of fame, bungalows with a lunar architectural concept, a space resort, a space park, and many more.[613] In this project, a university to be called Space University will be built on 16 acres of land and is scheduled to have a zero-gravity laboratory. The University will provide opportunities and facilities for researchers to conduct zero-gravity research in the form of collaborations between Malaysian local universities and the University of Zurich.[614] Apart from that, among the significant projects is the space plane development project. This project will produce space planes that will take astronauts, space tourists, space researchers and scientific payloads into space. The astronaut hall of fame is a unique centre of space activities that offers a space camp, a space education workshop, a 360-degree Digital Dome Theatre, and a Space Flight Gallery that exhibits flight carriers.[615] The project also offers the

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August 2002, available at http://www.utusan.com.my/utusan/info.asp?y=2002&dt=0831&pub=utusan_malaysia&sec=rencana&pg=re_06.htm&arc=hive, accessed: 14 May 2014.

[609] Bandar Jasin Bestari is a smart modern township that is being developed by the Malacca state government.

[610] It was reported that Selangor will be a backup site as it will not be ready for development for another two years. See Norul Ridzuan Zakaria, "New Space Facility in Muslims Heavyweight Country: Malaysia Spaceport Project", *Onislam,* 24 May 2012, at, http://www.onislam.net/english/health-and-science/science/457187-spaceport-malaysia-project.html; Azriel, Merryl, "Spaceport to be Built in Malacca", *Space Safety Magazine,* 10 May 2012, at http://www.spacesafetymagazine.com/2012/05/10/spaceport-malaysia-built-malacca/, both accessed: 14 May 2014. See also http://en.wikipedia.org/wiki/Malacca, accessed: 14 May 2014.

[611] Other historical facts include the following: the Government of Malacca was founded in 1400 with the establishment of the Malacca Sultanate. Malacca was occupied by various powers starting from 1511when it was occupied by Portugal; in 1641 it was occupied by the Dutch and in 1824 by the British. See Norul Ridzuan Zakaria, *id.*

[612] See Norul Ridzuan Zakaria, *id*.

[613] See Norul Ridzuan Zakaria, *id*.

[614] See http://spaceportmalaysia.com/v2/, accessed: 14 May 2014.

[615] *Id*.

development of bungalows with a lunar architectural concept. This is a unique residential unit that has a moon living-related concept.[616] A space resort is a six-star resort that will accommodate astronauts, space tourists, space scientists, space researchers, space enthusiasts, and general visitors. It will also be the official venue for international high-profile space conferences and meetings. The space park is a theme park designed and equipped with space travel-themed rides including space travel simulators and coasters.[617]

However, the Spaceflight Terminal is located at the Malacca international airport, which is 20km to the north of the Malacca Space Centre. This Terminal will be physically connected to the Malacca Space Centre via a light rail system. The Spaceflight Terminal will be the last stop for astronauts and space tourists before they are carried into outer space by the suborbital space plane.[618]

There are seven partners in this project, namely Talis Enterprise of Germany, University of Zurich, the IAASS, Swiss Propulsion Laboratory (SPL), Bristol Spaceplanes Ltd, Saturn SMS, and Space Future. Talis Enterprise of Germany is a project partner in the development and operation of Spaceport Malaysia. It is developing a space plane called 'Enterprise'. The Enterprise will be an official suborbital space plane of Spaceport Malaysia. It will be operated from Malacca international airport with its administration centre at the Spaceflight Terminal. It will carry six passengers to 130km above sea level, and passengers will experience a few minutes of zero gravity. The flight passengers will be trained, certified and prepared for a few days at the Malacca Space Centre prior to the flight. The cost of the whole package for one passenger is expected to be around euro 150 000.[619] The University of Zurich is a project partner providing advice on zero-gravity activities related to the operation of Spaceport Malaysia. A zero-gravity laboratory at the Malacca Space Centre will enable the Malaysian local universities to conduct research in the related field in collaboration with the University of Zurich. The IAASS is the consulting partner with respect to space safety for the planning, designing, development and operation of Spaceport Malaysia.[620] However, the Swiss Propulsion Laboratory (SPL) is the designer and developer of the rocket propulsion system. It is involved in the design and development of the Enterprise rocket plane and the

[616] For more details, refer to *id*.
[617] *Id*.
[618] See Norul Ridzuan Zakaria, *supra* note 610.
[619] See Norul Ridzuan Zakaria, *supra* note 610. See also http://spaceportmalaysia.com/v2/, accessed: 14 May 2014.
[620] Refer to http://spaceportmalaysia.com/v2/, accessed: 14 May 2014.

operation of Spaceport Malaysia and the Malaysian local suborbital space plane programme.[621] Bristol Spaceplanes Ltd.'s Ascender Project was in fact the original reference in the creation of the Malaysian local suborbital space plane programme. This indeed led to the authorities' understanding of the significance of the space industry and resulted in the emergence of the Spaceport Malaysia project. Meanwhile, the Saturn SMS is a renowned consulting agency in aerospace safety. It provides safety consultancy services not only for the planning and design of Spaceport Malaysia but also for its development and operation. As for Space Future, the concept of Spaceport Malaysia was pioneered by Prof. Patrick Collins and Space Future in 2002, and both remain stakeholders in the project.[622]

Apart from the above, the STS-MC is also conducting research and promoting the idea of a seaborne spaceport.[623] This idea involves a mobile spaceport where the space plane can take off or land from a suborbital space plane carrier ship. This is an interesting idea since the spaceport can be moved to different beautiful locations in order to realise the space tourists' dreams of flying into space while viewing the various beautiful panoramas surrounding the port, as well as viewing the earth from outer space.[624] The seaborne spaceport is also more practical for a suborbital space plane's vertical take-off and landing criteria as the planes can operate from those ships without runways.

1.5. CONCLUDING REMARKS

In this chapter, the discussion concentrates on Malaysian space experiences and activities with respect to the past, present and future. It elaborates on three major subject matters: policy and laws, space technological development and research, and space applications and activities.

From the foregoing discussion, a number of conclusions can be drawn. The first concerns outer space policy and laws with regard to Malaysia's outer space activities. In this respect, it is evident that Malaysia, at present, has a number of laws specifically dealing with telecommunications and multimedia activities. However, it still lacks a conclusive space

[621] *Id.*
[622] *Id.*
[623] See Pamphlet "Seaborne Spaceport", by STS-MC. Norul Ridzuan Zakaria, "Seaborne Spaceport by STS-MC", email to author, 7 August 2010.
[624] *Id.*

policy as well as a convincing domestic space law. Although it was reported that such a policy and law are in the development process, progress is very slow for several reasons, especially the shortage of legal experts on the drafting of space law. Moreover it must be noted that, since Malaysia is a federal country governed by the Malaysian Federal Constitution, all existing and future domestic laws and legislation will have to be in accordance with the Malaysian Federal Constitution. It is observed that in pursuance to Article 74 and the Federal List (Item 1(a) and (b) of the Malaysian Federal Constitution, the Federal Parliament has the exclusive power to make laws relating to the state's external affairs including matters in respect of space treaties, agreements, and conventions. Furthermore, there are a number of subject matters listed under the Federal List that seem to correspond with outer space-related activities, which provides strong grounds for believing that the legislative jurisdiction and power in regard to outer space law, policy and activities is mainly a competence of the Federal Government.

Secondly, Malaysia's involvement in space and technological research is quite encouraging in both the governmental and non-governmental sectors as well as in the higher educational institutions. The governmental sector is likely to focus more on space activities such as launching and manufacturing satellites, remote sensing and meteorological activities, and promoting space technology education programmes in schools and higher educational institutions. The non-governmental sector, on the other hand, is likely to focus on telecommunications and broadcasting activities, launching communication satellites, as well as on the space tourism sector. With regard to the higher educational institutions, the study shows that courses in space technology programmes are offered by various Malaysian universities and this will contribute tremendously to the growth of Malaysian outer space activities. However, the situation is different with regard to space legal education, the development of which seems to have fallen well behind. This educational gap should indeed merit special attention from the higher educational institutions in Malaysia.

Thirdly, there are nine major areas of space applications and activities in Malaysia: telecommunications and broadcasting, remote sensing, meteorology, navigation, satellite manufacturing and launching, the *Angkasawan Negara* Programme, scientific research, suborbital space planes, and commercial spaceports. The first three areas, namely telecommunications and broadcasting, remote sensing, and meteorology, can be considered the most active areas of application in Malaysia. However, the navigation area of application

seems to have recently attracted the attention of users. However, such applications are becoming more common every day. For the satellite manufacturing and launching areas, the study finds that this is an emerging opportunity for space technology with which Malaysia is likely to engage, especially after considering the benefits and profits that could be earned for the country. As for the *Program* A*ngkasawan Negara*, the activity is viewed as a promotional tool to inspire the Malaysian community, especially students, to become aware of the significance of space technological developments and research. The study also finds that the scientific research conducted in outer space via this Programme and the results thereof are viewed as a catalyst for other future scientific space research. In regard to the suborbital space plane and spaceport development activities, the study finds that the major involvements are from the non-governmental sector. Thus, it is realised that there is a strong possibility that the non-governmental sector, besides the governmental sector, will also play a significant role and contribute tremendously towards the development and progress of Malaysian space activities.

From the above conclusion, it is submitted that there is a need for Malaysia to have a reliable domestic space policy as well as legislation to regulate and govern the country's space activities. In view of the strong prospects for development of the above-mentioned activities, which will rapidly develop and grow further in the coming years, it is clear that this phenomenon will require a domestic space law to cope with the development, as well as to guide the smooth running of the industry. Thus, in order to finally propose the said law, this study will move on to discuss the Malaysian involvement and cooperation at the international level with respect to the international space laws, agreements, and organizations. This will be presented in the next chapter.