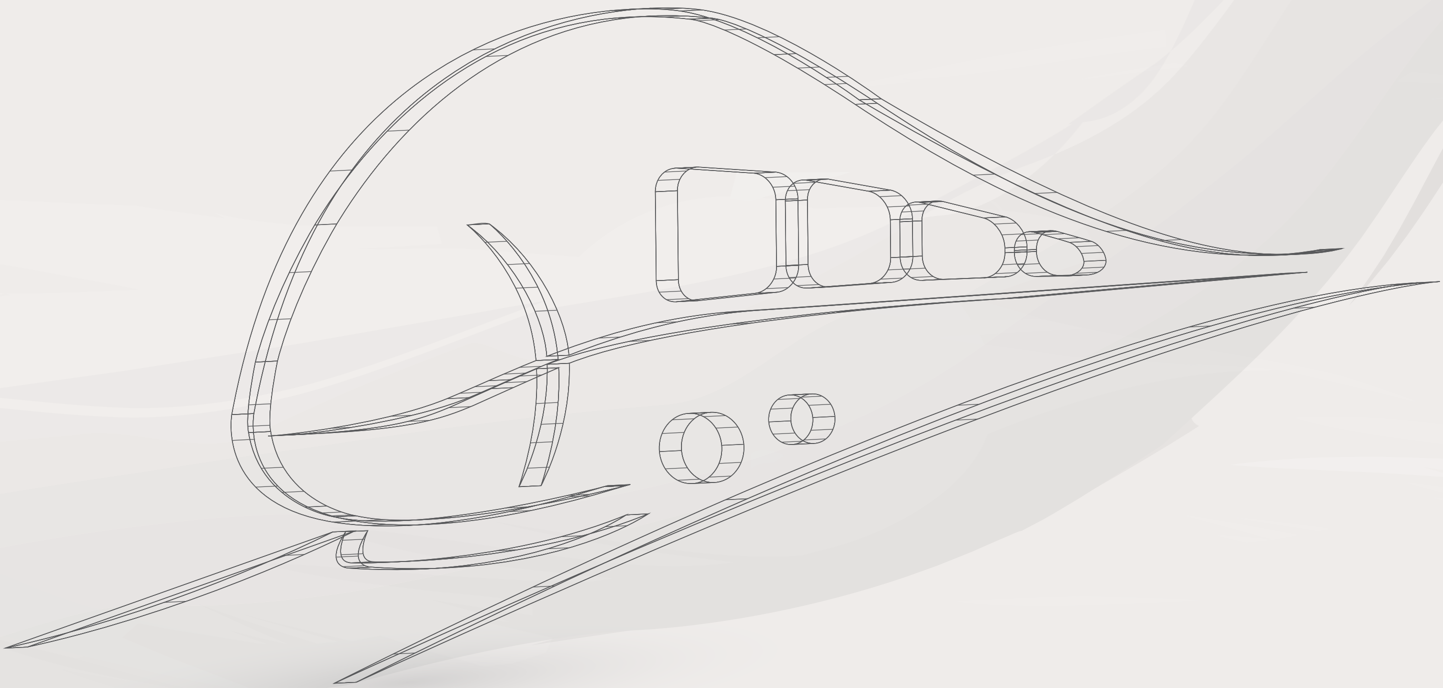
MEGA SCIENCE 2.0
SECTORAL REPORT



TRANSPORTATION

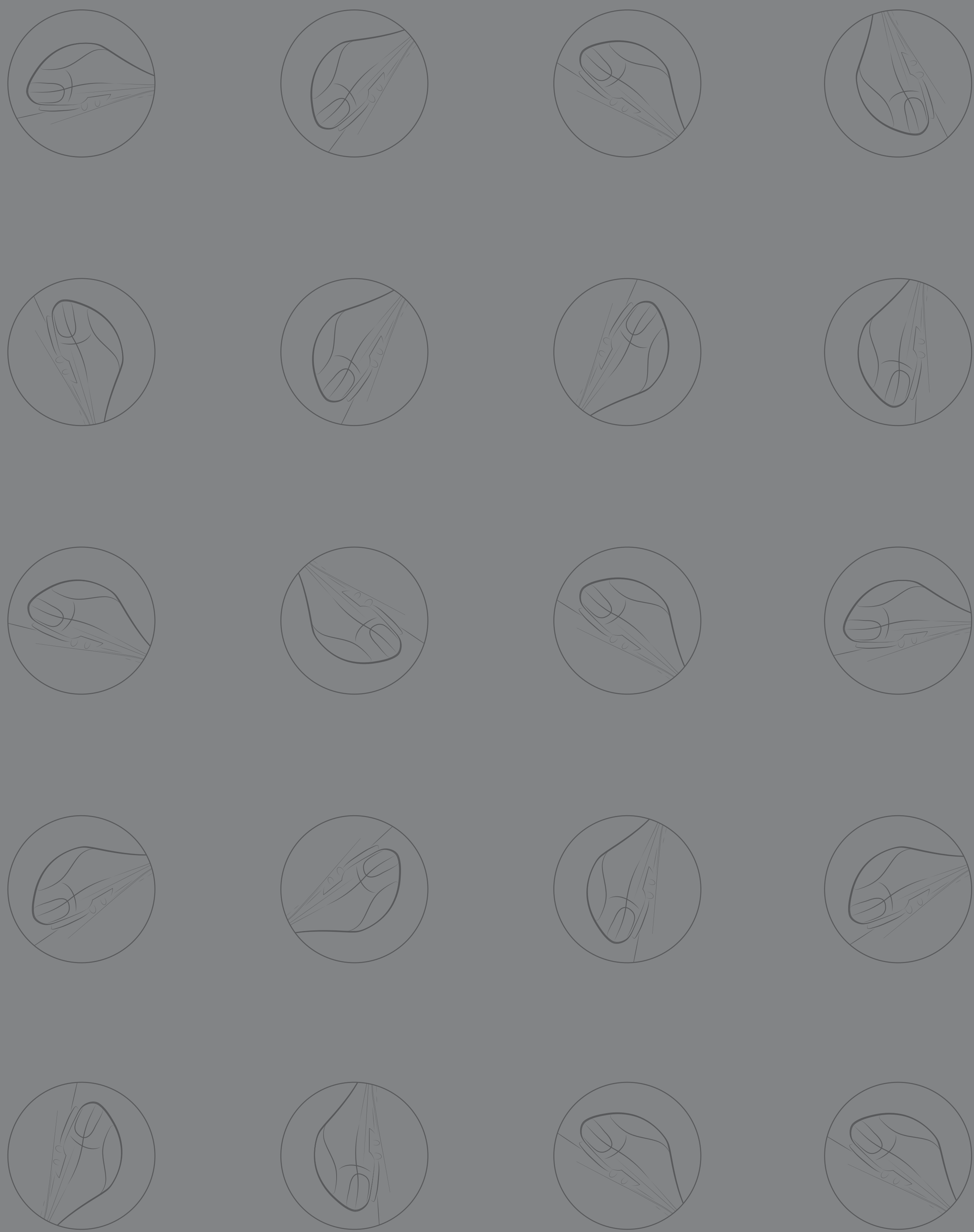

MEC
SCI

MEGA SCIENCE 2.0

Transportation Sector

AKADEMI SAINS MALAYSIA

Contents



FOREWORD

These Sectoral Reports are the output of the Academy's Mega Science Studies for Sustained National Development (2013-2050), a Flagship Programme of the Academy, first introduced by my predecessor, Academician Tan Sri Dr Yusof Basiron FASc. The first series of reports covering Water, Energy, Health, Agriculture and Biodiversity have already been published.

The Academy had adopted the concept of a Mega Science Framework as a comprehensive vehicle to drive the use of Science, Technology and Innovation (STI) to contribute towards economic growth. Mega essentially means big, therefore the disciplines of Mega Science implies a pervasive (broad-based), intensive (in-depth), and extensive (long period of engagement) use of science knowledge to produce technologies, products and services for all sectors of the economy to derive economic growth and development. It also calls for extensive investment in research and development activities to enhance the knowledge base for the targeted sectors. Since knowledge in marketing and finance is equally important in promoting the success of a commercial venture as compared to technical needs, it is envisaged that the Mega Science approach will require research to be conducted both in non-technical as well as in traditional scientific sectors.

We are confident that the ideas and findings contained in this second series of Reports covering the Sectors of Housing, Infrastructure, Transportation, Electrical and Electronics, and Environment, where the science, engineering and technological areas have been identified in the short-term (2013 – 2020), medium-term (2021 – 2035) and long-term (2036 – 2050) periods, will be of use by the central agencies' policy makers and planners as well as by the other relevant Ministries.

I would like to record our appreciation to the Government of Malaysia for supporting this Study financially as part of the 10th Malaysia Plan. Continued financial support from the Government is essential for the Academy to continue with its Flagship Programmes in the other Sectors which have already been identified. I would also like to congratulate the Sectoral Team Leaders and all Fellows of the Academy who were involved in producing these Sectoral Reports for a job well done.

TAN SRI DATUK DR AHMAD TAJUDDIN ALI FASc
President
Academy of Sciences Malaysia

PREFACE

In this second series of the Mega Science Framework Studies for Sustained National Development (2013-2050), undertaken by the Academy of Sciences Malaysia, STI opportunities have been identified and roadmaps provided for the short to long term applications of Science, Engineering and Technology (SET) in the critical and overarching sectors such as housing, infrastructure, transportation, electrical and electronics, and the environment sectors. These sectors were selected on the basis of their inter-connectedness with the electrical and electronics sector providing the platform towards the "Internet of Things" and linking the four other sectors seamlessly.

One of the most frequently asked questions by decision-makers and scientists themselves is "How can STI contribute more effectively to economic development and wellness in a sustained manner without compromising the environment's sustainability". There are good reasons to refer to STI because they have a track record to meet critical challenges posed primarily by the growth of human population and their wants. In this respect, and especially in the 5 new sectors, STI will rise again to meet the new challenges in response to the national and global demand to factor towards enhancing quality of life in all products, processes, services and development projects.

The biggest challenge to all scientists is how to use the fixed earth resources (especially water, land, forests and minerals) to produce food, water and goods for human needs without depriving habitats for the millions of other species and destroying the ecosystems. Proven existing technologies must continuously be improved to be eco-friendly whilst the emerging one such as renewable energy, genomics, stem cells, nanotechnology, biotechnology and the noveau-ICT must conform to the new order of sustainability, ethical and moral obligations whilst contributing to the economic development of the nation. The environment sector has attempted to address these issues.

There are vast opportunities in various sectors of the national economy which can be leveraged upon in an attempt to resolve challenges and problems faced by the populace through innovative approaches in the application of SET. Through identifying and developing various tools through SET, it will go towards ensuring that our economy is not only sustained but sustained in a sustainable manner.

The Academy recognises the importance of cross disciplines linkages that must be integrated during planning, implementation and monitoring of national programs and projects. Social engineering must be designed to match the rapid technical advances to minimise their negative impacts, including the implementation of Life Cycle Assessments (LCA) of the various products and services in these five sectors.

PROFESSOR DATO' DR SUKIMAN SARMANI FASc
Project Director
Mega Science Framework Study 2.0
Academy of Sciences Malaysia

ACKNOWLEDGEMENT

THE TRANSPORTATION SECTOR STUDY TEAM

The Academy of Sciences Malaysia wishes to thank and acknowledge the following Sectoral Team Members for the provision of their expertise and technical input in the preparation of the Report as well as for ensuring that the Report was completed in a timely manner:

(i) Professor Dr Nasrudin Abd Rahim FASc (Leader)

(ii) Professor Dr Zahari Taha FASc

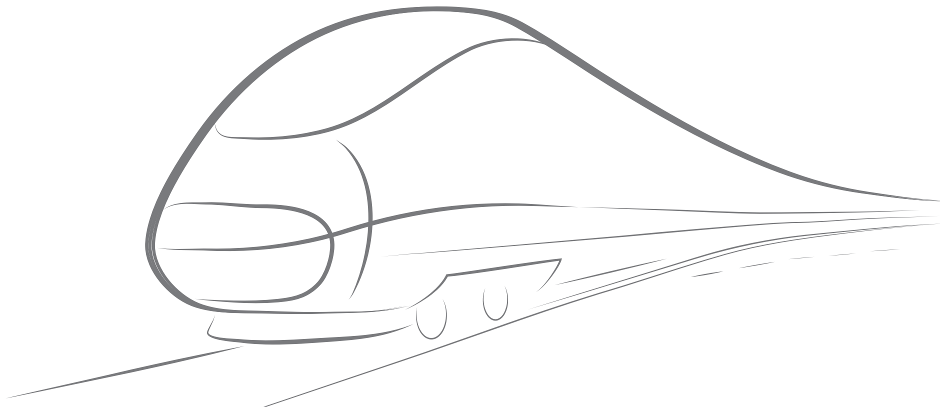
(iii) Professor Ir Mohamed Rehan Karim

(iv) Dr Md. Hasanuzzaman

(v) Dr Siti Rohani Sheikh Raihan

EXECUTIVE SUMMARY

MEGA SCIENCE 2.0 | TRANSPORTATION SECTOR



This work is designed to study on the future of the Transportation Sector of Malaysia and provides a framework for the short-term (2020), medium-term (2035) and long-term (2050). This project is an initiative of Academy of Sciences Malaysia (ASM).

There are five major Transportation areas studied in this work, namely:

- Land Transportation
- Rail Transportation
- Aerospace Transportation
- Maritime and Inland Water Transportation
- Safety and Enforcement Management Services

In conducting this study, the team has applied several methods, which are:

- Literature Review

A Literature review was provided using various sources (academic journals, newspaper cuttings, the internet, and so on).

- Transportation Sector Stakeholders Workshop

Two sessions of stakeholders' workshop were conducted on 22 January 2014 and 10 February 2014, respectively. The goals of these workshop were to obtain feedback from the stakeholders of the Transportation sectors, and in the same time developing a feasible framework for Malaysia's Transportation sector for the short-term, medium-term, and long-term.

Objectives/Aims of the Study

Among the objectives of this study are:

1. to establish Malaysia's current status in the Transportation sector;

2. to analyse the Malaysian Government's current policies, strategies and plans;

3. to set the desired outcomes for Malaysia's Transportation sector for the year 2020, 2035 and 2050;

4. to benchmark our country's Transportation sector against other developed countries and identify suitable technologies that can be applied in our country;

5. to identify current STI gaps and propose ways to bridge the gaps;

6. to identify areas of research, development and commercialisation where Malaysia has a competitive edge and can contribute to overall sustained economic growth of the country;

7. to review international best practices of STI policies and plans for sustained national development in the Transportation sector; and

8. to prepare a draft action plan and road map for 2020, 2035 and 2050 as well as R&D needs for the plan's implementation.

Summary of the Report

The Transportation sector is an important enabler in the nation's economic drive. Without proper Transportation linkages and networks, the country, alongside with all its planned mega projects and vision of becoming a developed nation, will crumble.

Japan, South Korea, Germany, and Singapore are all developed countries with excellent, world-class Transportation facilities. Their network of Transportation is so comprehensive and their interconnectedness between different transportation modes is near flawless. These countries' Transportation industries truly support the nations' development agenda. Thus, we need to further consolidate our nation's Transportation sector in order to cater for the country's vision of becoming a developed nation by the year 2020.

Among the main findings of the report include creating a sole agency in charge of the country's Transportation sector (as currently practiced in Singapore, Germany, France, Britain, and other developed countries);developing a comprehensive Integrated Land Use – Transportation Master Plan so as to include air, marine, riverine, and land transportation implementing an Intelligent Transportation System to fully integrate the ICT in the transportation sector; improving the Public Transport and its coverage; improving the intermodal connectedness between different Transportation modes; doing detailed studies on each airports and seaports – including the ports' projected capacity, their impact to the environment, and future technologies needed; establishing regional and international level maintenance, repair and overhaul (MROs) for aeroplanes and ships; and establishing a Transportation-focussed research institute to cater for Malaysia's future Transportation and human resource needs.

Apart from that, the Government also should really consider establishing rail links between major ports (seaports and airports) to the industrial estates and the city to ensure goods and materials can be efficiently and effectively transported. As the Northern Sea Route starts to be ice-free and utilised - reducing maritime journey between East Asia and Western Europe from 21000km using the Suez Canal to 12800km. The Malaysia's railway system should be part of theTrans-Asian Railway to ensure that we can be a part of the world's economy.

The establishment of high-speed rail connecting Kuala Lumpur to Singapore, development of the MRT, the opening of KLIA2, and the extension of LRT (on Ampang Line, Kelana Jaya Line, and the newly proposed LRT 3 line) are among the latest moves made by the government to improve the nation's Transportation sector. These moves are vital to ensure that these services can cater the need of a bigger number of consumers and giving more options to the public. As these projects are already open or are in its development stages, we can say that these are among the short-term, low hanging fruits that we can capitalise on in the near future.

In contrast, with the current existing policy that facilitates the use of private vehicles (widening of the highways, up to nine years private vehicles loans, etc.), the government would need to shift the priority to cater for energy efficient or electrical public vehicles and intermodal transports (better intermodal shift, wider network of public vehicles, improve public transport services, etc.). It is also hoped that the country will install high-speed train network intra- and inter-country as part of the Trans-Asian Railway. It is our vision that Malaysia's Transportation sector will become a sustainable sector by 2050.

LIST OF TABLES

LIST OF FIGURES

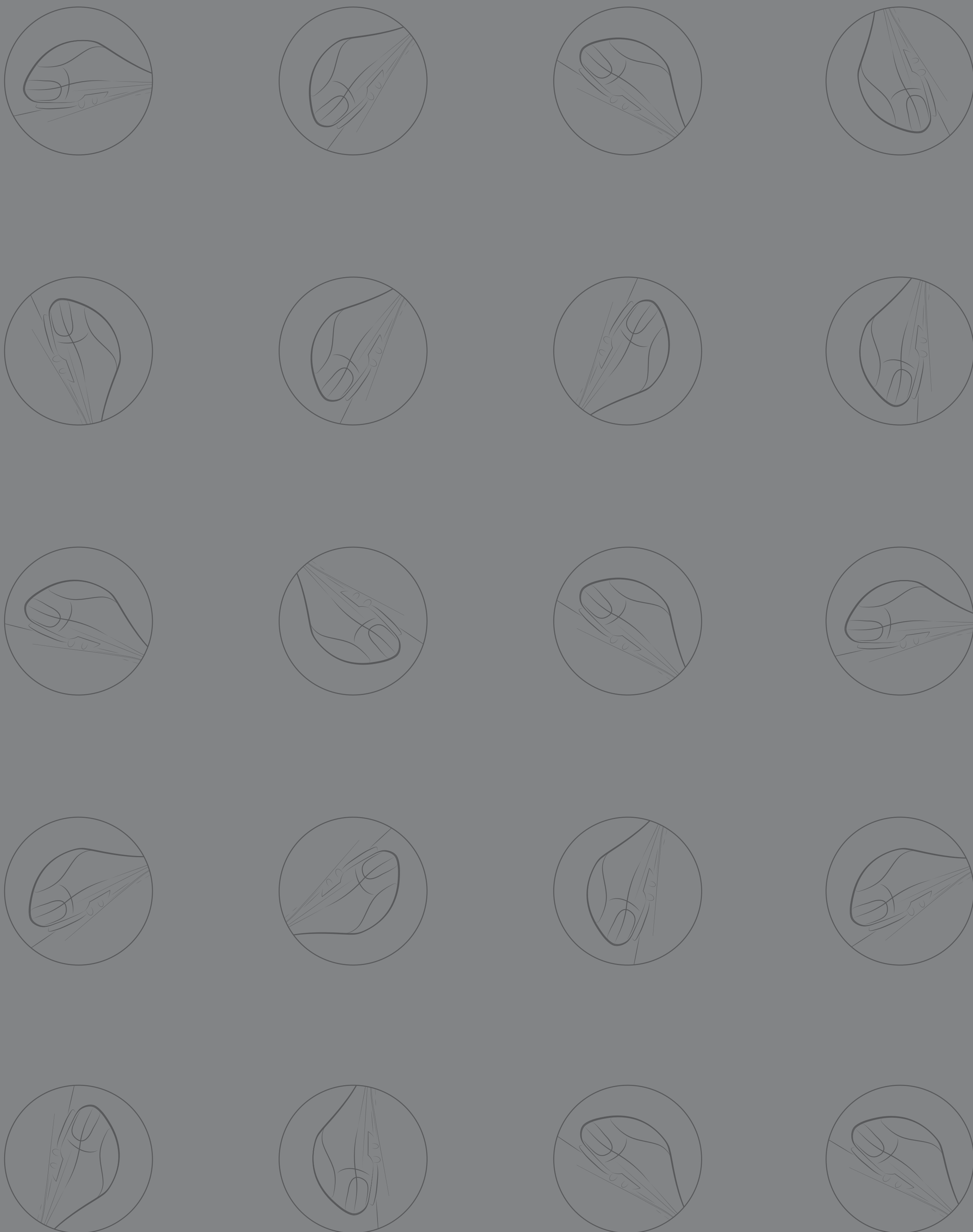
ACRONYMS

10MP — 10th Malaysian Plan
ACAS — Airborne Collision Avoidance System
ADB — Asian Development Bank
ADR — European Agreement concerning the International Carriage of Dangerous Goods by Road
ADS-B — Auto Dependent Surveillance Broadcast
AIS — Automatic Identification System
ALCAM — Australian Level Crossing Assessment Model
ALCRM — All Level Crossings Risk Model
AMO — Approved Maintenance Organisations
ANGKASA — National Space Agency
ANPR — Automatic Number Plate Recognition
APTS — Advance Public Transport System
ASM — Academy of Sciences Malaysia
ATC — Air Traffic Control
ATI — Aerospace Technology Institute
ATIS — Advanced Traveller Information System
ATMS — Advanced Traffic Management System
ATT — Average Turnaround Time
AVCS — Advanced Vehicle Control Systems
AVI — Automatic Vehicle Identification
AVL — Automatic Vehicle Location
BRT — Bus Rapid Transit
BTP — Bus Transformation Plan
BTS — Bangkok Mass Transit System
CAA — Civil Aviation Act

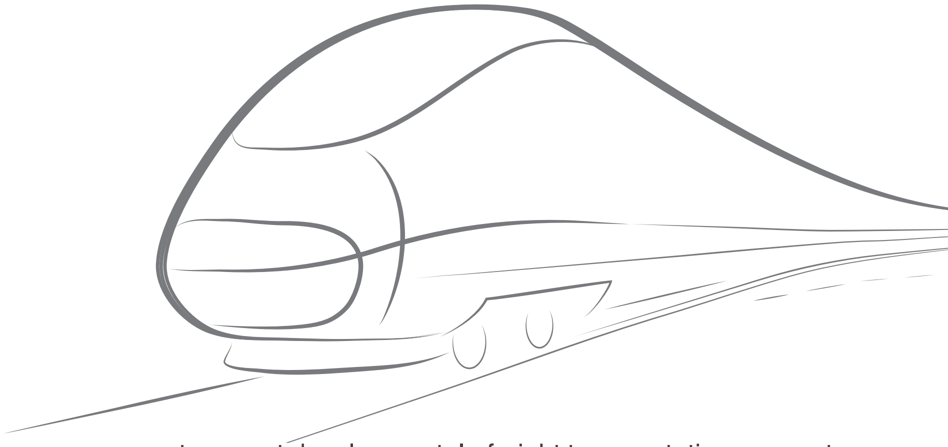
CAMO — Airframe Maintenance & Modification, Component & Engine Maintenance Support, Line Maintenance & AOG Support, Engineering &Specialised Services, Integrated Fleet Technical Management, Engineering Management
CAPSCA — Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation
CAR — Civil Aviation Regulation
CBU — Completely Built Unit
CCTV — Closed-circuit Television
CDM — Clean Development Mechanism
CNG — compressed natural gas
CPR — Cardiopulmonary Resuscitation
CRV — Commercial Rebuilt Vehicles
CSM — Common Safety Methods
CTMEU — Council of Transport Ministers of the European Union
CTR — Centre for Transportation Research
CTRM — Composite Technology Research (M) Sdn. Bhd.
DMU — Diesel Multiple Unit
DOSH — Department of Occupational Safety and Health
DTP — Double Track Project
ECER — East Coast Economic Region
ECMT — European Conference of Ministers of Transport
ECRL — East Coast Rail Link
ECRR — East Coast Rail Route
EDT — Electrified Double Track
EDTP — Electrified Double Track Project
EEV — Energy Efficient Vehicle
EPP — Entry Point Projects
EPS — Electronic Payment System
EPU — Economic Planning Unit
ERL — Express Rail Link
ERTMS — European Rail Traffic Management System
ESC — Electronic stability control
ESI — Environmental Ship Index
ETC — Electronic Toll Collection
ETP — Economic Transformation Plan
FCD — Floating Car Data
FIS-B — Flight Information Service-Broadcast
GDP — Gross Domestic Product
GEF — Global Environmental Facility
GKL/KV — Kuala Lumpur/Klang Valley
GKL/KV LPTMP — GKL/KV Land Public Transport Master Plan
GMDSS — Global Maritime Distress and Safety System
GMT — Gummi Metall Technik
GNI — Gross National Income
GPS — Global Positioning System
GSIE — Global Safety Information Exchange
GTP — Government Transformation Programme
HSR — High Speed Railway
IATA — International Air Transport Association
ICT — Information, Communication and Technology
IIP — Integration and Interchange Plan
IoT — Internet of Things
IoV — Internet of Vehicles
iRAP — International Road Assessment Programme
IRTAD — International Traffic Safety Data and Analysis Group
ISPS Code — International Ship and Port Facility Security Code
ITIS — Transport Information System
ITS — Intelligent Transport System
IWTS — Inland Waterway Transportation Systems
JARI — Japan Automobile Research Institute
JPJ — Jabatan Pengangkutan Jalan
JTIS — Journey Time Indication System
KTM — Keretapi Tanah Melayu
KTMB — Keretapi Tanah Melayu Berhad
KV — Klang Valley
KVMRT — Klang Valley Mass Rapid Transit
LiDAR — Light and Radar
LL — Load Lines
LNG — Liquefied Natural Gas
LP — Local Plan
LPG — Liquefied Petroleum Gas
LPT — Land Public Transport
LPTMP — Land Public Transport Master Plan
LRT — Light Rapid Transit

LUP	—	Land Use Plan
MAE	—	MAS Aerospace Engineering
MAPO	—	Moscow Aircraft Production Organisation
MAS	—	Military Aerospace Sector
MHA	—	Malaysian Highway Authority
MIGHT	—	Malaysian Industry-Government Group for High Technology
MIROS	—	Malaysian Institute of Road Safety Research
MITRANS	—	Malaysia Institute of Transport
MKPIs	—	Ministerial Key Performance Indicators
MLFF	—	Multilane Free Flow
MMEA	—	Malaysian Maritime Enforcement Agency
MOT	—	Ministry of Transport
MOU	—	Memorandum of Understanding
MRO	—	Maintenance, Repair and Overhaul
MyVAP	—	Malaysian Vehicle Assessment Programme
NADI	—	National Aerospace & Defence Industries
NAP	—	National Automative Policy
NCAP	—	New Car Assessment Programme
NCER	—	Northern Corridor Economic Region
NET	—	Nottingham Express Transit
NFI	—	National Foresight Institute
NKEAs	—	National Key Economic Areas
NKPIs	—	National Key Performance Indicators
NKRAs	—	National Key Results Areas
NMT	—	Non-Motorised Transport
NOx	—	Nitrogen Oxide
NPP-2	—	National Physical Plan 2
NSA	—	National Safety Authorities
NSE	—	North-South Expressway
NTS	—	National Travel Survey
NUP	—	National Urbanisation Policy
OCR	—	Optical Character Recognition
OECD	—	Organisation for Economic Cooperation and Development
OEM	—	Original Equipment Manufacturer
ORT	—	Open Road Tolling
PANS	—	Procedures for Air Navigation Services
PDRM	—	The Polis Diraja Malaysia
PEMANDU	—	Performance Management and Delivery Unit
PM	—	Particulate Matter
PRC	—	People's Republic of China
PSC	—	Port State Control inspections
PTC	—	Positive Train Control
PWD	—	Public Work Department
RA	—	Risk Assessment
RAMS	—	Reliability, Availability, Maintainability and Safety
RCOE	—	Rail Centre of Excellence
RFID	—	Radio Frequency Identification
RMP	—	Royal Malaysian Police
ROSREG	—	Road Safety Research Group
RSA	—	Road Safety Audit
RSD	—	Road Safety Department
RSSB	—	Rail Safety and Standards Board
RTD	—	Road Transport Department
RTRI	—	Railway Technical Research Institute
RU	—	Railway Undertakings
SAP	—	Special Area Plan
SAR	—	Search and Rescue
SBR	—	Seatbelt Reminder
SCADA	—	Supervisory Control and Data Acquisition
SCORE	—	Sarawak Corridor of Renewable Energy
SDC	—	Sabah Development Corridor
SEA	—	South East Asia
SMART Tunnel	—	Stormwater Management and Road Tunnel
SMPs	—	Speed Map Panels
SMS	—	Safety Management System
SOLAS	—	Safety of Life at Sea Convention
SOx	—	Sulphur Oxide
SP	—	Structure Plan
SPAD	—	Land Public Transport Commission
SRB	—	Sarawak Rivers Board
SRIs	—	Strategic Reform Initiatives
TBS	—	Terminal Bersepadu Selatan
TDMP	—	Travel Demand Management Plan
TIS	—	Travel Information Service
TIS-B	—	Traffic Information Service-Broadcast
ToD	—	Transit-oriented Development
TOS	—	Transit Operations Software
TRA	—	Transport Research Alliance
TRB	—	Transportation Research Board
TRG	—	Transportation Research Group
TSP	—	Traffic Signal Priority

TTP	—	Taxi Transformation Plan
UAV	—	Unmanned Aerial Vehicles
UM	—	Universiti Malaya
UMPEDAC	—	UM Power Energy Dedicated Advanced Centre
UNECE	—	United Nations Economic Commission for Europe
UNEP	—	United Nations Environment Programme
UPT	—	Urban Public Transport
URDP	—	Urban Rail Development Plan
UTHM	—	University Tun Hussein Onn
VIP	—	Video Image Processing
VSR	—	Vessel Speed Reduction Programme
VTA	—	Vehicle Type Approval
VTS	—	Vessel Traffic Services
WP	—	Wilayah Persekutuan



CHAPTER 1
INTRODUCTION



Transportation can be defined as a network that includes several distinct but interlinked components: infrastructure, urban planning, vehicles and instruments, operational and administrative procedures, ICT applications related to the infrastructure and on-board network services. The optimal operation of all these components determines the capability to move people and goods effectively and efficiently. By optimising the capacity of the network and better exploiting the relative advantages of every mode, problems such as congestion, emissions, accidents, pollutions etc., can be reduced. Such optimisation demands the enhancement and operation of the network as a whole, whereas currently modal networks are isolated and, in some occasion, even lack of integration between local areas within modes. For instance, the integration of aviation with high-speed rail will be crucial for passenger transport development. In freight transportation, a smart and integrated logistics system needs to be realised, where development of ports and intermodal terminals is critical.

The urbanisation trend occurring nowadays will require a ‘model shift’ towards more environment friendly transportation modes, especially in the context of urban transport. However, there exist several difficulties in implementing sustainable transport system for urban cities in developing countries. Exponential population growth, urbanisation, rapid development of cities and high income has led increase in travel demand. The service of the transportation sector has always been subspar. Most transport facilities fail due to lack of proper planning and design. The pedestrians and non-motorised vehicle users are less considered when planning urban transport system that causes a variety of traffic in the roads and further complications.

1.1 HISTORY OF TRANSPORTATION

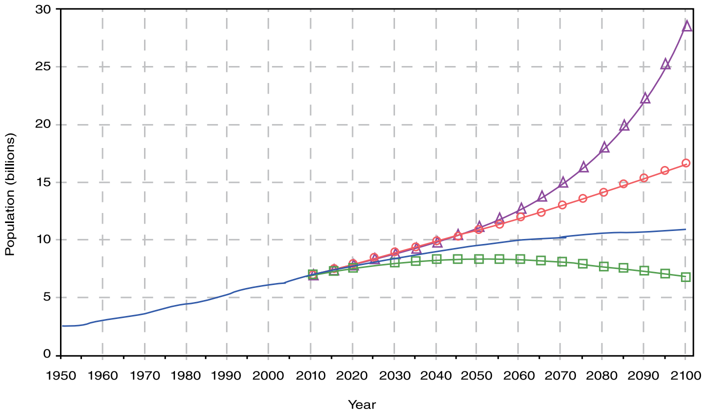


Figure 1.1 Population of the world, 1950-2100, according to different projections and variants

Source: Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat (2013)

According to the 2012 revision of the official United Nations population estimates and projections, the world population is projected to increase from 7.2 billion in 2013 to reach 8.1 billion in 2025, and kept on increasing to a total 9.6 billion in 2050 and 10.9 billion by 2100. The increase will take place almost exclusively in the developing countries and one of the recognised countries is Malaysia. This growth size will certainly exert a great pressure on the cities' transportation industry and since the most significant portion of the population growth is expected to happen before 2050.

Hence, the need for a set of carefully planned developments and expansions of the Malaysian transportation sector inside the size-fixed territory of the country is becoming extremely crucial. Science and technology which has in the past contributed to the quick movements of human beings through the invention of cars, trains, ships and airplanes shall be the key to the needed solutions of the problem. This is further supported by the pressing concern of environmental sustainability which renders the conventional modes of development irrelevant. An intelligent, highly efficient, clean, and sustainable transport industry is sought after in almost every major city in the world.

1.2 TRANSPORT AND SUSTAINABILITY

Transport is the movement of *things* from one place to another. *Things* refer to all beings living and non-living: people; commodities; information; energy and waste; which are moved through a collection of networks, vehicles and hardware working in concert in a *transport system*. Examples of transport are the movement of people through walking on a pedestrian network or by vehicles; transport of liquids through piping networks; transfer of information through optic cables; and transfer of electricity through high voltage cables (Hutton 2013). This study limits its discussion on the movement of people and goods or *passenger* and *freight transport*.

Transport is a complex social, technical and economic system that interacts with urban and regional planning decisions, logistics, energy use, economics, engineering advancements and environmental impacts. The fact that transport remains a particularly difficult territory for the advancement of sustainable development policy is a testament to its complexity. What has been put forth by various sides as a pathway to sustainability up to now usually has only touched on a myriad of ways that transport is integrated into larger systems of human activity (Goldman & Gorham 2006).

The issue of sustainability was first brought to global attention in 1987 by the Report of the World Commission on Environment and Development: Our Common Future famously known as the Brundtland Report. The report sees the issue of sustainable development as follows:

> "Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs"
>
> (Brundtland Report 1987)

Sustainable development is a continuous process rather than a fixed state of harmony. It is a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development, and institutional change are made consistent with future as well as present needs.

Beatley (1995) argues that there is no universally accepted definition of *sustainability* or *sustainable development*. The meanings of these words are not immediately obvious but they serve as an important catalyst for thinking systematically about the future we wish to bring about. With the absence of one singular definition, many have tried to interpret sustainability with their own definition with the aim to develop useful policy guidance:

- European Conference of Ministers of Transport (ECMT)

– "A sustainable transport system is one that is accessible, safe, environmentally-friendly and affordable."

- Transportation Research Board (TRB)

– "… sustainability is not about threat analysis; sustainability is about system analysis. Specifically, it is about how environmental, economic and social systems interact to their mutual advantage or disadvantage at various space-based scales of operations."

- Organisation for Economic Cooperation and Development (OECD)

– "… transportation that does not endanger public health or ecosystems and that meets needs for access consistent with (a) use of renewable resources that are below their rates of regeneration; and (b) use of non-renewable resources below the rates of development of renewable substitutes."

To illustrate, the Council of Transport Ministers of the European Union (CTMEU) had adopted a more expansive definition of sustainable transport. Their definitions of sustainable transport are as follows:

- It allows the basic access and development needs of individuals, companies and societies to be met safely and in a manner consistent with human and ecosystem health, and promises equity within and between successive generations.
- It is affordable, operates fairly and efficiently, offers choice of transport mode, and supports a competitive economy, as well as balanced regional development.
- Limits emission and waste within the planet's ability to absorb them, uses renewable resources at or below their rates of generation, and uses non-renewable resources at or below the rates of development of renewable substitutes while minimising the impact on land and the generation of noise.

The term *green transport* is also commonly used interchangeably with sustainable transport. Green transport is defined by the United Nations Environment Programme (UNEP) as follows:

> "Green transport is one that supports **environmental** sustainability through the protection of the global climate, ecosystems, public health and natural resources. It also supports the other pillars of sustainable development, namely economic through affordable, fair and efficient transport that supports a sustainable competitive economy as well as balanced regional development, and the creation of decent jobs and social through allowing the basic access and development needs of an individual, companies and society to be met safely and in a manner consistent with ecosystem health, and promoting poverty reduction and equity within and between successive generations."
>
> (UNEP 2011)

The definitions above by ECMT, TRB, OECD, CTMEU and UNEP are examples of programmes that envision sustainable transport as an end-State of what a sustainable system might look like. Another approach to developing policy guidance avoids any attempt to define sustainable transport as an outcome. They instead present policies that would push for scenarios along a path that is more sustainable than present trajectories (Goldman & Gorham 2006).

One example of this approach is the Low Carbon Green Growth Roadmap for Asia and the Pacific report published by the United Nations Economic and Social

Commission for Asia and the Pacific (UNESCAP). The report does not in itself define sustainable transport, but rather it provides the direction towards sustainable transport which requires:

- Managing and reducing the reliance on private cars; and

- Making sustainable forms of transport, including public transport, more attractive (UNESCAP 2012).

The reasons for these measures will be discussed later in this report, but they provide a clear and relatively easy understood pathway for policy makers to conceptualise as specific policy initiatives. The downside of the approach is that by dealing with specific policies, the system can sometimes be blinded by the complexity of the transport system itself which could result in unintended consequences or overstate what can be realistically expected from particular policies (Goldman & Gorham 2006).

1.3 CURRENT TRANSPORTATION TRENDS IN MALAYSIA

Transportation is an induced demand of the need to move people and goods from one place to another to fulfil social and economic activities. Transportation forms the backbone for economic growth as it enables trade while technological advancements in transportation play a major factor in globalisation.

Although transportation trend can differ significantly between locations and places, a certain pattern can be seen between the social and economic growth, provision of transport infrastructure to accommodate this growth and the resulting preferred transportation choice of the general population.

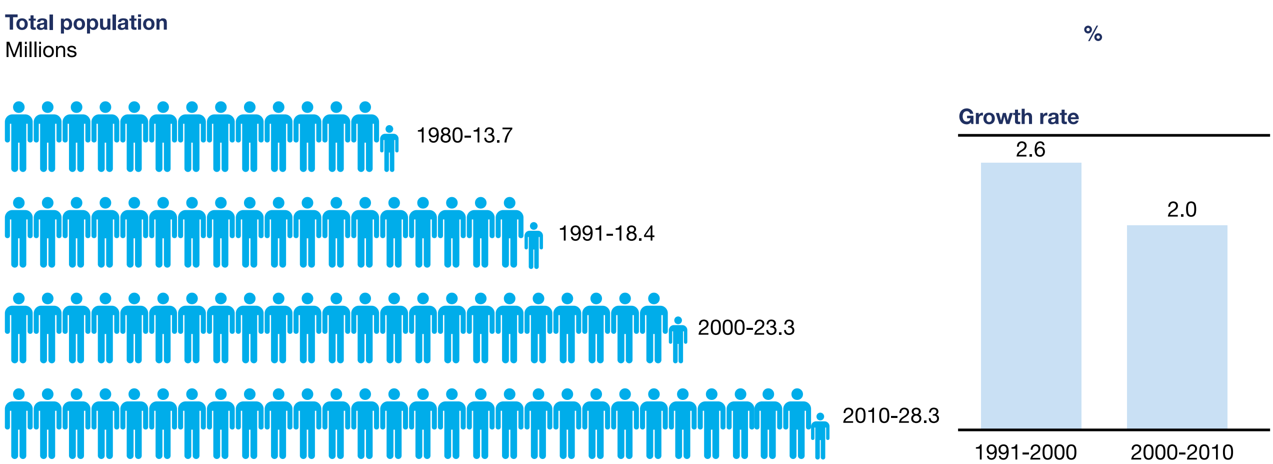


Figure 1.2 Malaysia's total population and annual growth rate until 2010

Source: SPAD 2012

• *Total Population and Annual Population Growth*

The Population and Housing Census conducted in 2010 shows that the total population of Malaysia since 1980 has doubled to reach 28.3 million people. The average annual population growth was consistent between 1980-1991 and 1991-2000 at 2.6%, while the period of 2000-2010 recorded lower annual growth rate at 2.0%. This is in line with other developing countries which also exhibit similar trend of shrinking population growth as demonstrated in **Figure 1.2**.

The Klang Valley area includes the States of Selangor, Wilayah Persekutuan (WP) Kuala Lumpur and WP Putrajaya have seen the largest population growth among all the states since the 1980 to 2010, as shown in **Table 1.1**.

The total population size of Malaysia is projected to increase by 10 million to 38.6 million people in 2040, with a decreasing growth rate of 0.6% in 2040, in tandem with the targeted decline in fertility rate and international migration.

Table 1.1 Malaysia's Population Growth According to States, 1980 – 2010

State	Population								
	1980	1991	GR (%) 80-91	2000	GR (%) 90-00	2010	GR (%) 00-10	2020*	GR (%) 10-20
MALAYSIA	13,136,109	17,563,420	33.7	22,198,276	26.4	27,565,821	24.2	37,227,402	35.0
Johor	1,580,423	2,069,740	31.0	2,584,997	24.9	3,233,434	25.1	4,400,620	36.1
Kedah	1,077,815	1,302,241	20.8	1,571,077	20.6	1,890,098	20.3	2,464,335	30.4
Kelantan	859,270	1,181,315	37.5	1,287,367	9.0	1,459,994	13.4	1,770,772	21.3
Melaka	446,769	506,321	13.3	605,239	19.5	788,706	30.3	1,118,946	41.9
N. Sembilan	551,442	692,897	25.7	829,774	19.8	997,071	20.2	1,298,205	30.2
Pahang	768,801	1,045,003	35.9	1,229,104	17.6	1,443,365	17.4	1,829,034	26.7
Perak	1,743,655	1,877,471	7.7	1,973,368	5.1	2,258,428	14.4	2,771,536	22.7
Perlis	144,782	183,824	27.0	198.288	7.9	227,025	14.5	278,751	22.8
Penang	900,772	1,064,166	18.1	1,231,209	15.7	1,520,143	23.5	2,040,224	34.2
Sabah	929,299	1,734,685	86.7	2,468,246	42.3	3,120,040	26.4	4,293,269	37.6
Sarawak	1,235,553	1,642,771	33.0	2,009893	22.3	2,420,009	20.4	3,158,217	30.5
Selangor	1,426,250	2,291,429	60.7	3,941,316	72.0	5,411,324	37.3	8,057,338	48.9
Terengganu	525,255	766,244	45.9	880,234	14.9	1,014,776	15.4	1,259,751	24.0
WP Kuala Lumpur	919,610	1,145,342	24.5	1,305,792	14.0	1,627,712	24.6	1,685,020	3.6
WP Labuan	26,413	54,241	105.4	70,871	30.7	85,272	20.3	111,193	30.4
WP Putra-jaya	0	5,730	N/A	11,501	100.7	67,964	490.9	169,597	149.5

Note: GR – Growth Rate for the period
* – Projected

Source: Department of Statistics 2010

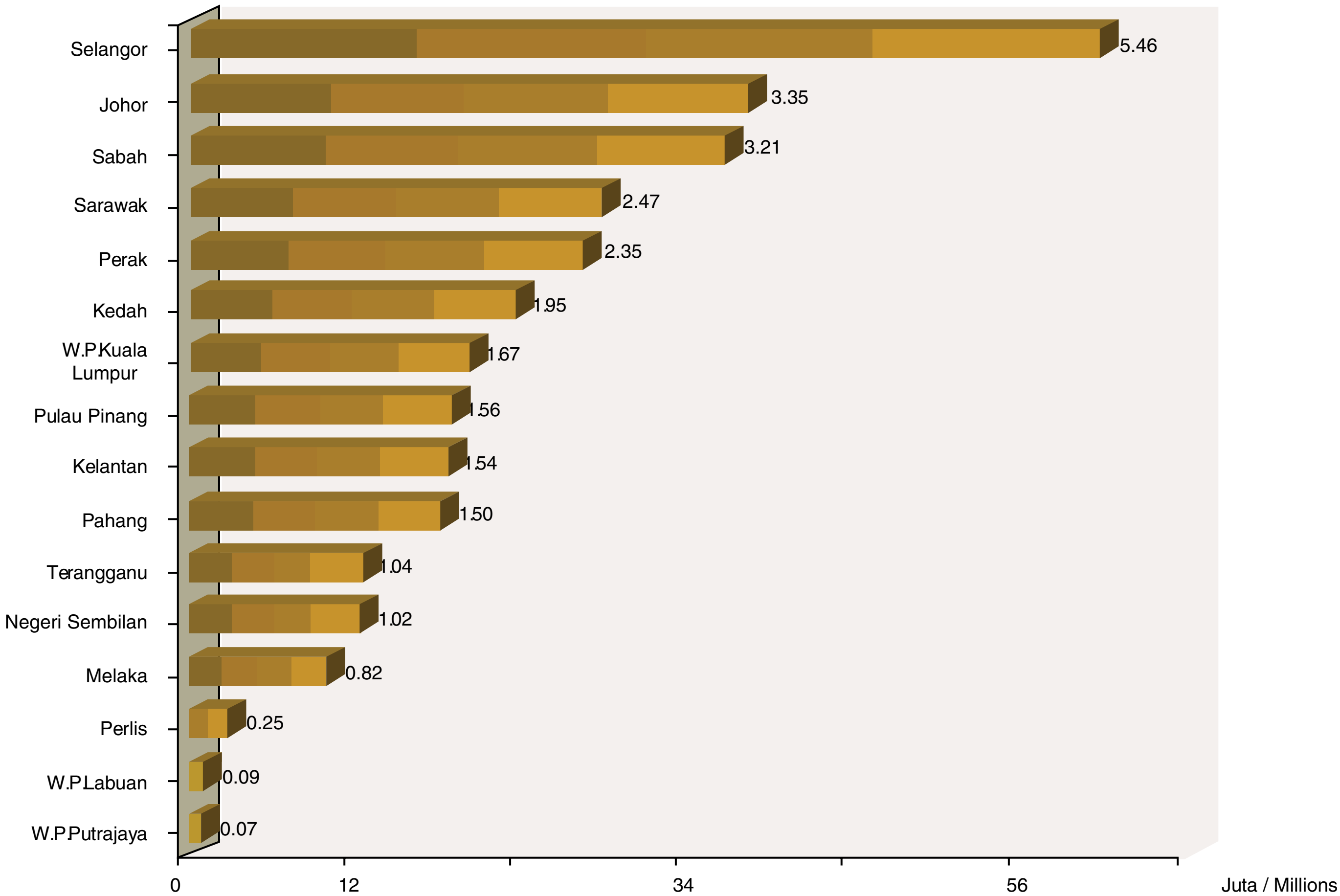


Figure 1.3 Malaysia's population growth from 1980-2010

Source: Department of Statistics 2010

Population Distribution

In terms of population distribution according to State (2010), Selangor was the most populous State with 5.46 million, while Wilayah Persekutuan (WP) Putrajaya and WP Labuan were the two least populated states at 72,413 and 86,908 residents respectively, as shown in **Figure 1.3**.

Population Density

The population density also correlates back to the increase in population, which stood at 86 persons per square kilometre in 2010 compared with 71 persons in 2000. The most densely populated states were WP Kuala Lumpur,

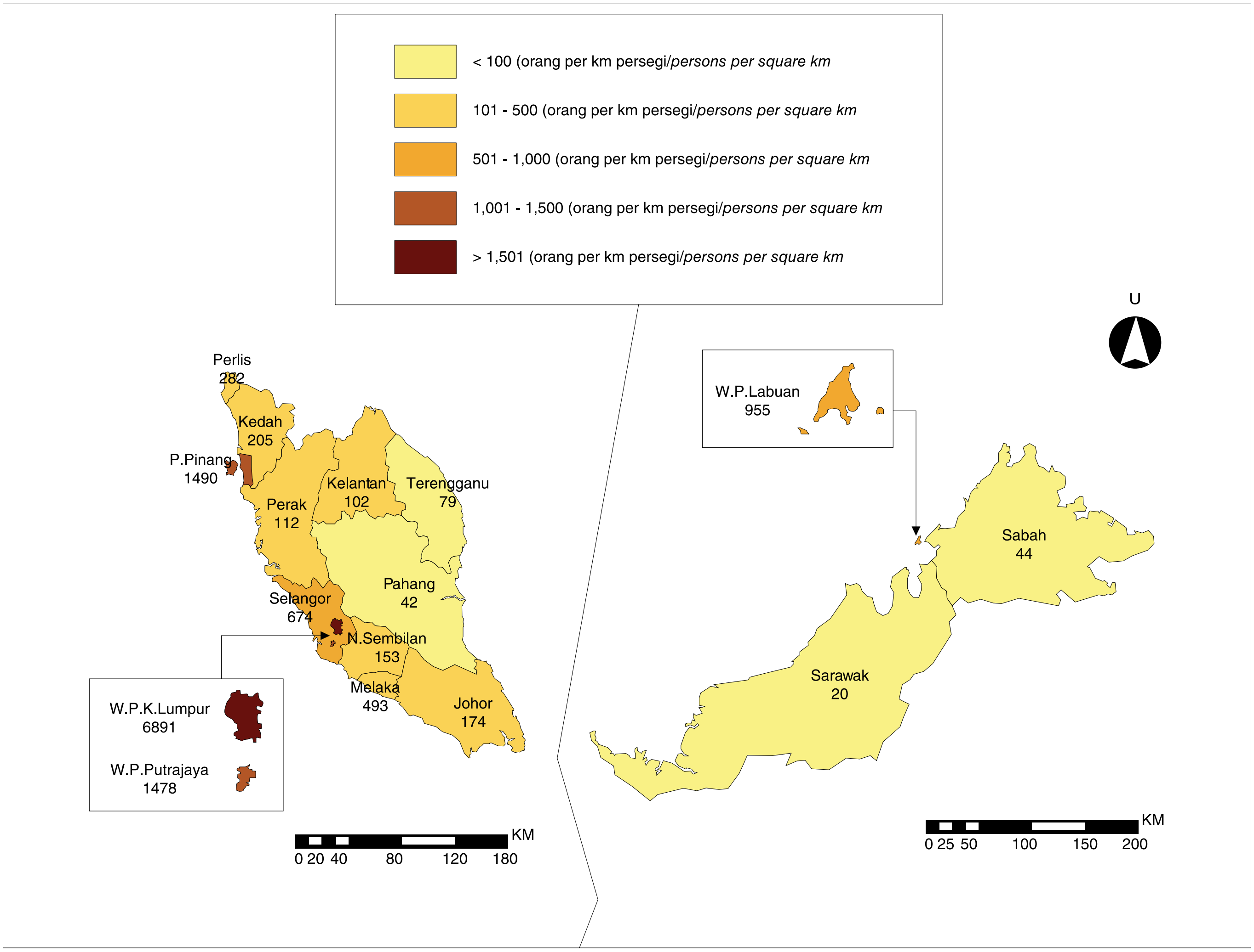


Figure 1.4 Malaysia's population density by State in 2010

Note: Penang and WP Putrajaya recorded 6,891, 1,490 and 1,478 persons, respectively.

Source: Department of Statistics 2010

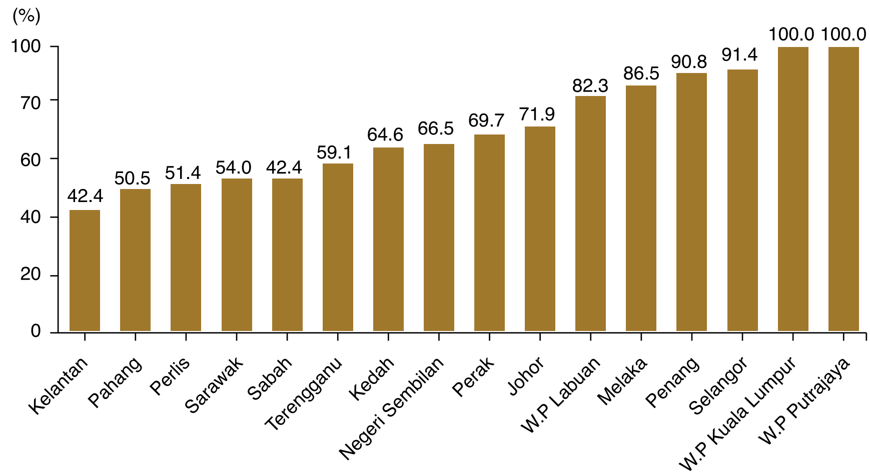


Figure 1.5 Malaysia's level of urbanisation by State in 2010

Source: Department of Statistics 2010

Urbanisation

In line with the rapid development, the proportion of urban population also increased to 71.0% in 2010, as compared to 62.0% in 2000. WP Kuala Lumpur and WP Putrajaya are considered to be at 100% level in urbanisation, followed closely by Selangor at 91.4% and Penang at 90.8% as in **Figure 1.5**.

Economy

Malaysia's impressive rate of development since 1970 has seen the real Gross Domestic Product (GDP) grown by 6.3% per annum until 2010. As shown in **Figure 1.6**, Malaysia's economy grew at a steady rate between 2005 until 2012, with a setback in 2010. Between 2004 and 2013, the GDP has increased from $124.749 billion to $303.53 billion, a growth of more than 50%.

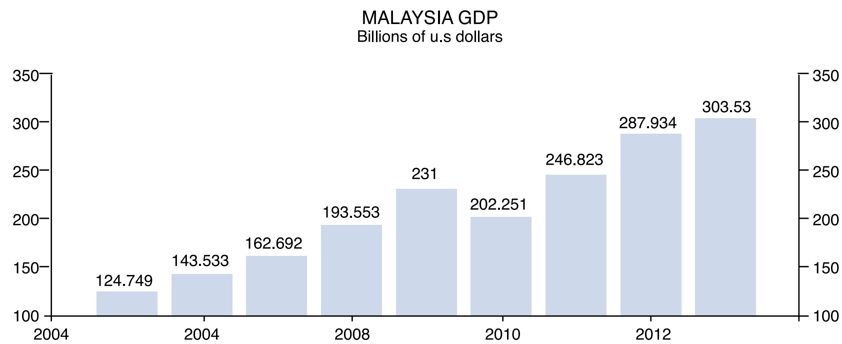


Figure 1.6 Malaysia GDP

Source: www.tradingeconomics.com

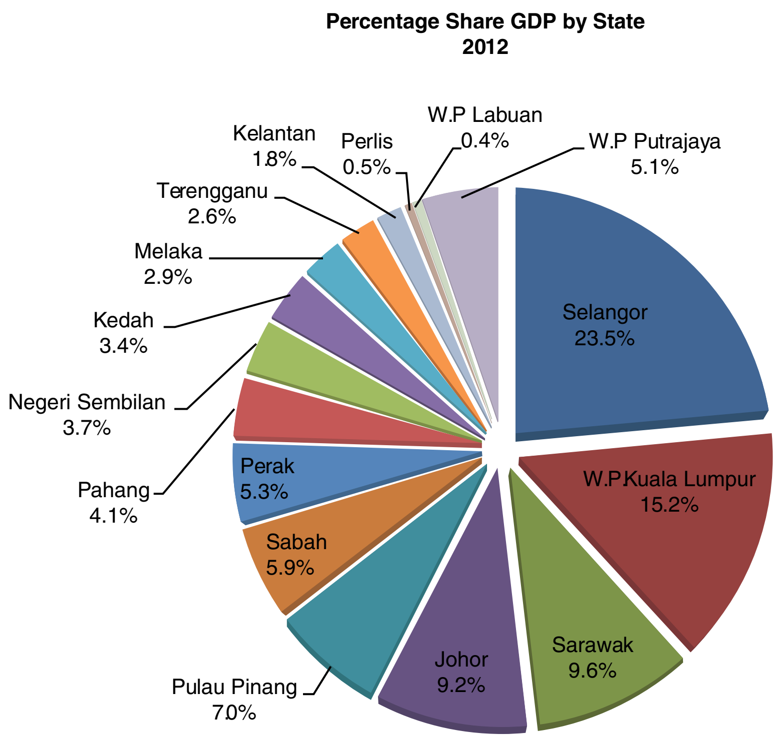


Figure 1.7 Percentage share of GDP by State in Malaysia in 2012

Note: Over the period of 2011-2013, per capita income also grew from RM29,783 to RM33,010, in line with the nation's aspirations to reach the high income status. In 2012, namely five States - Selangor (23.5%), WP Kuala Lumpur (15.2%), Sarawak (9.6%), Johor (9.2%) and Penang (7.0%) were found to be the main contributors to the national economy, with a combined share of 64.5% as shown in Figure 1.7.

Source: Economic Planning Unit, Prime Minister's Department 2012

Total Employed Population

In 2010, the total employed population recorded an increase of 40.9% compared in 2000, which was an increase from 11.4 million from 8.1 million. The Economic Planning Unit (EPU) also reported that employment have grown steadily over the period of 2011 – 2013 from 12.3 million to 12.8 million.

The employment growth rate by state indicates Selangor, Perlis and Pahang experiencing the biggest growth for the period 2002-2012 with well over 50% growth. WP Kuala Lumpur recorded the lowest growth at 3.75%, as in **Figure 1.8**.

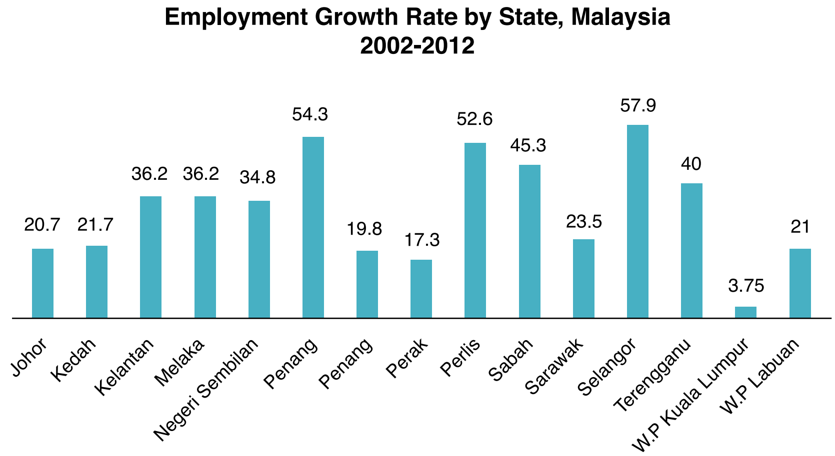


Figure 1.8 Employment growth rate by State in Malaysia from 2002 to 2012

Source: Department of Statistics 2010

Private Vehicle Ownership

The social and economic prosperity translates to an improved quality of life and purchasing power of the population. The availability of relatively affordable cars by national car and motorcycle manufacturers are also major factors contributing towards the high rates of motorisation in Malaysia. Registration of private motorcycles and cars has increased almost three-fold from 4.7 million in 1990 to 18.6 million in 2010 (SPAD, 2012).In 2012 alone, there were 628,239 and 609,596 new registered cars and motorcycles respectively, as demonstrated in **Figure 1.9**.

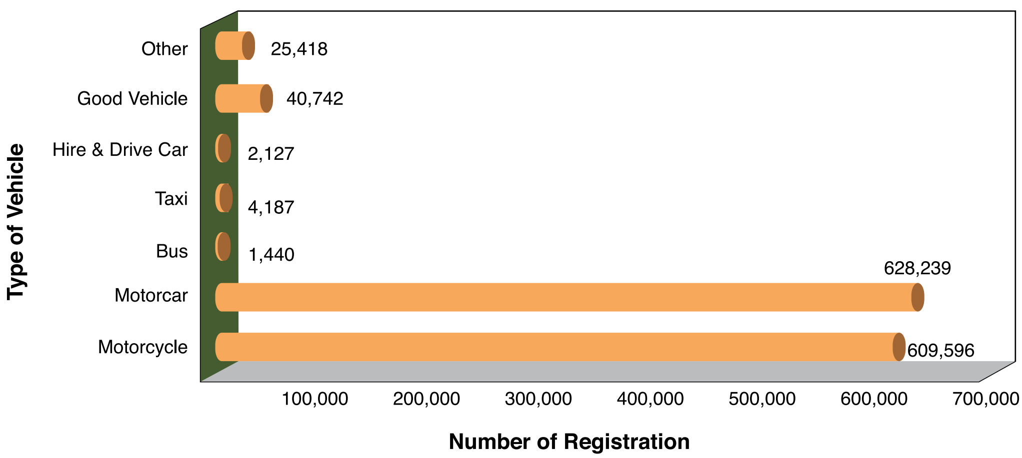


Figure 1.9 New registered motor vehicles by type in Malaysia

Source: Ministry of Transport 2012

Furthermore, until 2012, the total registered motor vehicles in Malaysia were recorded at 22.7 million. Of particular significance are an almost equal number of motorcycles and cars which stands at 10.59 million and 10.35 million respectively as in **Figure 1.10**:

WP Kuala Lumpur had recorded the highest total number of registered vehicles at 5.32 million, followed by Johor at 3.09 million, Selangor at 2.47 million and Penang at 2.33 million. This is shown in **Figure 1.11**:

State	Motorcycle	Motorcar	Bus	Taxi	Hire&Drive Car	Good Vehicle	Other	Total
PERLIS	66,684	21,055	208	199	5	1,865	1,430	**91,446**
KEDAH	773,671	292,997	3,334	3,739	775	36,275	20,156	**1,130,947**
PENANG	1,226,223	1,000,131	6,131	3,931	499	68,381	20,920	**2,326,216**
PERAK	1,190,091	687,213	4,982	4,518	73	66,323	39,055	**1,992,255**
SELANGOR	1,150,029	1,052,353	7,798	11,581	257	161,874	82,223	**2,466,115**
W. PERSEKUTUAN	1,536,607	3,332,767	20,112	39,394	15,586	222,683	153,413	**5,320,562**
N.SEMBILAN	481,513	309,135	2,869	2,162	15	41,876	8,244	**845,805**
MELAKA	402,740	303,162	2,076	1,838	49	25,419	6,703	**741,987**
JOHOR	1,574,475	1,312,016	10,548	12,392	120	131,007	54,398	**3,094,956**
PAHANG	499,887	345,882	2,099	2,670	16	40,365	15,011	**905,931**
TERENGGANU	320,658	183,793	1,178	1,099	16	20,300	7,565	**534,609**
KELANTAN	452,800	267,542	2,055	2,006	13	26,731	8,300	**759,447**
SABAH	276,278	570,267	6,902	5,124	1,282	107,406	59,608	**1,026,867**
SARAWAK	638,162	676,364	3,253	2,387	590	81,499	62,823	**1,465,078**
MALAYSIA	**10,589,818**	**10,354,678**	**73,536**	**93,040**	**19,296**	**1,032,004**	**539,849**	**22,702,221**

Figure 1.10 Total of motor vehicle ownership by type and Statein Malaysia until 2012

Source: MOT 2012

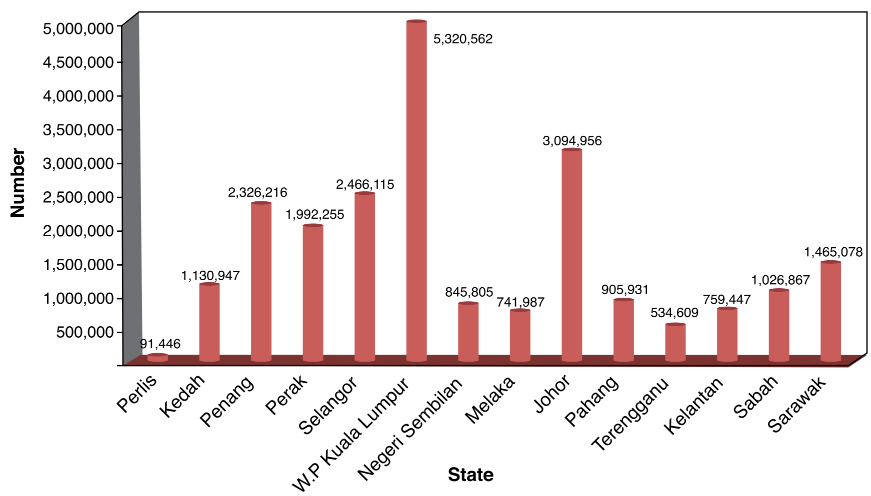


Figure 1.11 Total motor vehicles by State in Malaysia until 2012

Source: MOT 2012

Household Car and Motorcycle Ownership

The 2010 Census also indicates the increasing number of private households owning cars. The number had increased from 49.1% in 2000 to 59.2% in 2010. Almost all States recorded near or more than 60% of the population owning cars, with the exception of Sabah and Sarawak. Households in WP Putrajaya recorded the highest car ownership at 85.2%. Overall, the percentage of household which owns two or more cars over the period of 2000-2010 also increased significantly from 10.1% to 19.3%. The percentage of motorcycle and scooter ownership for the whole of Malaysia was recorded to be 48.8% in 2010, with Perlis, Kedah and Kelantan recording 80.2%, 74.7% and 73.8% respectively. (Department of Statistics 2013).

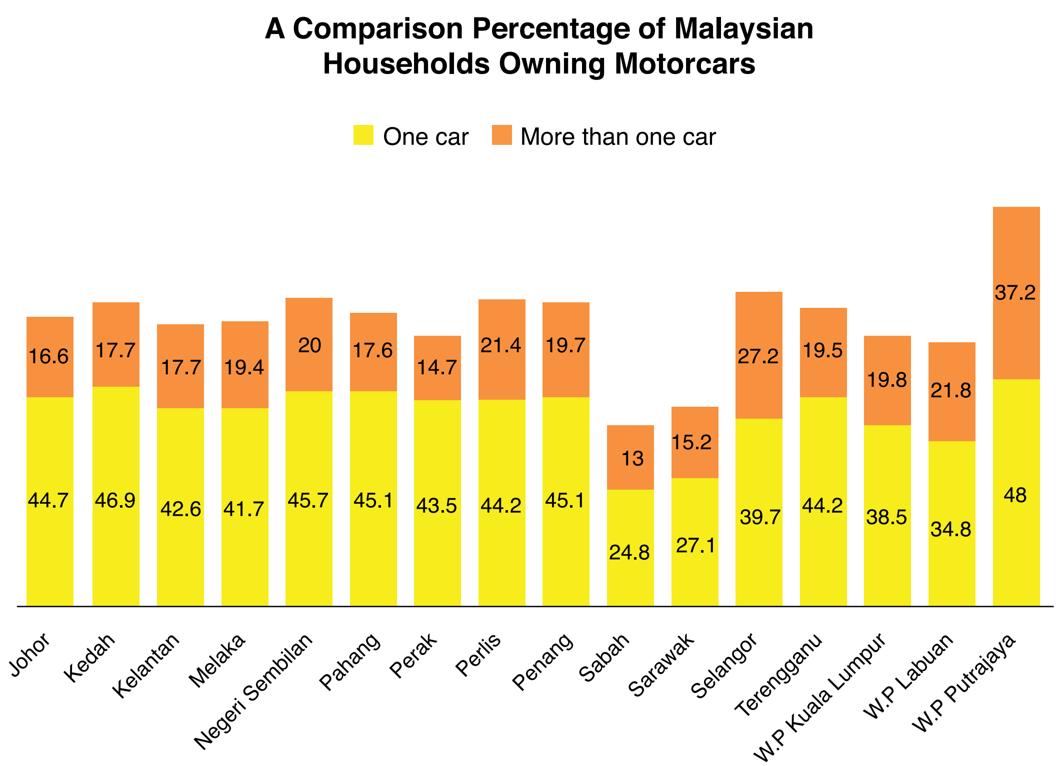


Figure 1.12 Percentage of Malaysian household owning cars in 2010

Note: Percentage of Malaysian Household Owning Motorcars 2010

Source: Department of Statistics 2013

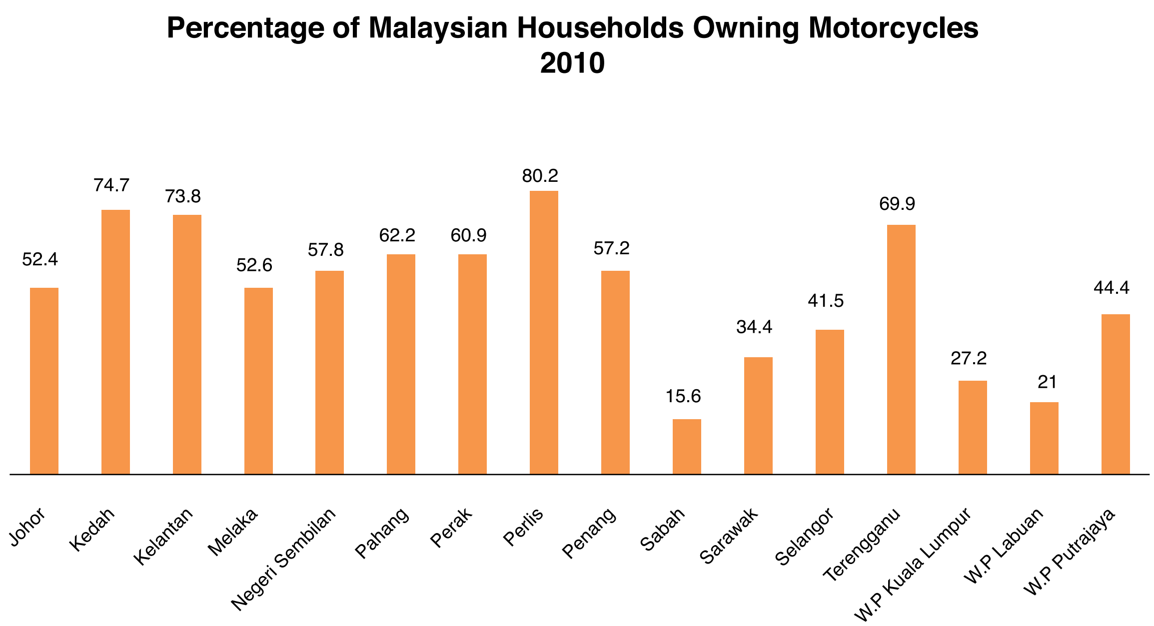


Figure 1.13 Percentage of Malaysian household owning cars in 2010

Note: Percentage of Malaysian Household Owning Motorcars 2010

Source: Department of Statistics 2013

This trend of motorisation is not exclusive to Malaysia but also in most other developing countries. Transport in urban areas is shifting away from Non-Motorised Transport (NMT), which includes walking and cycling) and public transportation to motorised forms of personal transport such as cars and motorcycles. Private vehicle ownership is increasing rapidly as the wide-spread growth of income allows motorised vehicles to become affordable to a larger proportion of the population (UNESCAP 2012).

This trend is also driven by the inability of other transport options, especially the public transport system to cope with travel demand. Private transports are also seen as superior in that they offer direct door-to-door travel, without the hassle of waiting for transport service. Public transport and NMT are often seen as uncomfortable, inconvenient and unsafe (GEF 2010). Malaysia's increase in travel demand – which has more than tripled from 13 million trips per day in 1991 to 40 million in 2010 across all modes of transport have mostly been served by trips in private vehicles.

Whilst public transport ridership is increasing in absolute terms, its overall modal share is decreasing, especially in urban areas where mobility demands are most intense. The most recent authoritative data from 2008 indicates that the land public transport modal share in the Klang Valley has dropped to as low as 10% (SPAD 2012).

The trend indicates that private vehicle ownership is consistently increasing in Malaysia which may have serious environmental and socio-economic costs. These costs will be highlighted in following chapters.

1.4 LOCATION OF TRANSPORTATION NETWORK, ROUTES AND LINKS IN MALAYSIA

The following are the locations of Malaysia's current transportation network, routes and links:

The North-South Expressway (NSE) is the longest highway in the country with a total length of 772 kilometres spanning from Bukit Kayu Hitam in the north, to Johor Bahru in the southern most part of Peninsular Malaysia. The expressway links a number of major cities

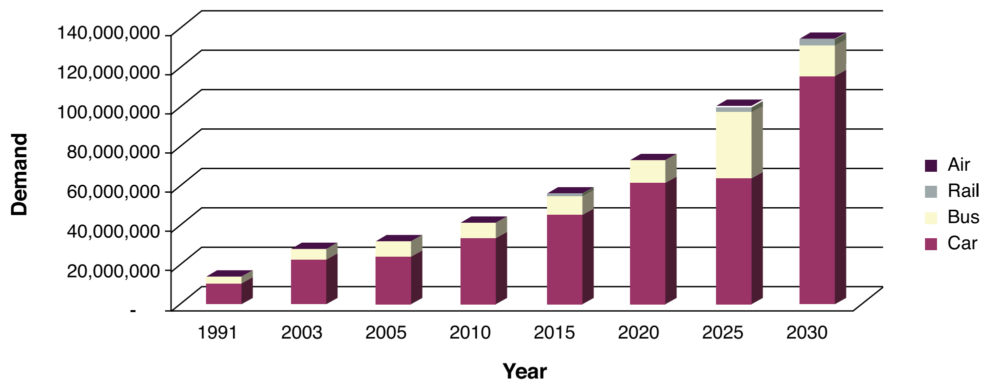


Figure 1.14 Malaysia's growth in travel demand

Source: SPAD 2012

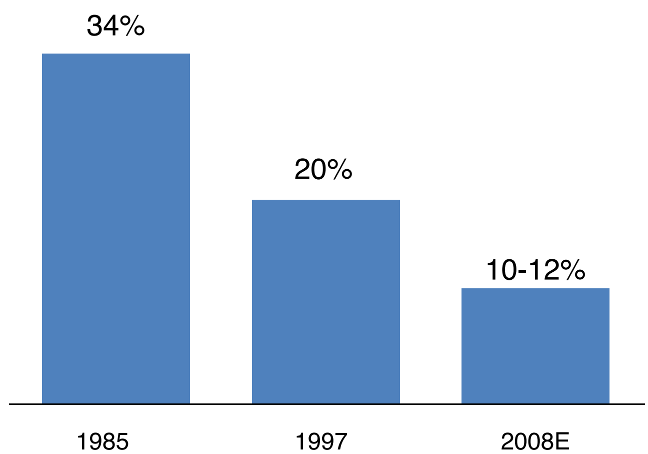


Figure 1.15 Percentage of AM peak public transport modal share

Source: SPAD 2012

Figure 1.16 Main expressways in Peninsular Malaysia operated by PLUS Malaysia Berhad

Source: PLUS

in the western part of Peninsular Malaysia, forming the backbone of land transportation in the west coast of the peninsula. Compared to the old Federal routes, the expressway provides a faster option for reducing travelling time between various towns and cities. It consists of either 4 or 6 carriage ways.

The main roads in Sarawak start from Kuching in the south to Miri in the north. As of now, 77% of the State is served by roads, while the other 23%, which is located in the far interior part of the State, in the Kapit and Baram regions – are inaccessible by road. By 2010, 24,653km of roads was established in the State, from which 67% is paved and the rest is unpaved (gravel/earth).

The main roads in Sabah connect the whole state and are mainly situated near the seas – South China Sea and Sulu Sea. The state's interior districts of Nabawan and Kota Kinabatangan are inaccessible by roads. According to the Malaysian Department of Statistics, the road networks in Sabah as of 2010 are 21,315km, a huge increase from only 17,246km in 2006. From the figures, about 44% of the main roads in Sabah are tarred while the other 56% are still gravel or earth roads.

Figure 1.17 Main roads in Sarawak

Source: JKR Sarawak

Figure 1.18 Main roads in Sabah

Source: JKR Sarawak

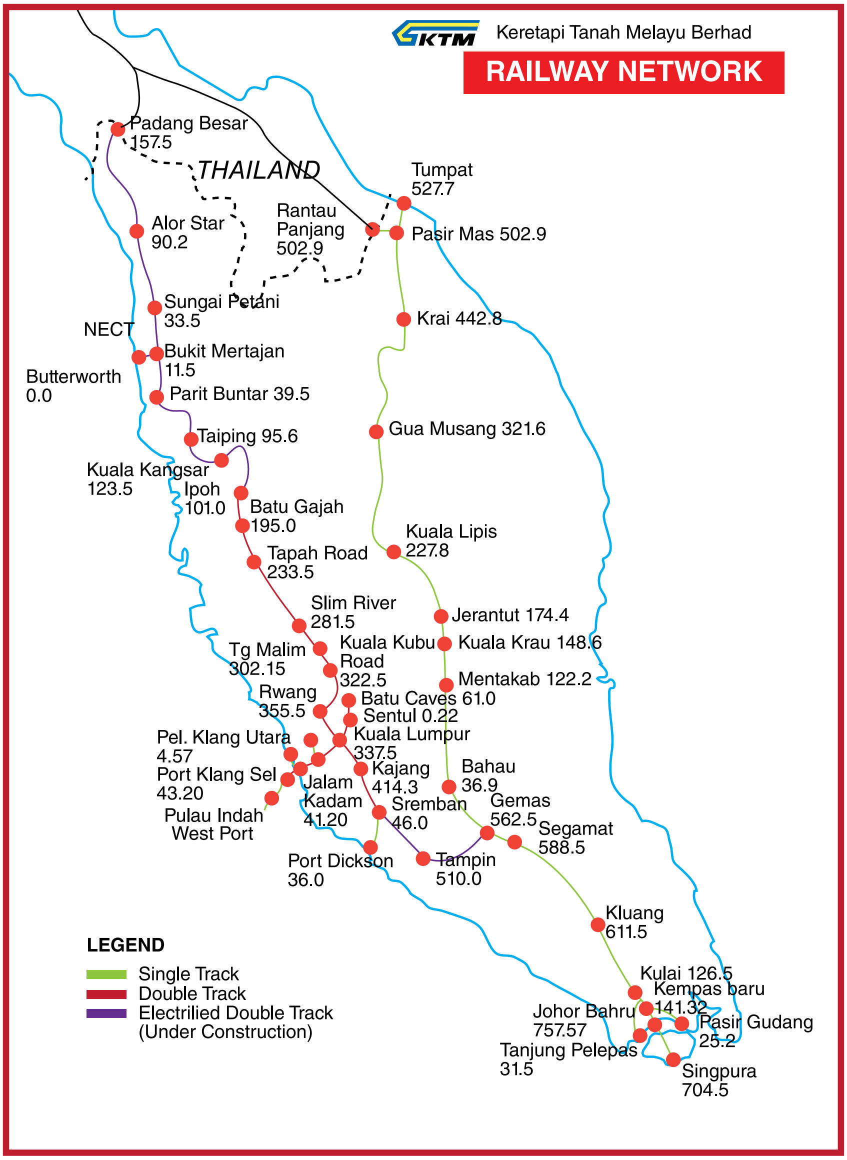


Figure 1.19: Rail transport network in Peninsular Malaysia

Source: JKR Sarawak

The Peninsular Malaysia railway network spans from Padang Besar, Perlis and Tumpat, Kelantan in the north to Johor Bahru in the south. At the country's border, it is connected to the Thailand's railway network in the north, while in the south it goes all the way to the island city of Singapore. The whole operation of the railway is managed by Keretapi Tanah Melayu Berhad (KTMB). In 2010, length of the railways in the Peninsular is 1,658km.

With a length of 134km, the railway in Sabah connects Tanjung Aru near Kota Kinabalu to Tenom. It consists of 14 stations. The company operates several types of carriages Namely Diesel Multiple Unit (DMU), railbus, railcar, and carriage & wagon.

Figure 1.20 Rail transport network in Sabah

Source: Jabatan Keretapi Negeri Sabah

Figure 1.21 Federal ports in Peninsular Malaysia

Source: Department of Statistics

The ports in Malaysia are divided into Federal and State ports. Federal ports that are under the jurisdiction of Ministry of Transport can be further divided into major or minor ports. All the Federal ports in this Figure, are as major ports. Except for Kemaman, other ports in the figure above have been privatised and they are managed by their respectively port authorities.

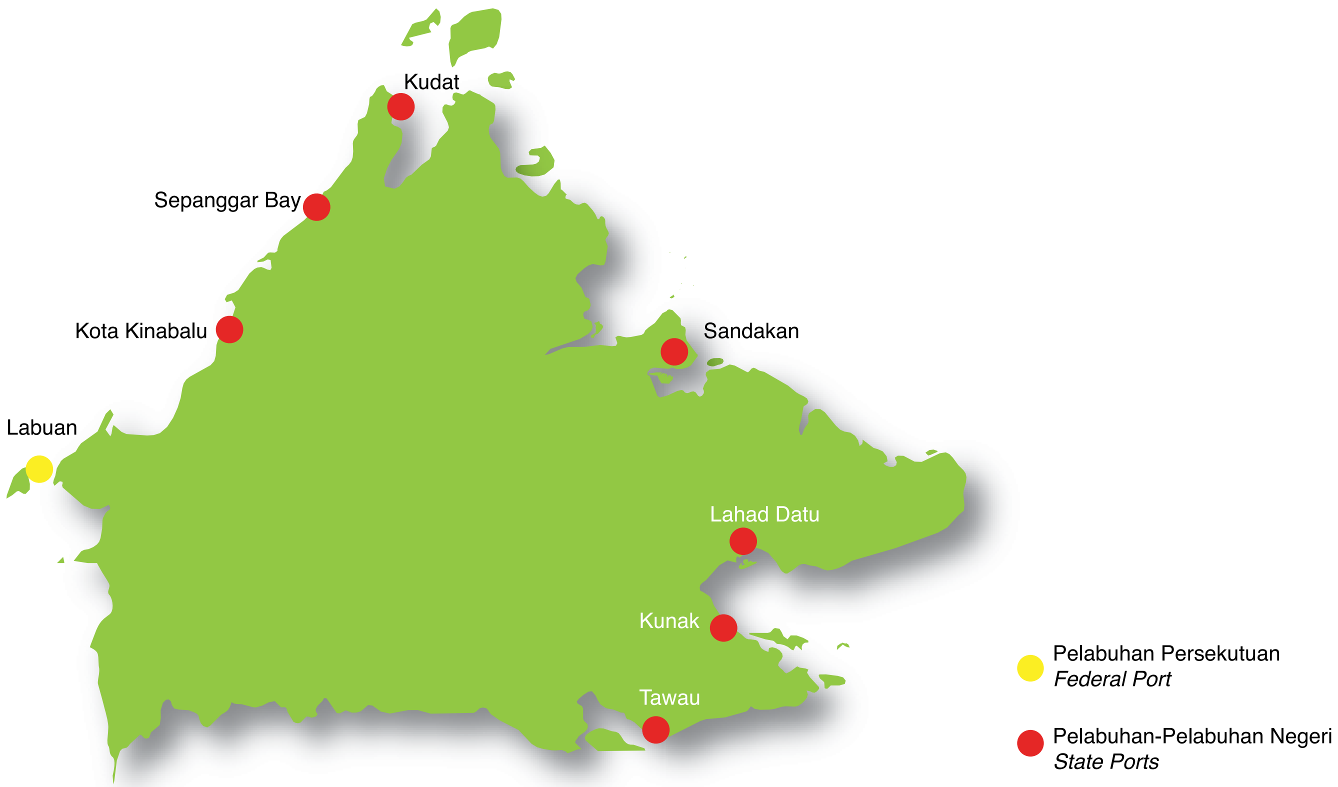


Figure 1.22 State and Federal ports in Sabah

Source: Department of Statistics

On the other hand, the ports in Sabah are under the State Statutory Bodies, except for Labuan which is a Federal Port. The other seven ports are managed by their respective authorities, reporting directly to the State Ministries concerned. Ports in this State are managed by Sabah Ports Sdn. Bhd., with the Sabah Port Authority as the regulator. Due to the mountainous geography of the State, roads are limited. Thus, this State's main cargo and transportation method is via its ports.

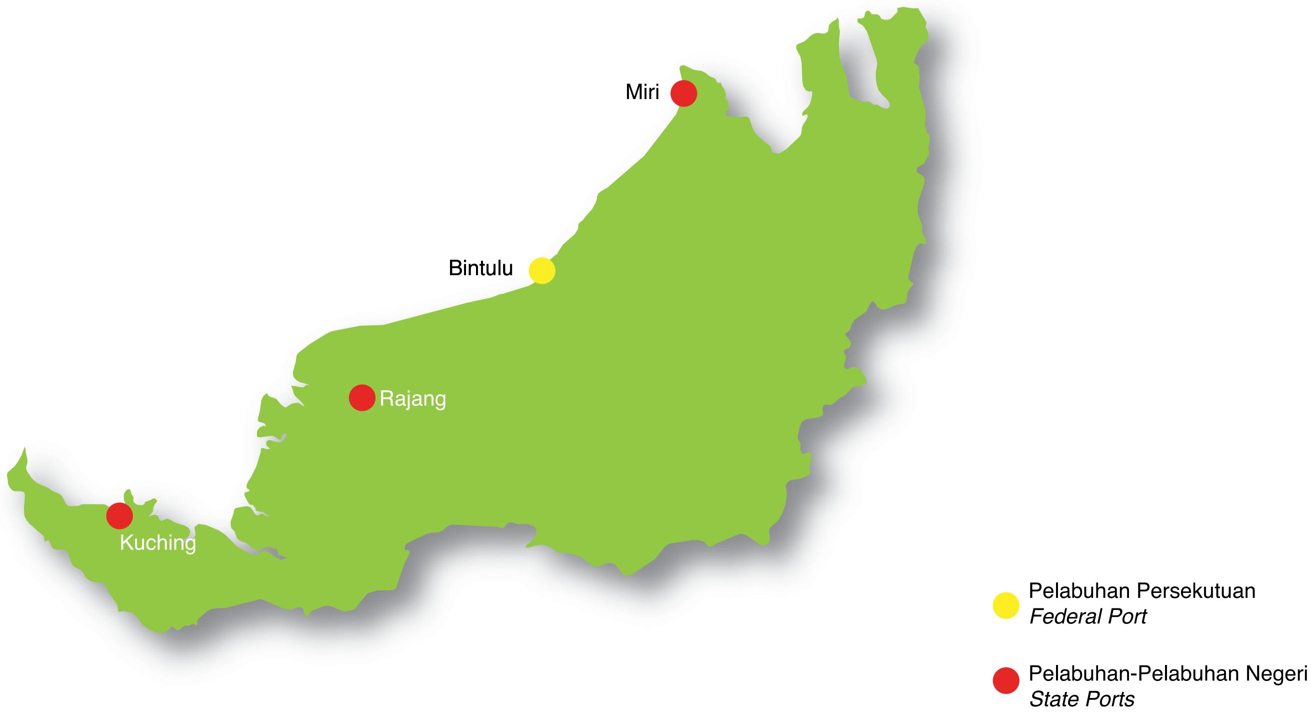


Figure 1.23 State and Federal ports in Sarawak

Source: Department of Statistics

As in Sabah, ports in Sarawak are under the State Statutory Bodies, under the Sarawak Port Authorities Ordinance 1961, except for Bintulu. It is a Federal port. The other three State ports are under their respective managements, namely the Rajang Port Authority, Kuching Port Authority and Miri Port Authority – all of which operate and own the respective ports. A majority of airports in Malaysia are managed by Malaysia Airports Holding Berhad (MAHB). There are three types of airports in the country, namely International Airports, Domestic Airports, and Airstrips. The locations of the airports in Peninsular Malaysia, Sabah and Sarawak are as the fgures shown.

Figure 1.24 Airport locations in Peninsular Malaysia

Source: Department of Statistics

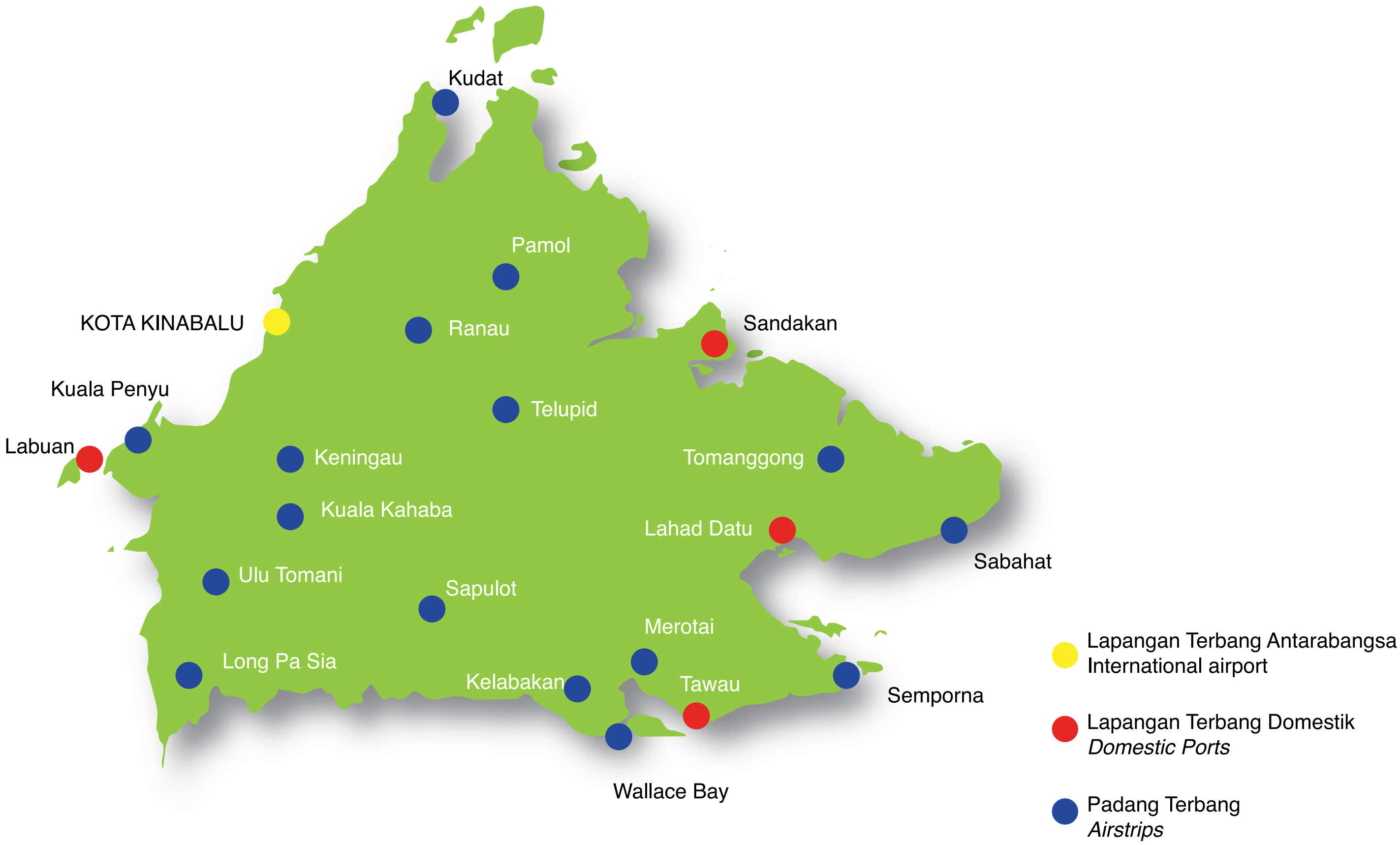


Figure 1.25 Airport locations in Sabah

Source: Department of Statistics

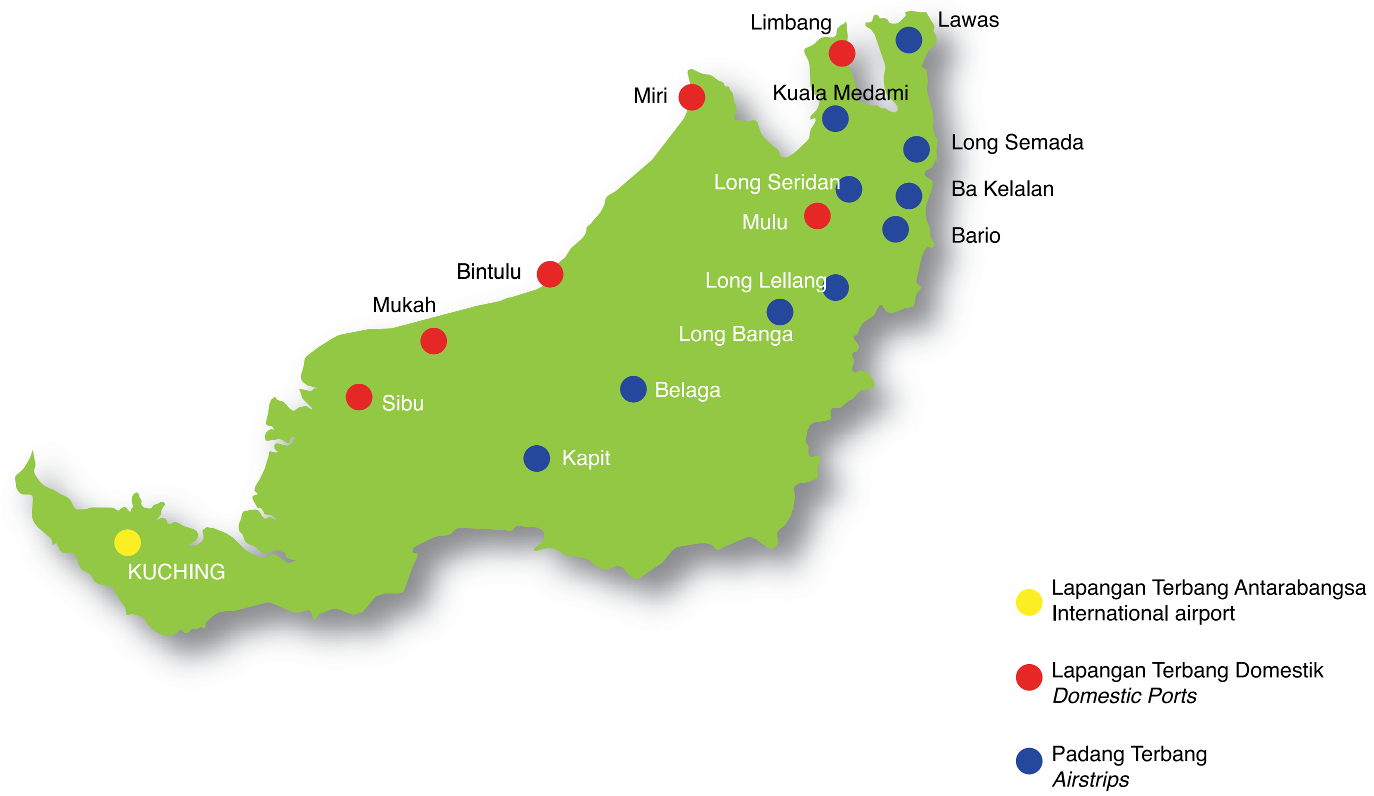


Figure 1.26 Airport locations in Sarawak

Source: Department of Statistics

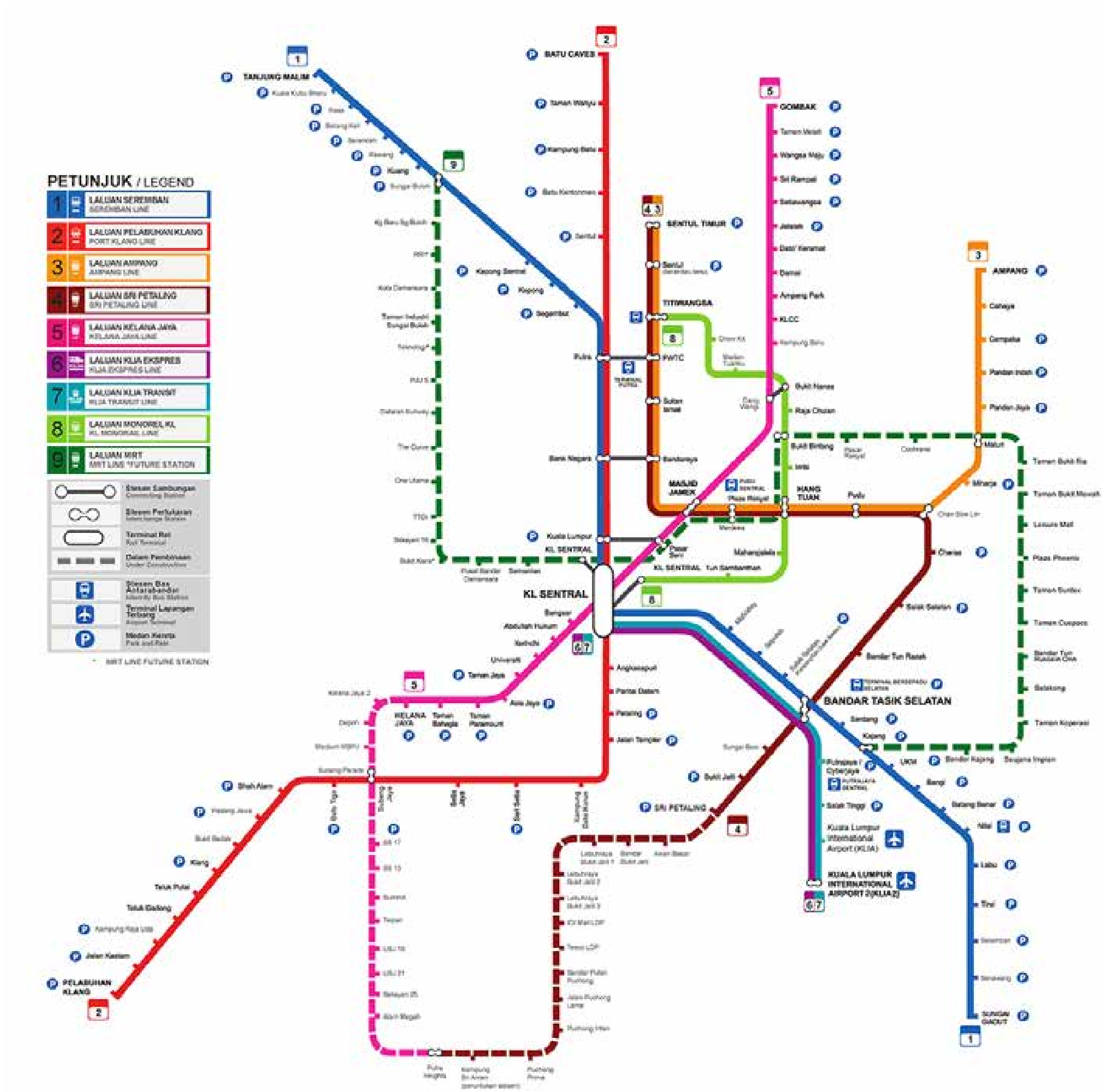
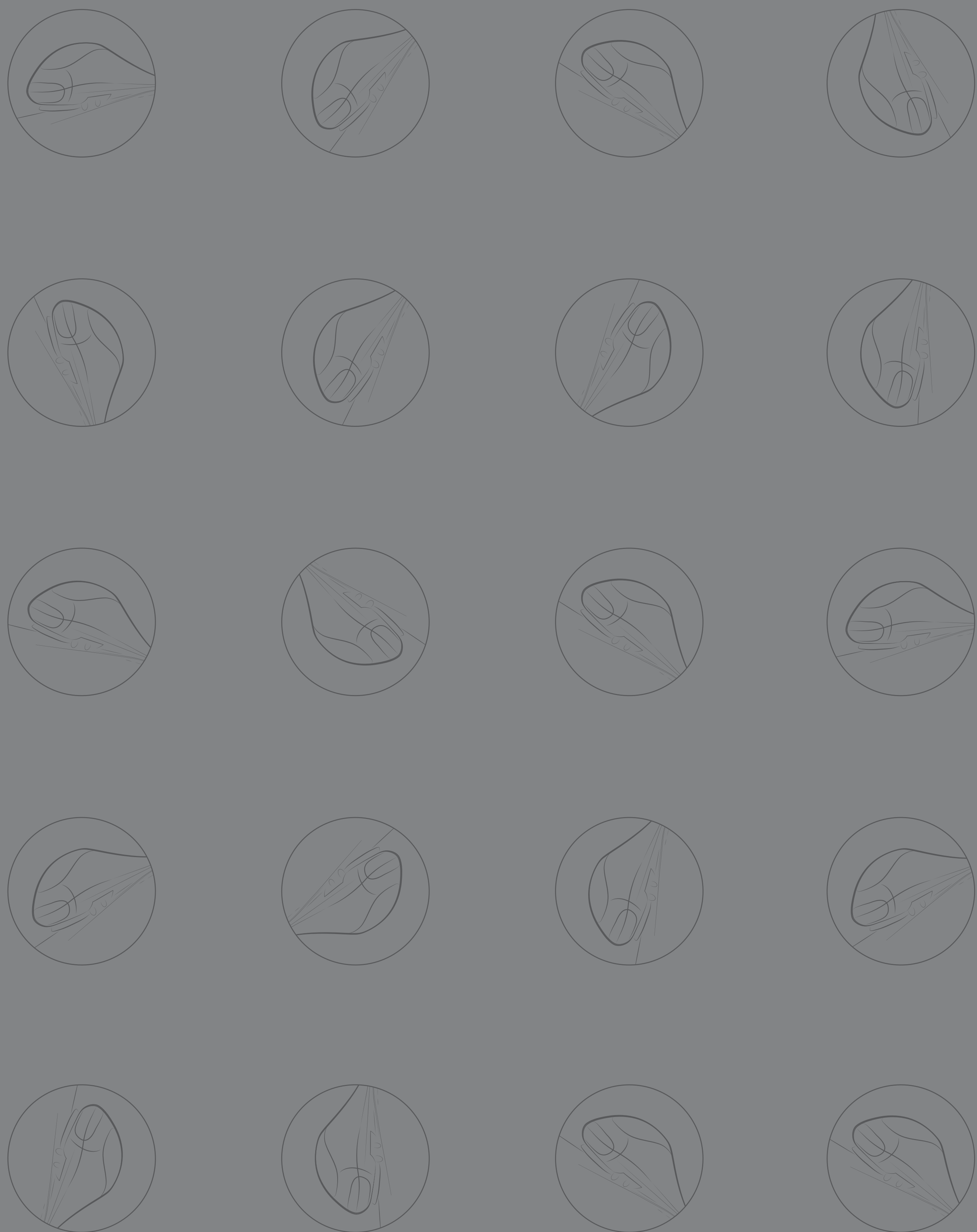


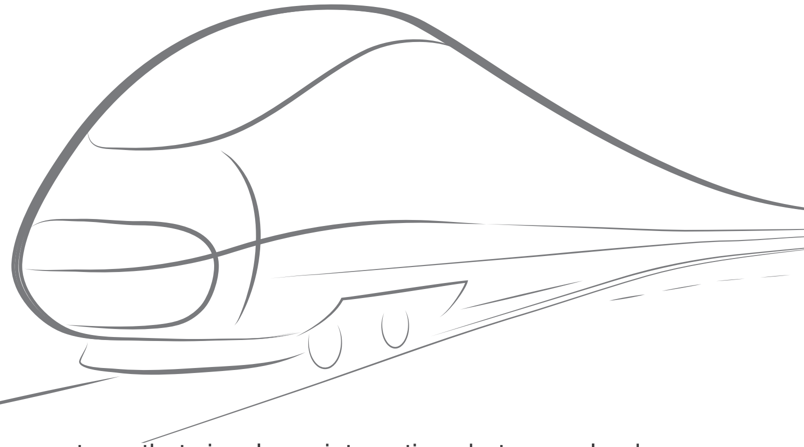
Figure 1.27 Transit rail transport network of Klang Valley

Source: SPAD

The transit rail networks in the core business area of Malaysia, the Klang Valley, consist of nine different lines. The lines are the Seremban Line, Port Klang Line, Ampang Line, Sri Petaling Line, Kelana Jaya Line, KLIA Express and Transit Line, KL Monorail Line, and MRT Line (currently under construction).



CHAPTER 2
INTRODUCTION



This part of the research will elaborate further on the Malaysian's current transportation system including the nation's policies, industrial activities, transportation courses offered in Malaysian universities, and research currently undertaken in the universities and industry.

2.1 LAND TRANSPORTATION: AN INTRODUCTION

Transportation is an induced demand of the need to move people and goods from one place to another to fulfil social and economic activities. Transportation forms the backbone for economic growth as it enables trade while technological advancements in transportation play a major factor in globalisation. Transportation is a complex system that involves interaction between land-use planning, infrastructure provision, transport economics, transport technologies and to some extent even the climate. The transport systems among countries often vary significantly, but a particular trend can be seen according to the level of economic development of a country.

Malaysia's impressive rate of development since 1970 has seen the GDP grown by 6.3% per annum until 2010. Meanwhile, the population has also more than doubled to reach 28.3 million since 1980. This growth has seen an increase in population density especially in urban centres, with the Central Region encompassing Kuala Lumpur and Selangor seeing the largest increase in population (SPAD & NLPTMF 2012).

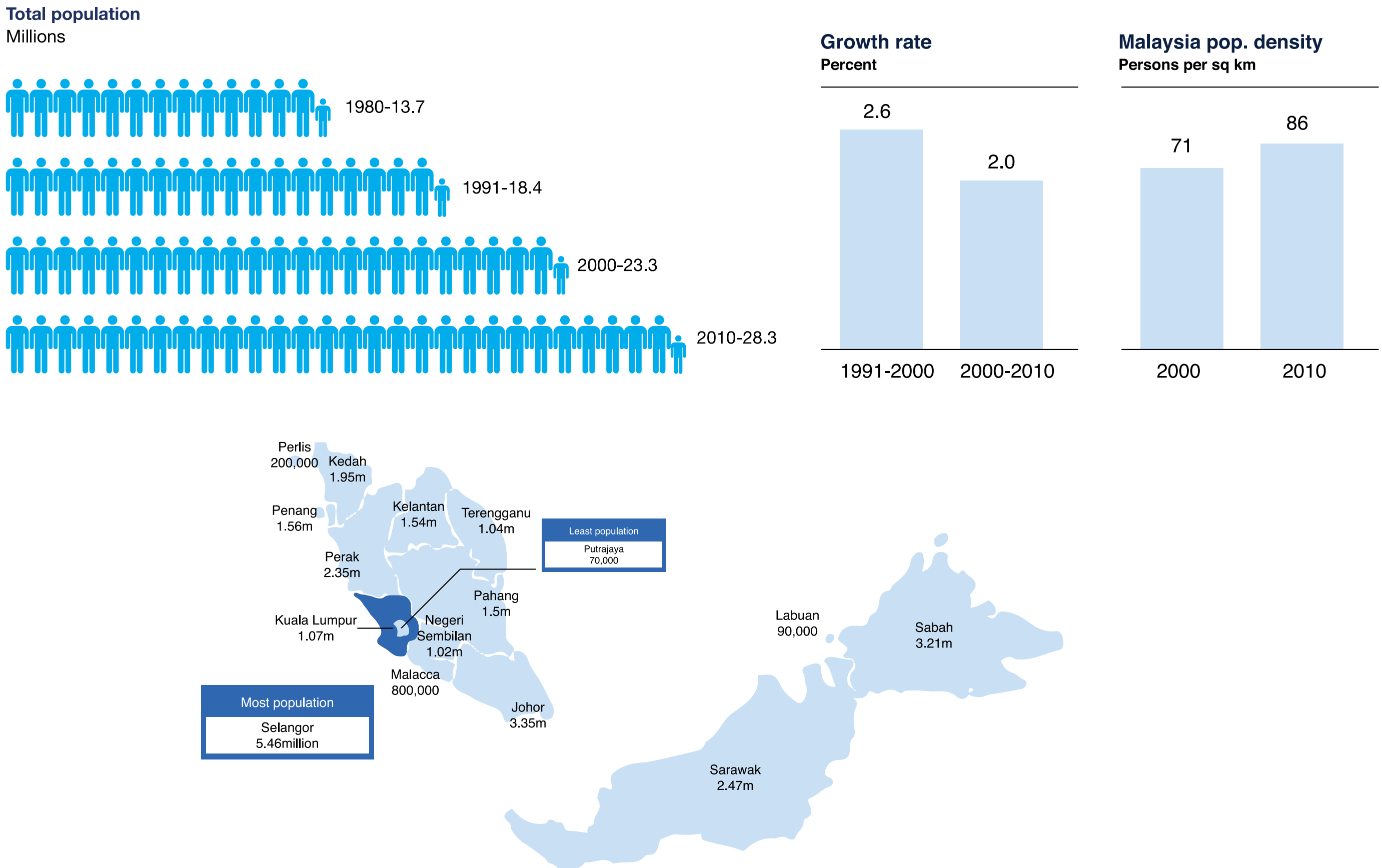


Figure 2.1 Malaysia's population growth from 1980-2010

Source: SPAD & NLPTMPF 2012

2.1.1 MALAYSIAN GOVERNMENT POLICY

2..1.1.1 POLICY ON SPATIAL PLANNING AND TRANSPORT

Land utilised has a direct impact on transport facilities, services and the people's eventual choice of transport mode. For instance, land use pattern that allows for dispersed, low density development with scattered housing, job opportunities, public amenities and services generally results in over-reliance on private vehicle for transport. The reverse is also true: a transit line enables high density, mixed use transit-oriented development that encourages use of public transport together with walking and cycling. The only sustainable way to cope with a growing population especially in urban areas, is to build up around a public transport corridor, while limiting sprawl to minimise reliance on private vehicles. Policies and plans on spatial development in Malaysia echo this statement.

Malaysia practices the three-tiered administration system consisting of the Federal Government, the State Governments (13 states) and the local authorities (city, municipal and district). Development planning is practiced at all three tiers of government for states within Peninsular Malaysia. The national development planning framework in Malaysia and the related documents is shown in **Figure 2.2**.

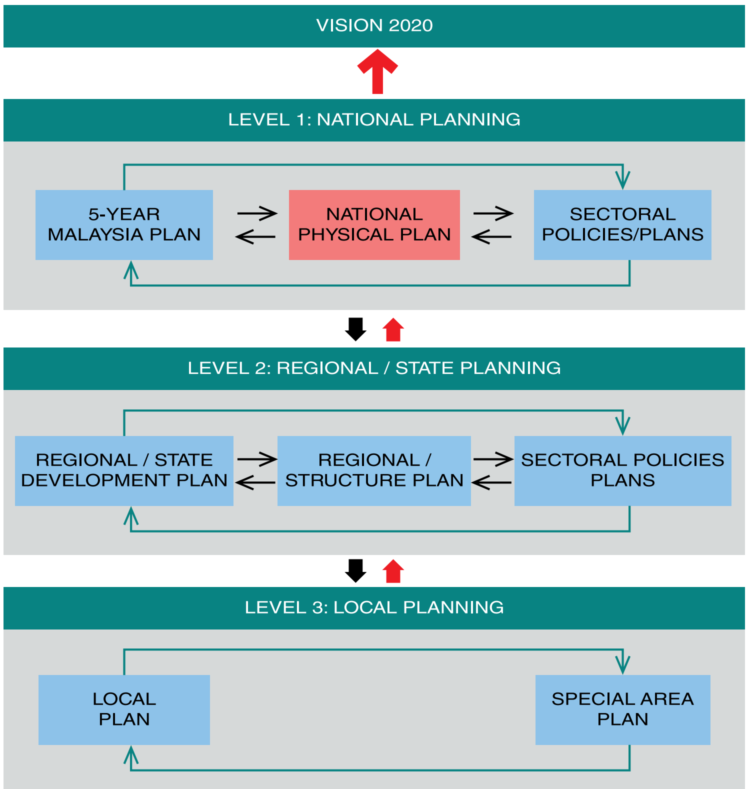


Figure 2.2 National Development Planning Framework in Malaysia

Source: Federal Department of Town and Country Planning Malaysia 2010

Vision 2020 is the long-term vision statement of the country and states the aspiration of the nation to become a "fully developed along with all the dimensions: economically, politically, socially, spiritually, psychologically and culturally", and achieve a high income nation status by the year 2020. Contextually, development planning in the country operates within the stated goals outlined in Vision 2020.

The NPP sets out the national strategic spatial planning policies and measures taken to implement them in respect to the general direction and broad pattern of the land use and physical development and conservation in Peninsular Malaysia to year 2020. The NPP does not apply to Sabah and Sarawak as they are governed by different planning legislations. The current version of NPP is the National Physical Plan 2 (NPP-2).

Goal of NPP-2:

The establishment of an efficient, equitable and sustainable national spatial framework to guide the overall development of the country towards achieving a developed and high-income nation status by 2020.

The goal of NPP-2 is supported by economic prosperity, environmental stability, social vibrancy and integration as envisioned in Vision 2020. The strive for spatial planning efficiency involves the need to focus on development activities in selected areas that offer the best growth potential supported by an integrated and efficient infrastructure.

NPP-2 puts particular attention on urban expansion of urban cities such as Kuala Lumpur, Penang and Johor. The National Urbanisation Policy (NUP) estimated that an additional six million people will live in urban areas between 2010 until 2020, which translated to an urbanisation rate of 75% in 2020. This equals to the total of 20.9 million people living in urban areas. The question is how to accommodate this growth? The strategy is to opt infill development and redevelopment for mixed-uses and higher densities to create a compact city form as opposed to current haphazard urban sprawl:

"There is no necessity for urban expansion to encroach into rural land that should be protected or conserved. A more compact urban footprint as opposed to current urban sprawl is most desirable to promote viable public transport and to protect the open countryside and forested areas as carbon sink in combating climate change. A majority of the financial, business and services sectors will be concentrated within the Town Centre for greater synergy and critical mass."

With the current trend of cities and towns rapid expansion, the built-environment is in danger of deteriorating into urban sprawls leading to rising traffic congestion. This strategy also supports the target of achieving liveable cities. Liveability has the common notions of enhancing the "quality of life", "well-being", "economic competitiveness and growth", as well as choosing the "preferred place to live". Transport is one of the key building blocks for creating liveable cities and sustainable communities.

Promoting Efficient Public Transport by integrating land use and transportation planning to reduce the need to travel and minimise journey to work. Apart from that, there is a need to promote a coordinated important is the need to promote a coordinated and efficient public transportation system particularly multi and inter modal transportation hubs in major urban areas.

NPP-2 also highlights that for public transportation to be economically viable, cities and towns should be in the form of more compact development and in the higher density nodes, such as Transit-oriented Development (ToD). Policies in the NPP-2 with regards to land transport are as follows:

NPP 28: An integrated national transportation network shall be established in recognition of the inter-relationship between land use and transport.

The NPP-2 proposes for an integrated national transportation system to be developed the railway forming the core system for people and goods transportation. Meanwhile the road system provides both an alternative mode and an articulation of the system. The two must be well integrated in order to work efficiently and effectively. The road and rail networks should be appropriately linked to facilitate multi-modal transport in order to achieve an integrated national transportation system. A high speed rail system is also proposed to effectively link major areas in the country.

The measures include developing a National Transport Policy and Master Transportation Services Network plan incorporating the role and function of road, rail, sea and air facilities and services at a national level. The integrated national transportation network in the NPP-2 is shown in **Figure 2.3**.

IP 22 : INTEGRATED NATIONAL TRANSPORTATION NETWORK

International Airport	Expressway
Domestic Airport	Major Highway
National Sea Port	High-Speed Rail Corridors
Regional Sea Port	KTM Electrified double Track Rail
Coastal Sea Port	KTM Single Track Rail
Main Centre	

Figure 2.3 IP 22 - Integrated National Transportation Network in the NPP-2

Source: Ministry of Housing and Local Government Malaysia

NPP 29: A national integrated high-speed rail system shall be established to complement the existing rail network.

A 300km/h high-speed rail system is proposed consisting of a West Coast line, an East Coast line and two cross lines spanning and linking the two coastal spines. The system is targeted as a high-density, high-speed passenger and cargo rail service that will link all existing conurbations, capitals and to major gateways into the country. The high-speed rail system is proposed as a bulk mover both for people and for goods servicing all existing conurbations and State capitals. It should also connect all the major gateways and ports (seaports, inland ports and airports) in the country. The policy requires for a National Railway Master Plan to be prepared incorporating both the high-speed rail network and the KTM electrified double track programme which covers both passenger and freight movement.

Figure 2.4 IP 23 - National Rail Network in the NPP-2

Source: Ministry of Housing and Local Government Malaysia

NPP 30: The national road travel shall be further extended for regional travel and for local access.

It is proposed that a minimum of three highway cross-link will be provided to bridge the West Coast and East Coast expressway systems. The national expressway system shall be supported by network of lower hierarchy roads such as highways and primary roads (federal and State roads), essentially for traffic dispersal from the expressways**,** the rail system and for local access. **Figure 2.5** shows the National Road Network in the NPP2.

IP 24 : NATIONAL ROAD NETWORK

	Expressway
	Major Highway
	High-Speed Rail Corridors
	Primary Road
	Towns
	State Capital

Figure 2.5 IP 24 - National Road Network in the NPP-2

Source: Ministry of Housing and Local Government Malaysia

NPP 32: The Transit-oriented Development (ToD) concept shall be promoted as the basis of urban land use planning in order to ensure viability of public transport.

It is proposed that main conurbations of Kuala Lumpur, George Town, Kuantan and Johor Bahru shall incorporate LRT, MRT and BRT (Bus Rapid Transit) routes into the urban fabric, and the stations and its immediate areas shall be designated for high-density commercial and residential development. It also requires improvements in terms of service and facilities such as feeder buses, park-and-ride facilities, covered walkways and disabled-friendly facilities.

NPP 33: An integrated public transportation system shall be established in all major urban centres.

The policy requires comprehensive integrated land use – public transport studies for all major conurbations. The target modal split is 30:70 by 2020 and 50:50 for the long term between public and private transport. It also requires improvement to the public bus service. It also proposes that an integrated mass rapid transit system be provided in all settlements with populations above 0.5 million. The use of Intelligent Transport Systems (ITS) is also targeted to complement the development of modern urban public transport facilities, which relies upon advanced electronics communications and IT for monitoring and tracking real time information on traffic flows and volumes is to better manage limited road space. The present level of ITS infrastructure is to be expanded in the three main conurbations.

Working in tandem with the NPP-2 is the Five-Year National Plan which addresses issues of socio-economic development of the country, while national sectoral policies addresses strategic issues of national importance. These documents provide an overall framework and are interpreted into the regional and state development plans and state-level sectoral policies. The Structure Plan (SP) distributes the expectations of future development within each state; and proposes major economic and infrastructure projects for the states. The SP for each state will provide the framework and basis for the preparation of a statutory Local Plan (LP) covering each district of the state. The SP sets out the policies and general proposals for the development and other use of land within each State; thus providing guidance for spatial development on states' issues of structural importance.

Local planning authorities draft the local level statutory development plans: the LP and Special Area Plans which are based on the state plans. The LP serve as vehicle for a more detailed and site specified development facilitation, including control at a local level. In addition, the Local Plans by their consultative process of preparation acts as contractual agreements on the use of all land within the planning areas between the Local Planning Authorities, the local residents and land owners. Conversely, the Special Area Plan (SAP) is part of the statutory Development Plan. It is prepared following the same procedures of the Local Plan and has the same effect as a Local Plan. It is an action-orientated Plan detailing out intensive and major changes in the near future for implementation, such as redevelopment of the inner city areas.

Malaysia practices a plan-led development system. This means that any development of land and buildings, require planning approval from the Local Planning Authority. Planning permission will be granted if the development is in conformity with the statutory LP, such as technical agencies requirements and public objections (Federal Department of Town and Country Planning 2010).

2.1.1.2 POLICY ON LAND PUBLIC TRANSPORTATION

There has been significant infrastructure development and investments in the public transport sector. Until 1995 the main modes of Land Public Transport (LPT) for intra-city travel were taxis, stage buses and minibus while Keretapi Tanah Melayu (KTM) and inter-city buses served demand for long distance travel. KTM Commuter begins operation in 1995 as the first rail system to run on electricity in Malaysia. With rapid economic growth in the Klang Valley (KV) during the turn of the century, there was a need to increase the capacity of the public transport system to cope with higher demand which leads to the implementation of the Light Rapid Transit (LRT) and Monorail. In 2002, Malaysia's first high-speed train, the KLIA Express, was launched – connecting KL Sentral and the Kuala Lumpur City Air Terminal (SPAD 2012).

Despite of that, in order to move forward, the LPT sector must overcome a few major challenges for it to remain the transport choice of the people. One is the rapid growth of motorisation and the decreasing modal share of LPT. The increase in household income means more people can afford to buy their own private vehicles. Private vehicle is seen to offer a more convenient mode of travel rather than going through the hassle of using LPT. **Figure 2.6** shows the percentage of AM peak public transport modal share.

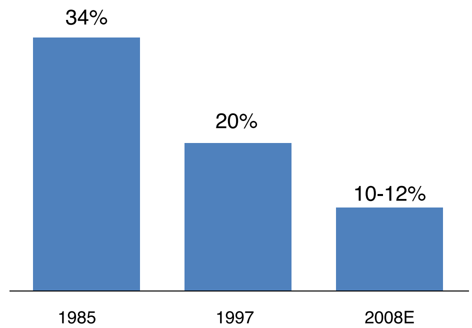


Figure 2.6 Percentage of AM peak public transport modal share

Source: SPAD 2012

The second and biggest hurdle is the challenge to coordinate LPT planning and enforcement under multiple authorities. All operate with their own objectives – aligned to their own charters and with the LPT agenda infused within their larger mandates. Nevertheless, there was no single regulator or agency with the express, and thus overriding responsibility for strategic management of the land public transport system (SPAD 2012).

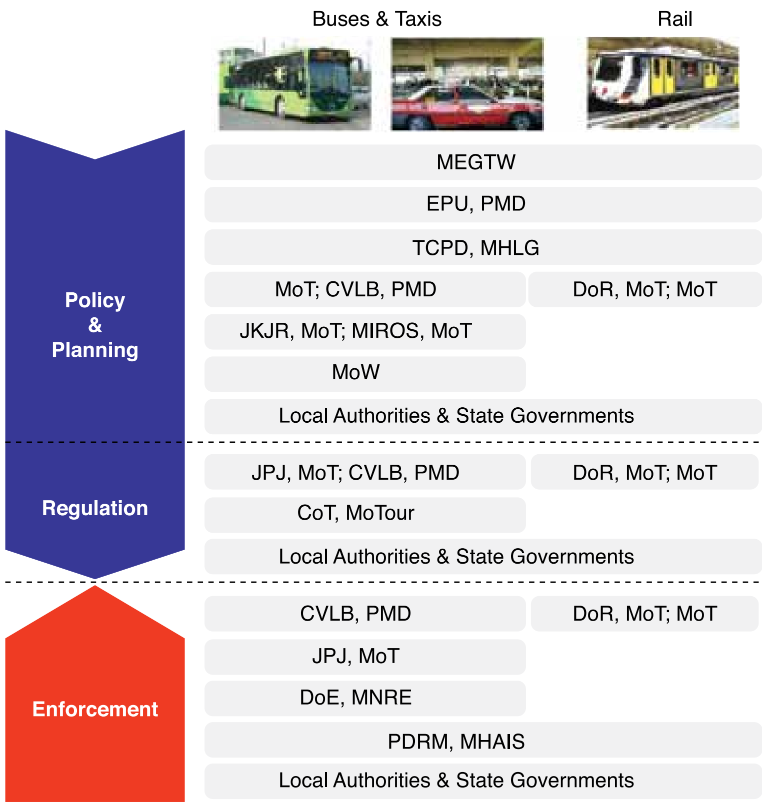


Figure 2.7 Authorities involved in land public transport

Source: SPAD 2012

These different ministries, departments and agencies were established with the aim of a focussed approach on individual issues that will deliver a more thorough solution to each specific problem. The primary issue here was a lack of coordination, leading to suboptimal land public transport delivery along multiple dimensions: planning, regulation, enforcement and integration with spatial development (SPAD 2012). **Figure 2.7** shows the authorities involved in land public transport.

Transport as an induced demand of mobility, is heavily linked with spatial development. The lack of coordination of spatial planning within a LPT network means that LPT implications were not always given adequate consideration, which results in a LPT system that is not integrated internally or with the broader spheres that affected it. It also affects the commissioning and implication of feasibility research. Such studies are often conducted on ad hoc basis and are commissioned by state or local authorities without active engagement with other agencies. As the integrated network perspective is marginalised, the outcomes of the studies tend to focus on infrastructure development in isolation as opposed to cross-system development (ibid.).

This lack of coordination has led to the shortcomings of the current LPT provisions. To illustrate, the multiple railway systems available in KL which were planned on an individual project basis are disjointed and overlap each other which inadvertently lead to poor connectivity and a fragmented network. There is also no common ticketing platform for travel that requires the transfers between the rail systems and the stage bus service. This fragmented approach also affects regulation, licensing and enforcement as they are often under the purview of various authorities (ibid.). It is within the context of an increasing need for a transformative solution in the land public transport agenda as a driver towards Vision 2020 that SPAD was formed through the enactment of the SPAD Act 2010 and gained its full powers with the gazetting of the Land Public Transport Act 2010 (SPAD 2012).

SPAD comes directly under the purview of the Prime Minister and is tasked with drawing up policies, planning and regulating all aspects of train, bus and taxi services as well as road and rail based freight transport under one roof. SPAD also has enforcement powers which are carried out with close cooperation with other enforcement agencies. **Figure 2.8** shows the Vision, Mission and Objectives of SPAD.

It is significant that SPAD's mandate is enforced by three principal documents that together anchor the entire national transformation agenda: the Government Transformation Programme (GTP), Economic Transformation Plan (ETP) and the 10th Malaysian Plan (10MP). However, in all documents, there is specific mention of the policies and transformations needed within the LPT system to deliver enhancements in economic growth and quality of life.

The GTP is a cohesive effort by the government to create a foundation for transforming the country into a developed and high income nation by 2020. Although efforts by the government had significantly grown the Malaysian economy and delivered crucial infrastructure for both the public and business communities, the government felt that the Malaysian engine needed to shift up to the next gear if the country were to reach its ambitious developmental goals.

Through extensive consultation with key stakeholders the government has come up with seven priority areas as in **Figure 2.9**, that require quick and big changes to address the urgent demands of the Bola Public designated as National Key Results Areas (NKRAs) and the delivery of the National Key Performance Indicators (NKPIs). Running parallel to the NKRAs are the Ministerial Key Results Areas (MKRAs) and the delivery of Ministerial Key Performance Indicators (MKPIs) in areas not covered by the NKRAs, but deemed important enough to receive the government's attention at the Ministerial level.

Vision

To lead the transformation of land public transport to become the rakyat's mode of choice

Mission

Ensuring a safe, reliable, efficient, responsive, accessible, planned, integrated, affordable, and sustainable land public transport system to enhance socio-economic development and quality of life

Objectives (public transport)

- A world-class public transport sector in Malaysia that champions commuter safety, security and delivery of efficient yet affordable services
- A competition framework between and within modes that strikes a balance between commuter affordability and operator financial sustainability
- Implentation of multi-modal integration initiatives and/or programs e.g. ticketing, physical connectivity, network planning and scheduling
- Cohesive and rigorously planned routes and networks which are deligently reviewed and regularly updated
- Increase usage of land public transport with the aim of meeting the target modal share
- Skilled and competent human capital and services in the land public transport sector
- Lower environmental impact of land public transport through reducing emissions of noise and pollutants, use of technology, and optimal use of resources
- Coordinated enforcement with relevant authorities on land public transport matters
- Diligent administration, regulation and monitoring of service standards
- Coordination and cooperation with relevant authorities to amalgamate land public transport planning with spatial matters to achieve cohesive plans

Objectives (freight transport)

- Competitive framework that strikes a balance between sustainability and reliability
- Cohesive and rigorous planning of routes and networks, which are diligently reviewed and regularly updated
- Implementation of multi-modal integration initiatives and programs, which may include ports, airports and other points of entry to the LFT network
- Diligent administration, regulation and monitoring of service standards
- Coordinated enforcement with relevant authorities on land freight transport matters
- Coordination and cooperation with relevant authorities to amalgamate land freight transport planning with spatial matters to achieve cohesive plans
- Skilled and competent human capital and services in the land freight transport sector
- Lower environmental impact of land freight transport through reducing emissions of noise and pollutants, use of technology, and optimal use of resources

Figure 2.8 The Vision, Mission and Objectives of SPAD

Source: SPAD 2012

The seven NKRAs

	Addressing the Rising Cost of Living
	Reducing Crime
	Fighting Corruption
	Assuring Quality Education
	Raising Living Standards of Low-Income Households
	Improving Rural Development
	Improving Urban Public Transport

Figure 2.9 The seven GTP NKRAs

Source: PEMANDU 2012b

The GTP has been divided into three distinct horizons: 1.0, GTP 2.0 and GTP 3.0, each with their own focal points. Each horizon aims to build on the achievements of the preceding one by introducing greater and deeper change. These structures will thus support other economic activities that will take Malaysia to developed nation status.

GTP 1.0	GTP 2.0	GTP 3.0
2009 > 2012	2013 > 2015	2016 > 2020
The firsh phase of the GTP seeks to initiate immediate and big changes to the civil service and government structure, to arrest the decline in key NKRAs, and to renew the faith of the rakyat in government. The first horizon of transformation aims to change deeply-rooted performance cultures within the civil service by challenging the various ministries to reform and address the greatest issues affecting the rakyat.	The second phase of the GTP builds on successes of GTP 1.0 by further deepening and broadening reforms to complete the transformation of the civil services. Meanwhile, steps will be taken to further develop a performance culture, which is crucially important in preparing Malaysia for th next phase of development.	The final stretch in helping Malaysia achieve its ambition Vision 2020 aspirations, GTP 3.0 no longer targets reform, but aims to evolve government to the next level, focusing on priorities such as innovation and rakyat-centric delivery models. Upon completion of these goals, Malaysia will have a pre-eminent system of governance that will rival the best in the world.

Figure 2.10 The horizons of the GTP

Source: PEMANDU 2012a

Improving Urban Public Transport is one of the NKRAs under the GTP and is led by the Minister of Transport. The UPT NKRA concurs that the lack of a focussed approach of the public transport network in KL has created a disjointed system that does not integrate into a comprehensive whole. The Urban Public Transport (UPT) NKRA was set up to address this issue by streamlining existing public transport options with additions of new ones such as the extension of LRT, KTM Komuter lines and MRT system.

The UPT NKRA has focussed its initiatives to increase the capacity, reliability, connectivity and convenience of public transport. The UPT NKRA focusses on GKL/KV because it is presently Malaysia's heart of commerce and because the traffic problem there is at a critical level. **Figure 2.11** shows the GTP UPT NKRA key focus initiatives.

The UPT strategy requires that initiatives put in place that would encourage and also discourage commuters to use public transport rather than their own vehicles. The UPT NKRA has identified six key focus initiatives that would effect this change, as follows:

> The NKRA's aim is to increase the modal share of public transport in GKL/KV to 25% from just 16.42% in 2011.

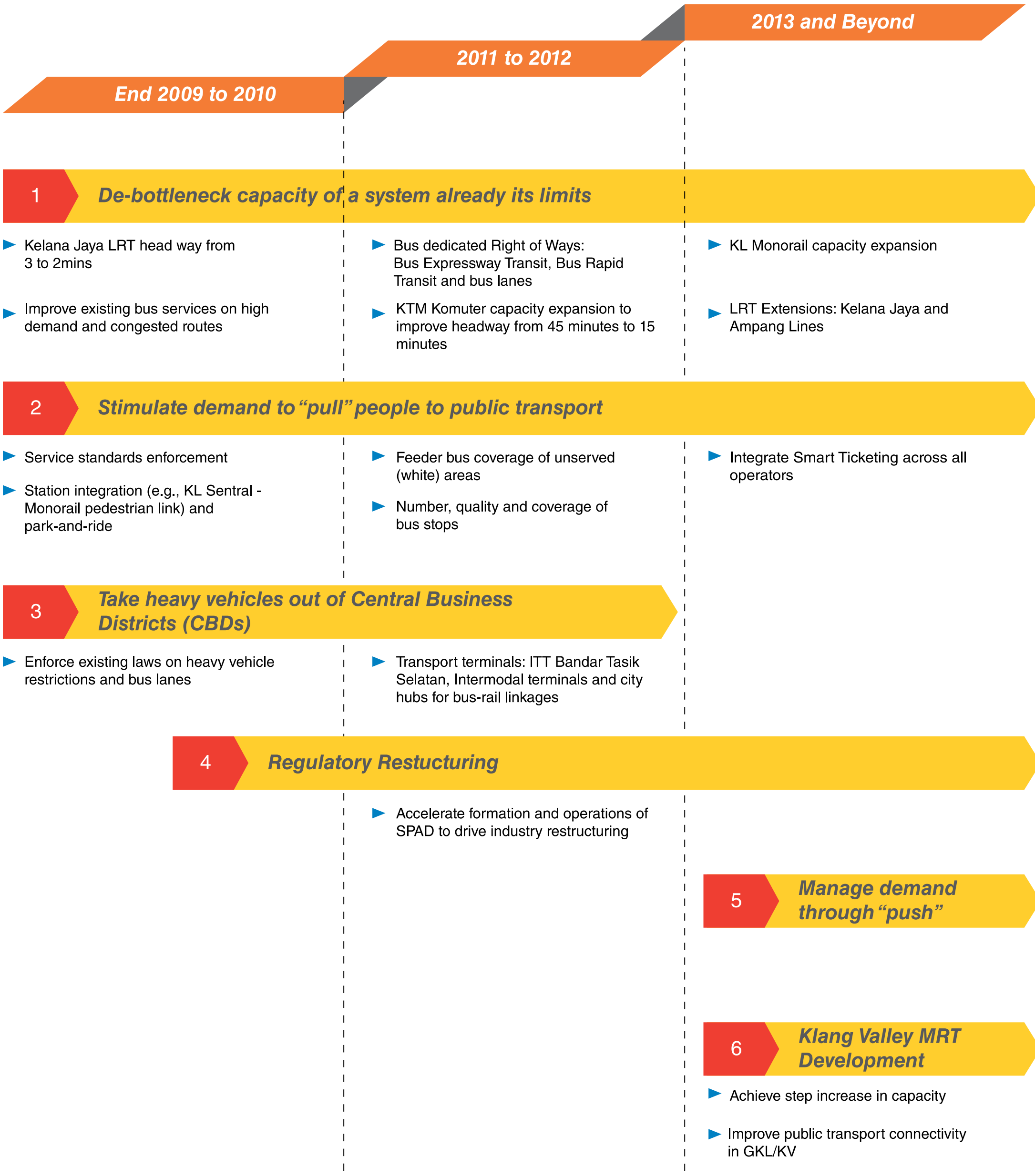


Figure 2.11 GTP UPT NKRA key focus initiatives

Source: PEMANDU 2012a

The focus in GTP 1.0 UPT NKRA was to transform public transport into a more attractive and viable option for commuters. Thereby, creating a "pull factor" to convince them to make the switch. The UPT NKRA has delivered the following outcomes under GTP 1.0 as in **Table 2.1**.

Table 2.1 Outcomes of UPT NKRA Under GTP 1.0

Outcomes	Description
Increasing capacity of Kelana Jaya LRT line	A total of 35 four-car sets were introduced for the Kelana Jaya LRT line in 2011.
Increasing capacity of KTM Komuter service	A total of 37 out of 38 six-car train sets ordered for the KTM Komuter have been put into service.
Improvement and addition of bus stops in GKL/KV	A total of 1,102 bus stops in Sepang, Subang Jaya, Ampang Jaya, Selayang, Shah Alam and elsewhere were upgraded in 2011. The planning of 306 new bus stops is currently underway.
Introduction of GoKL City Bus	A total of 15 buses servicing two lines of GoKL free public bus service within the KL City Centre was introduced in 2012.
Refurbishing & redesignating PuduSentral	The 35-year-old Puduraya Terminal has been transformed into an inter-urban use bus terminal and was officially opened on 16 April 2011.
Introducing Terminal Bersepadu Selatan	The Integrated Transport Terminal Bersepadu Selatan (TBS), comes equipped with modern facilities and comprises of 55 bus platforms, 150 taxi bays, 1,000 parking bays and 1,800 seats for the public. It began its full operation on 1 March 2011
Launch of Pasar Seni City Bus Hub	The launch of the Pasar Seni City Bus Hub in August 2012 greatly enhanced integration between the bus and rail services in one of the busiest areas within the Kuala Lumpur city centre and is the first of several planned for five main corridors covering the heaviest traffic areas. The Pasar Seni City Bus Hub is also serviced by the Go KL City Bus.
Construction of Gombak Park & Ride	The Gombak Park & Ride is a parking bay facility for 1,200 cars that allows commuters to use rail to travel into and out of the city and was completed on 30 October 2012.
Implementation of Bus Information System	59 bus stops in Kuala Lumpur were outfitted with info boards that provide accurate to-the-minute information about the waiting time before the buses arrive.

Source: PEMANDU 2012a & PEMANDU 2012b

The outcomes delivered under GTP 1.0 have resulted in the increase of public transport ridership by 80,000 per day in 2012 with a rise in public transport modal share to 20% as shown in **Figure 2.12**. But the gains in ridership were offset by the faster growth of private vehicle use. Data indicates that public ridership grew to 930,468 trips in 2012 from 622,185 trips in the previous year. However, the number of private trips have grown to 4.35 million from 3.5 million over the same period as shown in **Figure 2.13** (PEMANDU 2012a).

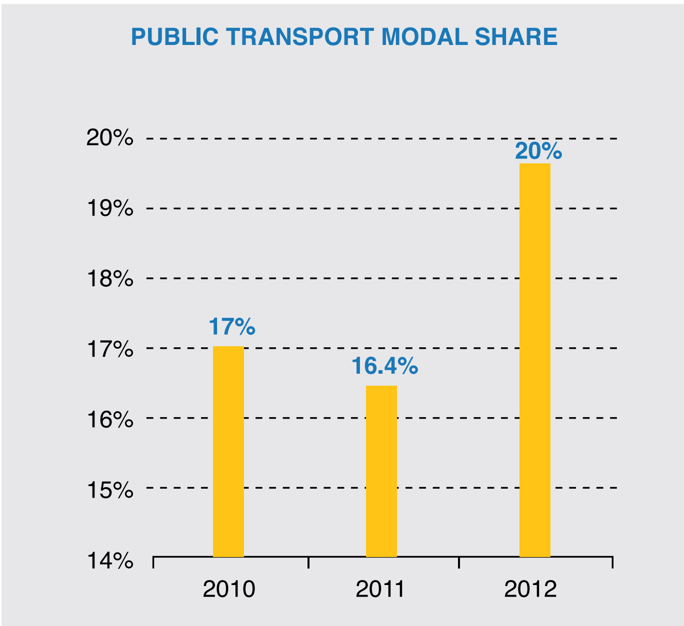


Figure 2.12 Public transport modal share from 2010 to 2012

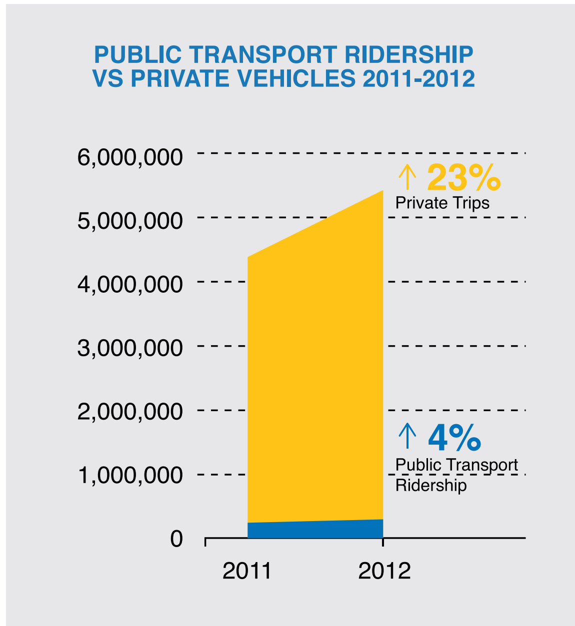


Figure 2.13 Public transport ridership vs private vehicle growth between 2011 and 2012

Source: PEMANDU 2012a

The aim of GTP 2.0 is to further enhance “pull factors” which will encourage commuters to make the switch. However, “push factors” through the discouragement of the use of private vehicles are also being considered for implementation. The combination of both “push and pull” factors is expected to improve public transport modal share over the next three years. The following three aspirations, in addition to the aim of reaching 25% public transport modal share, have been identifed under the GTP 2.0 framework (PEMANDU 2012b):

The following initiatives are to be implemented for the UPT NKRA under GTP 2.0 as shown in **Table 2.2**:

Table 2.2 Initiatives to be Implemented for UPT

NKRA UNDER GTP 2.0	
Buses	• Enhance Greater KL/KV stage bus network • Rationalise number of operators on overlapping routes and set up Inter Urban Transport Terminals to service Greater KL/KV • Set up city bus service within Central Business District (CBD) to service the commercial district • Reorganise and improve stage bus network and feeder bus system • Increase number of stage bus drivers and improve monitoring and enforcement of bus lanes • Expand bus rapid transit programme to provide faster inter-city commute • Improve bus stop facilities to encourage bus usage
Rails	• Enhance KTM Komuter service by improving service performance and reliability of core systems such as signalling, track and traction power supply • Extend the Kelana Jaya and Ampang LRT lines by linking them to other areas to boost carrying capacity by 100,000 commuters • Expand the Kuala Lumpur monorail system to increase its ridership capacity and create links to other locations not serviced by rail presently
Taxis	• Create a Centralised Taxi Service System (CTSS) to enhance enforcement, monitoring and to increase connectivity between operators to improve booking system • Create new taxi business model to increase the earnings of drivers by relieving pressure on maintenance and financing cost

Integration	• Addresses the passenger experience from the first to last mile • Create parkway drop-zones to better integrated existing facilities with pedestrian infrastructure • Drop-zone to focus on facilitating integration between bus and rail services • Upgrade stations to address the "mid-mile" issue by increasing station capacity and automated fare collection • Develop more pedestrian walkways and bridges to address the "last-mile" issue, encouraging more commuters to use public transport
Travel Demand Management	• Develops better parking control and management systems to discourage commuters from travelling to the city using cars and to use public transport instead • Puts in place a journey planner allowing commuters to plan their journeys based on their needs, e.g. fastest routes, routes with least amount of interchange, etc.
Enabling Projects	• Fare review to ensure commercial sustainability • Increase the number of bus drivers by starting a Driver's Academy and enhancement to their career package • Develop an enhancement joint task force that will solicit help from various bodies to tackle the public transport problem • Develop a "watching brief" to identify and prioritise areas of improvement nationwide • Develop a Business Revitalisation or Car Free Zones in Greater KL/KV to discourage the use of private vehicles.

Source: PEMANDU 2012a & PEMANDU 2012b

The GTP 2.0 Roadmap also highlighted other public transport transformation initiatives apart from the UPT in the Greater KL/KV region. The GTP's focus on improving the public transport system within the Greater KL/KV is to primarily ensure that the transport issue does not become an endemic problem in the near-term. There are also other public transport transformation plans aligned with the five developmental corridors covering the entire nation which are:

(i) East Coast Economic Region (ECER)

(ii) Iskandar Malaysia

(iii) Northern Corridor Economic Region (NCER)

(iv) Sarawak Corridor of Renewable Energy (SCORE)

(v) Sabah Development Corridor (SDC)

The ETP launched by the Government in 2010 is a comprehensive effort that aims to transform Malaysia into a high-income nation as aspired in the Vision 2020. Successful implementation of the ETP will see Malaysia's economy reach the levels of the developed countries.

The ETP consists of two parts which include 12 NKEAs which are drivers of economic activity that has the potential to directly contribute to economic growth, and six Strategic Reform Initiatives (SRIs), cross-cutting policy changes that will enable Malaysia to be competitive in the global arena. The 12 NKEAs as shown in **Figure 2.14**, are the key growth engines for our economy going forward.

Figure 2.14 The 12 NKEAs under ETP

Source: PEMANDU 2013

Greater Kuala Lumpur/Klang Valley (GKL/KV) has long been the pillar of Malaysia's economic growth and is already on the global map as one of the iconic cities of Southeast Asia. The city's growth must continue to intensify. Malaysia will not achieve its Gross National Income (GNI) growth aspirations without a significant, increased contribution from its primary city. However, it now faces fierce competition from neighbouring cities in attracting talent and multinational corporations. Its liveability lags many other Asian cities, public transport remains inadequate and many natural assets remain untapped. The aspiration for GKL/KV is to drive rapid growth in parallel with upgrading the city's liveability in a sustainable manner.

> The Greater KL/KV aspiration can be summarised as 20-20 by 2020, which is to be the only city that simultaneously achieves a top-20 ranking in city.

Nine EPPs along four dimensions have been identified to deliver on the Greater KL/KV aspirations as shown in **Figure 2.15**.

Dimension 1: Greater KL/KV as a magnet	• **EPP 1:** Attracting 100 of the world's most dynamic firms within priority sectors; and • **EPP 2:** Attracting the right mix of internal and external talent
Dimension 2: Greater KL/KV connect	• **EPP 3:** Connecting to Singapore via a high speed rail system; and • **EPP 4:** Building an integrated urban mass rapid transit system
Dimension 3: Greater KL/KV new places	• **EPP 5:** Revitalising the Klang River into a heritage and commercial centre for GKL/KV; • **EPP 6:** Greening GKL/KV to ensure every resident enjoys sufficient green space; and • **EPP 7:** Creating iconic places and attractions
Dimension 4: Greater KL/KV enhanced service	• **EPP 8:** Creating a comprehensive pedestrian network • **EPP 9:** Developing an efficient solid waste management system

Figure 2.15 The nine EPPs for the GKL/KV NKEA

Source: PEMANDU 2012c

Increasing the connectivity of GKL/KV falls under dimension 2 of the GKL/KV EPPs. The challenge here is that the current public transport system remains inadequate, fragmented and often unreliable to cater for demand in the region. As of 2009, public transport modal share stands at just 12%, having declined from 34% in 1985 and 20% in 1997. The aim is to replicate success of other major metropolitan areas such as Singapore, Hong Kong and Tokyo, which have public transport modal shares over 50% (PEMANDU 2012c).

EPP 3 aims to accelerate regional connectivity between Greater KL/KV and Singapore via a High Speed Rail (HSR) system, as shown in **Figure 2.16** and unlock economic growth in intermediate Malaysian cities. Decreasing the travel time to just 1.5 to 2 hours increases viability of daily travel between the two largest economic agglomerations in South East Asia (SEA). The HSR brings benefits by increasing travel demand in the region and creating business opportunities while meeting this demand with a sustainable form of transport. It is also expected to drive worker productivity through a reduction in travel time (PEMANDU 2012c).

High speed rail will provice non-stop services to major regional centres and intercity services

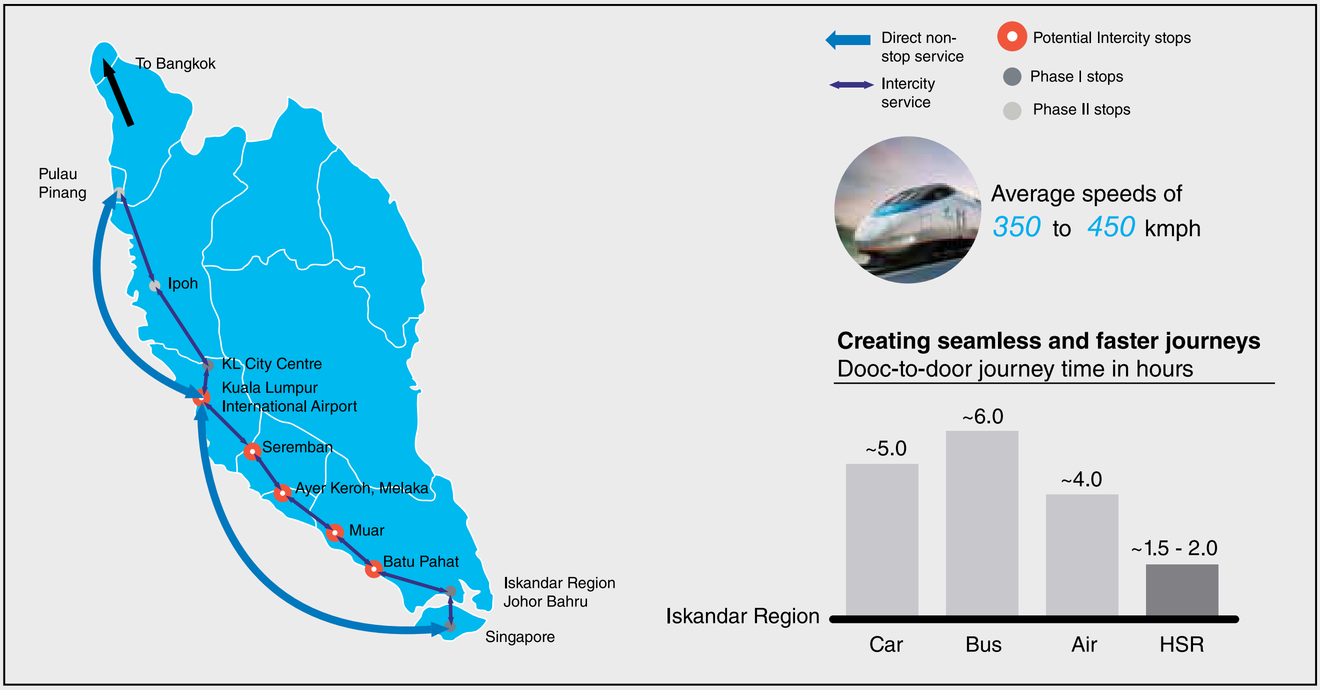


Figure 2.16 Connecting to Singapore via a HSR system

Source: PEMANDU 2012c

EPP 4 is an extension to the GTP UPT NKRA, with the expansion of the coverage of population living within an accessible system distance of an efficient rail system through the implementation of an integrated urban MRT system. The GTP UTP NKRA initiatives will increase existing urban rail capacity, primarily through investments in rolling stock, while the MRT system is designed to serve existing travel demands through a new corridor as well as serving future demands from upcoming major developments to reach GKL/KV's aspiration to achieve a 50% public transport modal share by 2020 (PEMANDU 2012c). **Figure 2.17** shows the MRT system and the expected percentage mode share.

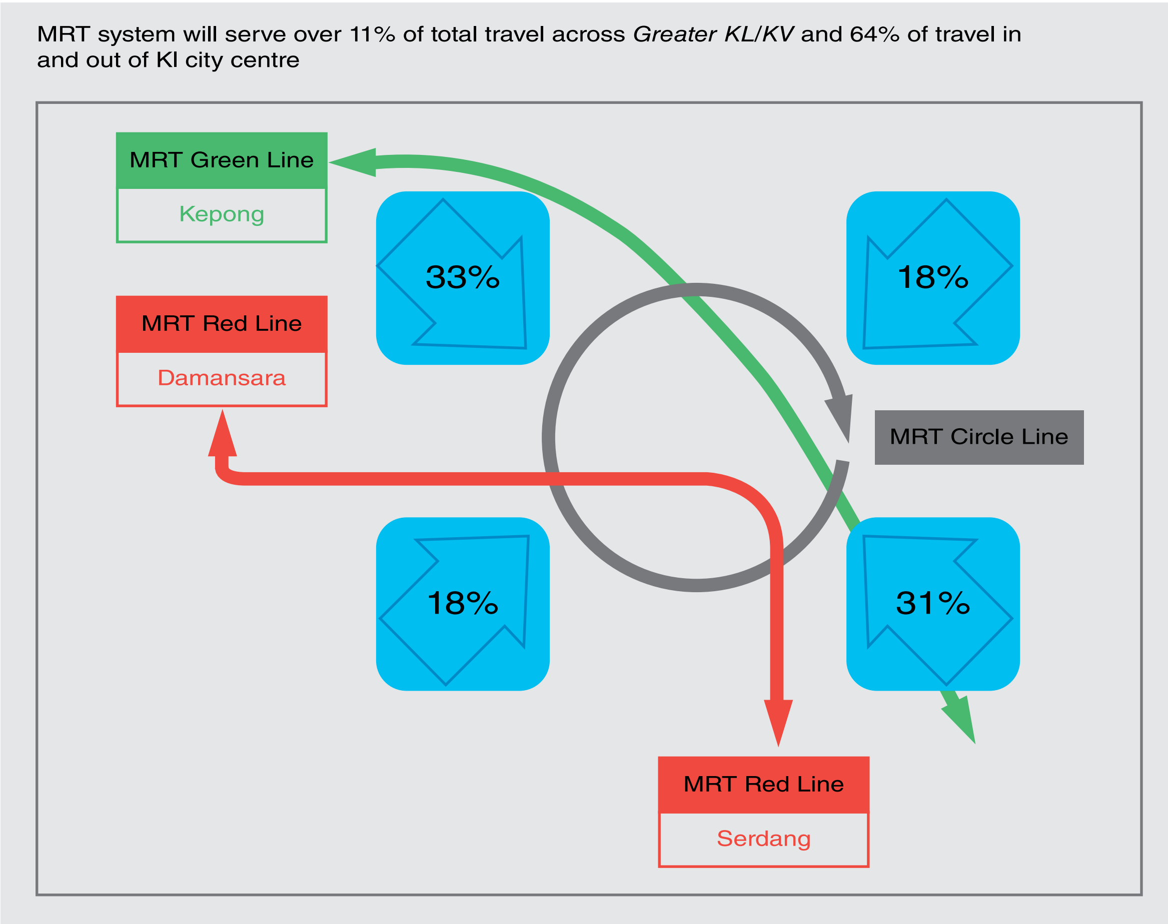


Figure 2.17 The MRT system and the expected percentage mode share

Source: PEMANDU 2012c

The 10MP for the year 2011-2015 reiterates the government's commitment towards the Government Transformation Programme (GTP) and the New Economic Model. The government is committed to ensuring a high quality of life in urban and rural areas in line with Malaysia's aspiration to become a developed nation. Towards reaching this end, strategies in the 10MP to build an environment that enhances quality of life focusses on items as shown in **Figure 2.18**.

Figure 2.18 Strategies to build an environment that enhances quality of life

Source: EPU 2010

The population in the GKL/KV area is slated to grow up to 10 million people by 2020 and by then urban areas will accommodate 75% of Malaysia's population. There are two options to accommodate growth, building up or building out. Building out, or sprawl, brings long commutes, congestion and pollution as well as adverse effects on environmentally sensitive land (EPU 2010).

In order to accommodate this growth and building vibrant liveable cities, compact urban development is encouraged under the 10MP. The government will facilitate better use of mechanisms for managing growth such as zoning, urban growth boundaries, growth control regulations and other development incentives, including renewal and redevelopment of brown-field sites. Mixed use development in neighbourhoods, combining residential, retail and office spaces is encouraged in order to reduce the need for travel and to encourage the presence of people-centric activities within the urban landscape. State and local authorities will be encouraged to move towards having a higher proportion of mixed-use commercial/ residential zoning in their Structural and Local Plans (EPU 2010).

However, high-density mixed-use development must be integrated with a well-functioning public transport system through ToD. Integration of land use and transportation plans in shifting towards compact and efficient cities will be an important component of LP. To develop a public-based transport system in the 10MP, the government will continue its efforts to strengthen its approach to transportation planning, integrating public transport and land use development in all national, regional and local development master plans. The goal of improvements will be to advance the development of vibrant and liveable cities, while also ensuring that small and medium sized cities are not left behind.

During the Plan period, strategies to position public transport as the mode of choice for all commuters will focus on areas as in **Table 2.3**:

Table 2.3 Focus Areas to Develop a People-Centred Public Transport System in 10Mp

Driving regulatory and industry reform	SPAD is tasked to deliver improvements in public transport through the following initiatives: • Developing and implementation of a 20-year National Land Public Transport Master Plan, along with region specific master plans; • Establishing a new operating framework for public transport operators; • Introducing innovative initiatives, such as BRT system; and • Pending successful implementation in Peninsular Malaysia, the Government will review the potential of expanding SPAD's scope to Sabah and Sarawak.
Increasing investment in transport capacity to keep pace with urban growth	GKL/KV initiatives: • The 34-km extension of the LRT lines • Delivery of 35 new four-car trains to the Kelana Jaya LRT line • Improve connectivity between the KTM Komuter, LRT and Monorail systems • Consider the extension of the monorail line • Addition of 38 new six-car trains to the KTM Komuter system • Implementation of 49-km GKL/KV BRT system consisting of three major corridors • Implementation of MRT system Other cities and urban areas initiatives: • Implementation of BRT system in the Iskandar Region, integrating traffic demand management initiatives, park-and-ride facilities and bus terminals • Increase frequency and coverage of the Rapid Penang bus service in Penang • Implementation of small-scale approaches to increase the capacity of public transport for medium-sized cities • Enhancement of river transportation as a mode of public transport in Sarawak Inter-city systems

	• The 197-km extension of the electrified Double Track Project (DTP) from Gemas to Johor Baru to increase KTM's track capacity • In the East Coast of Peninsular Malaysia and Sabah, rail services will be enhanced by modernisation of facilities and technologies
Promoting a seamless system across modes and operators	Efforts will be directed towards increasing the percentage of one-way journeys completed within one hour and with fewer than four transfers: • Improving pedestrian experience by increasing the number of bus stops closer to homes, upgrading pedestrian walkways as well as upgrading major rail and bus stations • Improving connectivity across different modes of public transport through the multi-modal transfer hubs such as ITT Bandar Tasik Selatan • Introduction of cashless ticketing system across all 16 public transport operators in GKL/KV • Implementation of Passenger Information System to improve the ease of using public transport
Establishing a robust monitoring and enforcement regime	With regulatory restructuring, LPT operators will be subjected to stringent performance monitoring and enforcement: • The Integrated Transport Information System (ITIS) in Greater KL will be upgraded into the performance hub for land public transport monitoring and enforcement efforts through the usage of Closed-Circuit Televisions (CCTVs) and Global Positioning System (GPS) trackers on buses to enable efficient performance monitoring • Establishment of KPIs for LPT operators • Strengthen enforcement of existing laws restricting the entry of heavy vehicles into the CBD area during peak hours

Source: EPU 2010

2.1.2 INDUSTRIAL ACTIVITY

Apart from the motor vehicle manufacturing and motor vehicle parts manufacturing under the automotive industry that focus on improving the vehicular technology (automotive section), industrial activity in the land transport sector includes building, upgrading and maintenance of road infrastructure by construction companies (infrastructure section). Among others the road infrastructure industry is applying new construction technologies as a measure to reduce energy and environmental impact of road construction such as applying new material to enhance pavement life-cycle; warm-mix technology that lowers temperature requirement compared to current hot-mix technology; and recycling of asphalt pavement.

Intelligent transport system is also a growing industry in Malaysia. TrafficSens Systems (M) Sdn. Bhd. is among leading companies developing smart traffic lights. Rather than passive traffic lights that triggered based on timer or vehicle detection, the TrafficSens system connects traffic lights at junctions in a certain area to work concurrently in order to provide the smoothest traffic flow for road users. LEDtronics Sdn. Bhd. is a LED digital display provider which plays a critical role in Travel Information System, either the Variable Message Signs for road users and Passenger Information Display at public transport terminal.

Portable Variable Message Signs are also commonly deployed during road works which is critical in informing road users of hazardous road condition. Katsana, is a GPS-enabled car tracking system developed by Pixelated Sdn. Bhd. in Malaysia. EVO Systems Sdn. Bhd. offers GPS-based Vehicle Tracking System for personal use as well as fleet management of freight trucks and public transport. Vehicle Tracking System (or Automatic Vehicle Location) is an important component of Advanced Public Transport System. Touch ‘n Go is the leading company in the smart card industry in Malaysia. It’s Touch ‘n Go cards are widely used for cashless toll payments and public transport fare payment. The SmartTAG is an infrared device that allows for Electronic Toll Collection while the vehicle is on the move. Integrated Transportation Solutions Sdn. Bhd. specialises in intelligent transportation system products and all of the products offered are developed in-house in Malaysia. The company is also the first to develop the first Weigh-in-Motion system in Malaysia, the Road-i.

2.1.3 UNIVERSITY PROGRAMMES

Transportation is a broad based profession that encompasses infrastructure, transport mode, traffic and control system. It is concerned not only with planning, design, construction, operation, maintenance and control of transportation facilities, but also with safety of users. It drives the economy through the provision of safe, economic, efficient, effective and environmentally sustainable delivery of transport services. Transportation draws strength from other allied professions and a usually not treated in isolation. Hence education and training programmes that involve engineering (Civil, Mechanical, Automotive, etc.) and planning (Town, Urban, Regional, Transport, etc.) generally contains subjects or modules dealing in one aspect of transport or another.

2.1.4 RESEARCH IN LOCAL UNIVERSITIES AND INDUSTRY

Research in local universities covers broad area of studies such as Transportation Planning, Public Transport, Highway Traffic, Road Safety, Intelligent Transportation System, Freight, Road Safety and Emergency Services. There are research centres and groups that focus on these areas such as the Centre for Transportation Research (CTR, Universiti Malaya) and Transportation Research Group (TRG, Universiti Teknologi Malaysia), while Road Safety Research Group (ROSREG, UniversitiTeknologi Malaysia)focuses their research in road safety. The Malaysian Institute of Transport (MITRANS, Universiti Teknologi MARA) focuses their research on freight transport and logistics policies. The UM Power Energy Dedicated Advanced Centre (UMPEDAC, Universiti Malaya) is the country’s main expert in their research fields of power electronics, traction, supporting controller, and battery management system.

2.1.5 CONCLUSION

These transformative targets set by the Government to galvanise the public transport system in Malaysia demonstrates that the Government is aware of the issues hounding our current car-oriented transport system and is implementing measures in order to ensure that the transport issue does not become an endemic problem in the near-term.

Nevertheless, there are other measures and strategies that are equally important and impactful that should be considered for implementation. Among these are urban planning policies that facilitates walking and cycling, prohibitive measures that will discourage the rakyat from using private transport and regulating improved vehicle technology and standards to reduce the level of GHG and air pollution emission. These strategies combined provide the best pathway towards sustainable transport as a whole. Moreover, there are also key barriers that the government must also overcome towards achieving sustainable transport goals in Malaysia.

This report also aims to explore and recommend additional measures and policies successfully implemented in other countries that can be implemented to further support the Government's initiative towards sustainable transport in Malaysia. This report will also highlight potential R&D&C opportunities in areas of science, technology and innovation that can contribute to the economic growth of the country and identify sources of future growth opportunities in the transport sector.

2.2 RAIL: AN INTRODUCTION

Rail transport has long been identified as a more efficient mode of transport for moving passenger and freight, compared with other types of land vehicles. The rail transport has the desirable characteristics of being capable of transporting a high volume of passengers and/or cargo. It is also more energy efficient, relatively safer and has a lower impact on the environment (Profllidis 2006).

In Malaysia, the development of transportation system has been heavily skewed towards road-based transport, and comparatively less attention has been given to the rail transport. In terms of transport infrastructure, the road length in Malaysia has increased eight fold, from 14,446km in 1980 to 117,604km in 2007. Conversely, the length of railway track has only increased with an average annual rate of 1% from 1989 to 2009 (Mustapha *et al.* 2011). As for the year 2010, the total length of the rail line in Malaysia is 1849km, with 57km of it using the standard (1.435 m) gauge and the rest using narrow (1.000 m) gauge (CIA World Factbook 2010). However, in the recent few years, the Government has been giving more attention to the development of rail transport.

According to the data by MIGHT (2013), more than RM50 billion has been invested by the Government on local rail industry since 1990. As for the year 2010, the local rail industry generates a turnover of approximately RM1.7 billion and created approximately 9,500 job opportunities. However, the turnover is still significantly lower than other modes of transport, where the turnover for aerospace, automotive and maritime were 25.9 billion, 25.5 billion, and 7.26 billion, respectively.

Figures 2.19 and **2.20** indicate the statistics for passenger and freight using rail in Malaysia, from 2010 to 2010. The passenger data is separated into those who travel on train operated by KTMB and those who use the light rail system (which covers the Putra line, Star line, KL Monorail, KLIA express and KLIA transit). Even though there is a slight decrease of KTMB passenger, the increase in light rail passenger is far more significant that there is a huge increase of overall rail passenger traffic, from 138 million in 2010 to 161 million in 2012, which is approximately 17% increment. The rail freight volume also exhibit similar increase, from 5.4 million tonnes in 2010 to 6.1 million tonnes. This shows that there is an increased potential of development in the rail industry in Malaysia. It is expected that more opportunity will arises in the local industry as the government is investing an estimated amount of RM 160 billion for future rail projects up to the year 2020 (MIGHT 2013).

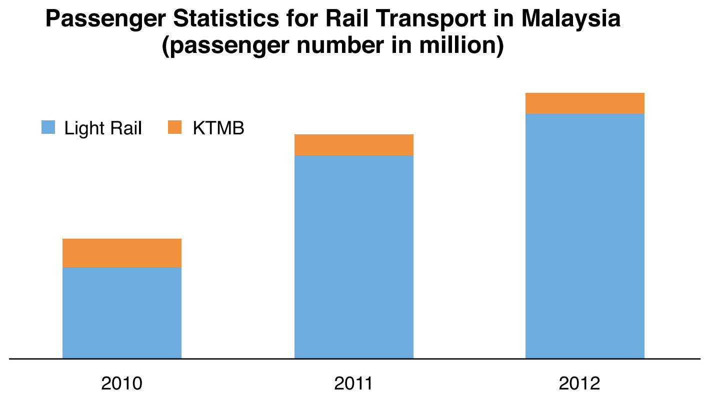


Figure 2.19 Passenger statistics for rail transport in Malaysia from 2010 to 2012

Source: MOT Malaysia

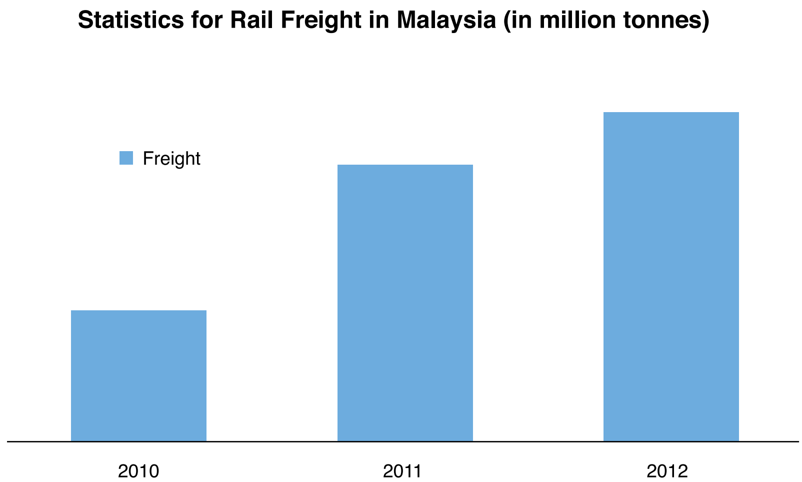


Figure 2.20 Statistic for rail freight in Malaysia from 2010 to 2012

Source: MOT Malaysia

2.2.1 MALAYSIAN GOVERNMENT POLICY

The rail transport has been identified as one of the key element for achieving an integrated national transportation system in Malaysia. In NPP 2, 2010, it was proposed that the railway serves as the fundamental means of transporting people and goods, while the road system acts more as an alternative mean of transportation and an articulation of the system. To achieve this, the integration of both the rail and road, through interactions and interlinks that allows multimodal transportation of people and goods, is crucial in ensuring efficient and effective operation of the system (Federal Department of Town and Country Planning, 2010). The importance of the rail industry to Malaysia's development can be seen from several recent important policies, master plans and reports published by Government bodies. Among these are:

i. NPP 2

ii. National Land Transport Master Plan

iii. ETP

iv. Future Rail 2030: The National Rail Industry Roadmap

2.2.1.1 NATIONAL PHYSICAL PLAN 2 (NPP2)

The National Physical Plan is a proposalthat was approved by the National Physical Planning Council to provide general outlines on the spatial planning policies and measures for Peninsular Malaysia for the year 2020. NPP 2 was finalised in 2010, and can be considered as a review of the NPP1, which was introduced in 2005. The document describes the overall land use and development policy for Peninsular Malaysia based on eight development themes, covering 41 development policies. One of the eight development themes as proposed in NPP2 is dedicated to the development of the transport system, with the theme being "Integrating the National and Urban Transportation Network". Under this theme, five policies have been identified (NPP28-NPP33). The brief descriptions on these policies, with a focus on the rail transport, are given as follows:

An integrated national transportation network shall be established in recognition of the inter-relationship between land use and transport - NPP28 (IP22: Integrated National Transportation Network)

Under IP22, the three transport network strategies have been identified:

i) Network Configuration

NPP 2 anticipated that the future integrated national transportation system should be a multimodal system supported mainly by well integrated road and railway network. It is also suggested that high-speed rail capable of running at 300km/h should be integrated as part of our transport system.

ii) National Gateways and Transportation Nodes

KL Sentral has been identified as the national transportation hub, where multimodal transport can be accessed. In particular, KL Sentral will be the central hub for various types of rail transport, such as the high speed train, the Express Rail Link, the KTM Commuter, LRT as well as Monorail.

iii) Urban Transportation and Intelligent Transport System

Under this strategy, it is mentioned that a single multimodal transportation authority is needed to oversee the planning and development of the integrated transport system.

A national integrated high-speed rail system shall be established to complement the existing rail network - NPP29 (IP23: National Rail Network)

It is suggested that a National Railway Master Plan needs to be set up; covering both high speed rail and KTM commuter train use to move both passengers and goods. With regards to high speed rail, it is suggested that capital of all States and the main cities need to be connected by high speed rail network. The Kuala Lumpur-Johor Baharu-Singapore is identified the priority track for high speed rail. The high speed rail extension to Bangkok is also suggested as part of the Trans-Asian Railway.

The national road network shall be further extended for regional travel access - NPP30 (IP24: National Road Network)

Under this policy, the road network is expected to be supported and integrated with the high speed rail network.

Major airports and seaports shall be developed according to their complementary function to enhance the nation's economic competitiveness and facilitate tourist arrivals - NPP31(IP25: National airports and seaports)

The main airports and seaport is expected to be supported by multimodal transportation system, with rail being one of its core components.

The ToD concept shall be promoted as the basis of urban land use planning in order to ensure viability of public transport - NPP32

It is suggested that the main railway terminals be developed to serve as an integrated multimodal transportation hubthat is supported by feeder bus, park-and-ride facilities as well as covered pedestrian walkways. The rail based transport, particularly, the LRT and MRT, shall be incorporated in the urban development of main cities. It is also highlighted here that the current LRT routes in KL area needs to be further integrated and extended to its surrounding growing suburbs.

An integrated public transportation system shall be established in all major urban centres - NPP33

It is suggested that cities with more than 0.5 million of population needs to be integrated with mass rapid transit system.

2.2.1.2 NATIONAL LAND TRANSPORT MASTER PLAN

SPAD had prepared and published the final draft of National Land Transport Master Plan on October 2013, as a foundation and guideline for the long term development of a sustainable land transport system in Malaysia. The master plan includes several subsidiary plans such as:

i) Urban Rail Development Plan

ii) Bus Transformation Plan

iii) Taxi Transformation Plan

iv) Interchange and Integration Plan

v) Land Use Plan

vi) Travel Demand Management Plan

In addition, a whole chapter of the master plan has been dedicated to addressing the issue on Land Freight. A major problem faced by land freight in Malaysia is the inadequate use of rail for freight moving. By using the rail, it provides a is more efficient and environmental friendly, for long distance freight movement, better efficiency and flexibility can be obtained. Here, it is mentioned that the Electrified Double Track (EDT) project connecting Ipoh and Padang Besar is expected to transport 64% of the KTMB's freight transport by 2023. The other planned railway network, e.g. the East Coast Rail Route (ECRR) is also expected to play a vital role in advancing the economic development in the East Coast Economic Region, with a forecasted annual freight load of 37 million tonnes by 2024.

2.2.1.3 ECONOMIC TRANSFORMATION PLAN (ETP)

Driven by the aspiration of bringing Malaysia to the rank of high income countries, the Government has introduced the ETP in 2010. It is placed under the management of Performance Management and Delivery Unit (PEMANDU), which is an agency under the Prime Minister's Office. From the ETP, twelve National Key

Economic Areas (NKEAs) have been identifies as having the potential of uplifting the country's economy. These NKEAs are to be given priority by the Government in terms of funding, human capital and Prime Ministerial attention. Under the NKEAs, a total of 131 Entry Point Projects (EPPs) have been identified through various laboratories conducted by PEMANDU under this ETP initiative. Two of the EPPs that are related to the rail industry development in Malaysia are as follows:

1) EPP 3 – High Speed Rail Connection to Singapore (NKEA: Greater Kuala Lumpur)

Under this EPP, a high speed rail system is to be built to connect Kuala Lumpur and Singapore as a move to enhance commercial activities between these two economic centres of the Southeast Asia. Currently, a feasibility study is being conducted by SPAD.

2) EPP 19 - Supporting Regional Rail MRO Services Via Electrical and Electronics Component Manufacturing

Under this EPP, a consortium is to be established to conduct electrical and electronics rail MRO activates. It is aspired that this consortium will grow to become maintenance and repair services provider in ASEAN regional. At the same time, research and developments will be conducted under this EPP, on obsolete electrical and electronics rail parts, sub-systems and components. Vendor development programs will also be conducted to develop local players and SME in this industry.

2.2.1.4 FUTURE RAIL 2030: THE NATIONAL RAIL INDUSTRY ROADMAP

The Future Rail 2030: The National Rail Industry Roadmap is a result of the joint collaboration between the National Foresight Institute (NFI) and Land Public Transport Commission (SPAD). The NFI is an organisation under Malaysian Industry-Government Group for High Technology (MIGHT) responsible for identifying the charting the direction of the nation on important technological issues.

The roadmap was partially revealed in the form of a published article in the myForesight magazine, where 9 drivers for the development of rail industry in Malaysia have been identified. These drivers are policy and institution framework, technology and human capital development, multimodal and integrated transport, market competition and value added products/services, connectivity and tourism, safety and security, localisation and globalisation, sustainability, and lastly geopolitical. The expected scenarios for five of these drivers by the year 2030 are described in the myForesight magazine, and are summarised as follows:

1. Policy and Institutional Framework

In the foresight report, it is mentioned that by 2030, a total of RM180 billion will be invested by the Government on installing new rail facilities. It is expected that SPAD will be playing an active role on developing the rail industry in Malaysia, including setting up a set of rail standards together with Standard Malaysia and SIRIM. It is suggested that under the coordination of the National Rail Industry Council, a large part of the programmes outlined in the rail industry road map should have been successfully implemented.

2. Technology and Human Capital Development

In terms of technology and human capital development, the report in myForesight suggested that by 2030, there should be a huge job market in Malaysia's rail industry. In line with that, the government has put in great effort in providing rail related workforce through various training institutes, especially through the Centre of Excellence for Rail set up by. In term of technology development, the report pointed out that the research output on the rail sector is yet to be seen, and current technology transfer is done mainly via "offset and reverse engineering". The report also suggested that funding for research and development for rail industry will not be a problem, as such research has been identified as one of the R&D priority by the National Science and Research Council and proper funding has been allocated.

3. Multimodal and Integrated Transport

In 2030, it is expected that railway network will be an integral part of the transport system in Malaysia, with improved coverage and connectivity through the whole Malaysia. Supported by efficient feeder together with improved reliability and service, rail is foreseen as the public's preferred choice of transport. Apart from being a medium of passenger transport, the railway is also expected to be the preferred choice of freight transport.

4. Market Competition and Value Added Products/ Services

With the support and attention from the Government, some of the local rail industry players are expected to have transcended from local champions to becoming competitive players in the global rail industry market by the year 2030. These companies will not only be capable of handling the local rail industry needs, but also compete with international companies in providing rail expertise in the global market.

5. Localisation and Globalisation

It is envisioned that by 2030, Malaysia has already established its name in the rail industry, where local companies are able to provide maintenance, repair and overhaul (MRO) services which are certified by international regulating bodies. From the global view, the advantages in terms of local talent, strategic location, good facilities and policies have drawn western train and equipment produces to set up manufacturing facilities in Malaysia, making Malaysia as a regional hub for railway industry.

2.2.2 INDUSTRIAL ACTIVITIES

Asset Management and Rail Operation

The rail transport in Malaysia are owned and run by several different companies and their subsidiaries. Keretapi Tanah Melayu Berhad (KTMB) is owned by the Malaysian Government, and operates several rail lines including locomotive, ETS, commuter as well as cargo wagon. RapidKL, a subsidiary and operating arm of Prasarana, operates the Putra LRT, Star LRT, Monorail and the cable car service in Langkawi. In Sabah, the Sabah State Railway owns and runs the train service in Sabah. Some other smaller rail service owner and operators include Express Rail Link (ERL) which owns and runs the KLIA express, and Melaka Taming Sari Berhad which owns and runs the Melaka Monorail.

Design, Manufacturing and Assembly

These include companies that supply systems, sub-systems, parts and components to the asset owners in the rail industry. This comprises of companies which are involved in components fabrication, to system and sub-systems integrator, as well as companies which function as final integrator in the rail industry. Currently, Malaysia relies on import of systems, subsystems and 68% of parts and components used by the rail industry (MIGHT 2013). Several notable companies involved in the design, manufacturing and assembly sector of the rail industry, and their respective service are as follows:

i. Scomi Rail – Signalling, power distribution, communication, Supervisory Control and Data Acquisition (SCADA) and Automated Fare Collection.

ii. Aldridge Railway Signals – Railway signals and equipment.

iii. Gummi Metall Technik (GMT) – rubber and rubber to metal bonded couplings and mountings

iv. Composite Technology Research (M) Sdn. Bhd. (CTRM) – composite inner and outer panel for monorail

v. SMH Rail – supply systems and sub-systems for train

Maintenance, Repair and Overhaul (MRO)

Another important group of the rail industry players are those involved in MRO services. These companies provide maintenance and support services to the rail operators. The MRO operation can be further categorised into the following five segments:

i. 1st and 2nd level Maintenance

ii. 3rd Level Maintenance

iii. Component Maintenance

iv. Propulsion Maintenance

v. Modification and Upgrade

It was highlighted in MIGHT (2013) that even though there are players in almost all segments of the MRO market, their capabilities to perform maintenance on complex system are not comprehensive.

2.2.3 UNIVERSITY PROGRAMMES

In order to ensure a sustained development of the rail industry, it is important to develop the local human capital in this field. Due to the lack of graduates trained specifically on the field of railway technology, the rail industry in Malaysia has been tapping on foreign talents as well as local graduates from related fields, such as engineering, logistics, technology to obtain their work force. While this will suffice for less technology intensive sectors of the rail industry, it is not an encouraging setting for industry players who are involved in more technology intensive activities. There is a need to develop local human capital specialised in the field of railway technology in order to ensure promising and sustainable growth of the rail industry.

In the past few years, some efforts have been given by both the government and the industry in providing education specific for the rail industry. This can be seen from the establishment of railway related subjects and courses in university and training centres. As can be seen from **Table 1**, currently University Tun Hussein Onn (UTHM) in Johor is offering general-based master course on railway engineering. Several other academies are also involved in providing railway specific education and trainings. MyRA and RapidKL Rail Academy established by KTMB and RapidKL respectively, provides mainly trainings for their employees, particularly the blue collar new entrants.

On top of these, a Memorandum of Understanding (MOU) has been signed between MIGHT (Malaysia) and Thales (France) on 29th July 2013 for developing human capital in rail industry, as part of the plan of creating a Rail Centre of Excellence (RCOE) in Malaysia. According to the MOU, MIGHT and Thales will be providing expertise on the field of signalling and communication for the RCOE. Based on the information found, it can be concluded that there is still plenty of space for improving the local human capital development for rail industry in Malaysia, especially in terms of STI development in rail industry. **Table 2.4** shows the list of rail-related courses/programs offered in Malaysia.

Table 2.4 List of Rail-Related Courses / Programmes Offered in Malaysia

University/Institute	Course Name	Remarks
University Tun Hussein Onn (UTHM)	Master of Science in Railway Engineering	- Full-time (three semesters) or part time (five semesters). **Compulsory courses:** Research methodology, transportation system and planning, infrastructure and track systems, train control system, rolling stock and traction system, railway management. **Elective subjects:** Railway electrification system, railway operation and maintenance, railway track engineering design, signalling and communication, project management, rolling stocks technologies and maintenance.
Malaysia Railway Academy (MyRA)	Programmes: 1) Development Programme 2) Management Programme 3) Safety Programme 4) Operational & Technical Programme	- Formerly known as Akademi KTM - A private higher educational institute managed by KTMB - Established MOU with UTHM
KLIA Professional & Management College	Diploma on Railway Management	
RapidKL Rail Academy	N/A	- MOU with UTHM on railway research

2.2.4 RESEARCH IN LOCAL UNIVERSITIES AND INDUSTRY

Unlike countries like Japan and China, where there are designated institutes responsible for spearheading researches in rail technology, rail research in Malaysia is more scattered. At the moment, there is no specific research group dedicated to conducting rail research. Rather, researches on rail technology are attempted as small projects under broader research theme such as transportation and logistics. Example of such related research groups are the Centre for Transportation Research (CTR) in University of Malaya, Malaysia Institute of Transport (MITRANS) in University Teknologi MARA, and Transport Research Alliance (TRA) in UniversitiTeknologi Malaysia.

Rail-related research activities can be capital intensive and requires specialised facilities or sensitive industry data. Such activities are usually done via collaboration between rail industry and local university. Universiti Malaya through UM Power Energy Dedicated Advanced Centre (UMPEDAC) shows their research interest on traction, power electronics, power system protection and power quality.

2.2.5 CONCLUSIONS

Based on the information gathered, it is evident that there is an increased in the emphasis given by the government on the rail sector. The introduction of new rail projects, as well as the upgrading of existing railways, has provided new hopes and opportunity for the rail sector and its supporting industry. The importance of rail transport can also be felt through the recent government policies, where the role of rail as an integral part of Malaysia's transportation system is repeatedly highlighted. In terms of education and research, there is still plenty of space for improvement. Given the current situation, there is a lack of local experts to support the desired growth in the rail industry's R&D activities.

2.3 AEROSPACE: AN INTRODUCTION

Airlines around the world are replacing older aircraft with more fuel efficient aircraft due to the rising cost of fuel and increasingly stringent environmental requirements. At the same time manufacturers are building aircrafts with better fuel efficiency, lower emissions and noise profiles. An increasingly globalised aerospace industry is also focusing more on core business, cost reduction and increased speed to market. Savings of between 20 and 30% are achieved by Original Equipment Manufacturer (OEM) integrators such as Airbus and Boeing when shifting their production to Asian countries such as China, India, Malaysia and Singapore.The focus is more on core competencies such as aircraft overall design, architecture, integration, and final assembly and delivery to end customers. A much reduced procurement cost is achieved by outsourcing more "design to build" packages rather than just "build to print".

The aerospace industry is focusing more on system integration, less internal production capability, and a desire to work with a lesser number of Tier 1 primes. For example Rolls Royce reduced the number of suppliers from 250 for the Trent 500 engine, to 140 for the Trent 900 and 75 for the Trent 1000. Many governments are applying off set conditions when procuring aircrafts and defence items. To illustrate, part of a Japanese Government order for Boeing 787 includes a consortium of local companies such as Mitsubishi.

High powered microwave weapons, hypersonic missiles, long-range and high altitude unmanned aerial systems and satellite-based high resolution full motion video cameras are some of the technology developed in the defence sector. Technologies to harvest solar power from space-based solar arrays, converted to microwaves, or high voltage wireless signals, to ground, air, and sea-based distribution networks are being developed for commercial application. The development of an efficient supersonic commercial aircraft without the sonic boom and environmental issues is much awaited.

To understand the future of the world Military Aerospace Sector (MAS) a knowledge of deficit spending of major customers such as the US and European governments is crucial. The aging fleets in this sector are becoming increasingly expensive to maintain and operate. The average age of the US Air Force fleet in 2008 was 24 years old. Therefore, it could be anticipated that aircraft procurement may increase even when defence spending is low. India and China are some of the countries that are expected to increase military expenditure. In particular, India, that has a high potential as an engineering and manufacturing partner.

The UK Government and industry have also invested £2 billion in a long term plan to retain the UK's position at the forefront of world aerospace manufacturing. The plan includes the creation of a UK Aerospace Technology Institute (ATI) which provides a platform for industry and academic researchers to develop technology for the next generation of quieter, more energy efficient aircraft. This will help win work on future aircraft programs and secure up to 115,000 high value jobs in aerospace and its supply chain in the long term.

2.3.1 MALAYSIAN GOVERNMENT POLICY

The Ninth Malaysian Plan (RMK-9, 2006-2010) has identified the aerospace subsector as one of the new sources of growth. Measures to further develop and promote the subsector include:

i. developing and promoting potential growth areas in the sub-sector;

ii. strengthening domestic capabilities;

iii. promoting support services; and

iv. developing Malaysia as an outsourcing centre for aerospace products and support activities. Measures are also being undertaken to develop and promote potential growth areas of competitive strength. These include:

i. nurturing domestic manufacturers of parts and components to support the production of small aircraft;

ii. continuing to focus on the manufacture of light aircraft, such as recreational and military trainer aircraft, while promoting the manufacture of small commercial and military aircraft;

iii. strengthening the maintenance, repair and overhaul activities through equipping the service providers with advanced technologies and upgrading the skills to undertake the activities;

iv. capitalising on the development of the space segment, such as the astronaut programme and building of satellites, which is expected to provide spin-off effects on scientific research and the development of the telecommunications industry; and

v. promoting domestic and foreign investments in the potential growth areas.

The Government are also seeking to enhance the capabilities of the subsectors by:

i. encouraging M&As among the service providers in maintenance, repair and overhaul activities to provide a wider range of services;

ii. promoting the development of software's by utilising digital technology in aerospace;

iii. providing more technical training programmes and specific advanced courses relevant to the sub-sector to upgrade the skills and knowledge of the workforce; and

iv. strengthening collaborations with foreign manufacturers and service providers. As an example, offset programmes will be leveraged upon to enable effective transfer of technologies. In addition, strategic collaborations with foreign aerospace companies will be promoted to acquire advanced technologies.

The support services are also being given attention by:

i. providing ground and support services at the airports to light aircraft users, in both business and leisure activities;

ii. encouraging local companies to upgrade their capabilities and venture into the production of support equipment and tooling's; and

iii. promoting greater collaborations with major companies in support services, for example, in the area of certification, through licensing and joint ventures.

The government is also promoting Malaysia as an outsourcing centre for aerospace products and support services by:

i. promoting and facilitating the establishment of more joint venture companies in Malaysia, especially in parts and components; and

ii. encouraging more passenger and cargo carriers to have their regional base in Malaysia, which will provide more opportunities to domestic service providers to undertake maintenance, repair and overhaul activities on their aircraft.

In addition the Malaysian National Aerospace blueprint, drawn up by the MIGHT through its might interest group in Aerospace, advocates for:

i. the establishment of a national level steering committee called National Aerospace Council to oversee the development of the aerospace industry,

ii. the setting up of a national aerospace coordinating body to act as a reference point for the various aerospace activities and investments,

iii. the upgrading of the Department of Civil Aviation to Civil Aviation Authority to provide the industry to a monitoring as well as regulatory function in the areas of airworthiness, air traffic control and aerospace product/services,

iv. putting in place a National Human Resource Development Programme to ensure that the quantity, skills and costs of personnel is adequate and competitive,

v. the establishment of Malaysian Agency for Space Administration (MASA) to strengthen Malaysia's entry into the space sector,

vi. the formulation of a national procurement policy which emphasises on local products/services and technology to ensure sustainable economic development and reduces import and financial outflow.

The "Malaysian Space Policy" currently being developed by the National Space Agency (ANGKASA) aims to:

i. set out the vision and goals of Malaysia space activities for the new century

ii. provide strategic context for investments in space exploration and exploitation by the government and industry in order that they contribute effectively towards the socio-economic well-being of the nation;

iii. mobilize and organise the resources (financial, manpower & institutional) to make such investments work for the nation in term of enhancing the productivity and skill-levels of the key economic sectors as well as the generation of high value added products, processes and services;

iv. establish the framework for the effective performance of the various actors involved in the exploration and exploitation of space including the engagement with external parties.

The development of the Malaysian defence industry is guided by the Defence Industry Blueprint. The primary focus of the Blueprint is to achieve a certain degree of self-reliance and ability to provide strategic support in sustaining the defence capabilities of the nation. Major thrusts and action plans in the blueprint are:

1. Human Resource and Competency Development

A comprehensive and cohesive human resource development plan will be formulated to develop critical competencies, to enable the industry to undertake its role in the nation's defence.

2. Technology Development

The industry will be encouraged to continue to upgrade technologies, either through R&D or technology acquisitions or transfers. To enable the Malaysian defence industry to have continuous access to advanced technologies for use by the Malaysian Armed Forces, a comprehensive programme will be formulated and undertaken to acquire technological capabilities, either through indigenous development or technology transfers from foreign partners, including international collaborations.

3. Industry Development

Focus will be given on developing the competency, technology and competitiveness of the defence industry. The requirement of the Malaysian Armed Forces on transportation equipment products will be capitalised in the development of the transport equipment industry.

4. Domestic Defence Requirement

The Policy on National Defence Procurement will be applied to provide greater opportunities to qualified domestic defence contractors in obtaining projects and being involved in determining major defence requirements. This measure will make it obligatory for OEMs to transfer related technologies and capabilities to local companies. The domestic defence procurement process will be leveraged upon as a tool in acquiring strategic technologies, as well as in the development of the Malaysian defence industry.

5. International Marketing

Greater efforts will be undertaken to take advantage of the global defence spending. Such efforts will create opportunities for companies involved in defence related activities to develop their technological and business capabilities to enable them to compete globally. These capabilities include internationally recognised standards and qualifications.

Targets for investments and exports have been set for the transport equipment industry, covering the three sub-sectors, namely, automotive, marine transport and aerospace, during the IMP3 period, 2006-2020:

i. Investments totalling RM42.3 billion for the entire period, or RM2.8 billion per annum; and

ii. Exports reaching RM22.7 billion by the end of 2020.

2.3.2 INDUSTRIAL ACTIVITIES

Two Malaysian companies in particular MAS Aerospace Engineering and AIROD are well established in the MRO sector.

MAS Aerospace Engineering (MAE) is one of the largest MRO providers in the world. It has 18 bays for wide body and narrow body aircraft within 6 hangars spread over an area of 120 thousand square meters. The services it provides include Airframe Maintenance & Modification, Component & Engine Maintenance Support, Line Maintenance & AOG Support, Engineering &Specialised Services, Integrated Fleet Technical Management, Engineering Management (CAMO), Maintenance Execution, Supply Chain Management, Engineering Training, MRO Consultancy and Total Airframe Capacity.

AIROD is an internationally recognised MRO company. It is a wholly owned subsidiary of NADI. The services it provides include aircraft maintenance, repair and overhaul, engine maintenance repair and overhaul, components repair and overhaul and modifications and upgrades.

ATSC Sdn. Bhd. (Aerospace Technology Systems Corp. Sdn. Bhd.) was formed on 25th June 1994 between the government of Malaysia, the Russian State Corporation "Rosvoorouzhenie" (presently known as FSUE ROSOBORONEXPORT), and Moscow Aircraft Production Organisation (MAPO) presently known as PJSC RAC "MIG" as part of an offset programme by the Government. It is a subsidiary of NADI. Its core business is the support and enhancement of MiG 29N/UB and Su 30MKM aircraft in its totality, from maintenance, supply and distribution of spares and materials, repair and overhaul, technical services, upgrading and modernisation covering engines, airframe and avionics.

In manufacturing, two companies, in particular SMEA and CTRM, stands out amongst the rest. SMEA is a wholly owned subsidiary of National Aerospace & Defence Industries (NADI). Its core business is the manufacture of aircraft parts, components and assemblies for customers worldwide. It has a wide range of capabilities and approvals, including Nadcap approvals. The company commenced operations in 1993. Since then, it has contracts to manufacture and assemble parts and components for various aircraft models, including Airbus A320, A340 and A380, and Boeing B777 and B747.

However, CTRM Aero Composites Sdn. Bhd. is a wholly owned subsidiary of Composites Technology Research Malaysia Sdn. Bhd. (CTRM). It was incorporated on 16 August 1994 as the manufacturing unit of CTRM, focusing on the manufacturing of composites components for both aerospace and non-aerospace segments. Major customers include Spirit AeroSystems, Goodrich Aerostructures, Airbus UK, EADS CASA, SONACA SA, EADS MAS, GKN Aerospace Services and BAE Systems Land System. In the services sector, Strand Aerospace Malaysia Sdn. Bhd. (SAM) provides services such as primary aero structures analysis covering; static. Fatigue and Damage Tolerance (F&DT), finite element, composite, design, in-service support, and aircraft structural integrity.

In general, industrial activities in Malaysia are more focus on providing maintenance, training and support services. There are very few involved in manufacturing and even fewer or none in research and development.

2.3.3 UNIVERSITY PROGRAMMES

Generally, undergraduate programmes are divided into aeronautical and aerospace engineering programmes. Aerospace engineering deals with the design, construction, including the science behind the physical properties of aircrafts, rockets, flying craft and spacecraft. Aeronautical deals only with aircrafts that operate in the earth's atmosphere. Hence, aerospace programs cover a broader field as compared to aeronautical as it includes such things as satellites systems. This also means that the depth covered by aerospace programs may not be in sufficient as required in the aerospace transportation industry given that Malaysia does not have outer space programs like NASA.

As such there are only three universities offering courses at the undergraduate level in aeronautical engineering. Namely, of this three, one university provides three variations of aeronautical engineering programmes namely professional piloting, aircraft maintenance and air traffic control. The three other universities are offering programmes in aerospace engineering. UniKL offers aircraft engineering technology programs at bachelor level in Mechanical and Avionics and a Bachelor in Aviation Management. It also provides engineering technology programs at diploma level in avionics, aeroplane and helicopter maintenance. Several other institutions are also offering aircraft maintenance programs at diploma level.

2.3.4 RESEARCH IN LOCAL UNIVERSITIES AND INDUSTRY

At UPM, research is being carried out in aeronautical engineering which includes aerodynamics, aerospace material, structure propulsion, flight mechanics and aircraft stability and control. In the area of astronautics engineering the research includes orbit mechanics, space environments, estimation and control of height, telecommunications, aerospace structure and rocket propulsions. While, USM conducts research in the fields of aerodynamics, aerospace structures, aerospace control, astronautics, aerospace composites and propulsion. UPNM, on the other hand, focusses on research in aerodynamics modelling and analysis, whilst UTHM conducts research on Fixed and Rotary Aircrafts, Aerodynamics and Propulsion, Aircraft Design, Wind Tunnel Testing and Unmanned Aerial Vehicle Design. In the industry, though, only CTRM seems to be involved in research. Nonetheless, there are no indications of whether these research are done in collaboration with the industry or are in support of the objectives stipulated in the Government policies.

2.3.5 CONCLUSION

It can be concluded that Malaysia has already the right policies in place that would address the prevailing trends in the global aerospace transportation sector, despite that, there seems to be a strong focus on MRO with very little emphasis on manufacturing. Moreover, in research, collaboration between universities and industries is lacking and do not seem to follow the global trend.

2.4 MARITIME AND INLAND WATER TRANSPORTATION: AN INTRODUCTION

The maritime sector is strongly pushing for cost reductions in terms of fuel efficiency of ships. New ships need to have higher fuel efficiency. This is partly due to increasing fuel prices and regulatory measures. Therefore, there is a market potential for fuel efficient systems and alternative fuel based solutions. The market potential is large in particular with containerships where it is expected to accelerate the replacement of vessels with more fuel efficient variants. However, if fuel prices continue to rise, fuel-efficiency solutions for retrofits will also become very attractive. An example of such technology is the use of liquefied natural gas. There are already a variety of LNG-powered passenger ferries and other vessels including 'ro-ro' cargo vessels already in operation in Norway. The ports there are also developing the necessary infrastructure for LNG re-fuelling. Besides that, other technologies that have a market potential include air lubrication which helps to reduce the friction between hull and sea water thereby reducing fuel consumption. Fuel-cell technology is also being developed to replace auxiliary engines in larger ships.

In the EU Maritime Transport Strategy 2009-2018 - a 10-years strategy plan to "promote safe, secure and efficient shipping on clean oceans, the long-term competitiveness of European shipping and related maritime industries in world markets, and the adaptation of the entire seaborne transport system to the challenges of the 21st century", six main areas of action are outlined. These include globalisation prospects, care of human resources, quality shipping as the result of a safe, secure and environmentally friendly transport system, international order, short sea shipping & logistics and RTD requirements. Both the authorities and the industry are involved in the implementation of the proposed strategy.

China and Korea holds the majority share of the world's shipbuilding market. China's rapidly growing shipbuilding industry has focussed primarily on commercial vessels. The People's Republic of China (PRC) Government classifies shipbuilding as a strategic sector. There is a strong emphasis on hull-block construction, investment in major new "greenfield" shipyards, and bolstering of Chinese firms' ability to produce marine diesels and gas turbines. Other areas of technological focus include enhancing systems integration abilities and developing the subcomponents. There is also a strong emphasis on human capital with Chinese universities and maritime academies producing nearly 1,500 marine engineers and naval architects per year, roughly seven times the number of such graduates from institutions in USA.

Korea's modernisation of the shipbuilding industry started in the 1960s with high speed growth during the 1980s before becoming a global leader in the beginning of 2000. The growth engine of Korea's shipbuilding industry is its high quality manpower that is fuelled by naval architects from 34 universities and colleges, including skilled a workforce of six shipyard training centres which produce 5000 per year. It also maintains the world best technology by enhancing its technology competitiveness and continuously introducing new technology. It has good infrastructure and on time management decision.

2.4.1 MALAYSIAN GOVERNMENT POLICY

The government has set five strategic thrusts for the long term viability of the marine transport sub-sector:

i. Enhancing domestic capabilities in the building of smaller vessels, ship repairing and maintenance activities;

ii. Intensifying the upgrading of skills and engineering capabilities;

iii. Strengthening infrastructure and support facilities;

iv. Strengthening the institutional support; and

v. Expanding activities in the fabrication of offshore structures.

The focus on in shipbuilding will be on smaller vessels of 30,000 DWT or lower. Thus, the existing capabilities, expertise and facilities are expected to be developed to support this. As a result, the ship repairing segment will need to upgrade their facilities with advanced technologies and improved the competency of their skilled personnel.

The government is implementing offset policies for the defence related marine transport products and services. This involves the training and transfer of technology from foreign manufacturers to Malaysian companies on defence related technologies in shipbuilding and ship repairing. Skills and engineering capabilities are being upgraded by:

i. providing more technical programmes to upgrade the technical skills of the local shipyards;

ii. encouraging the upgrading of the skills in ship designing and engineering, metallurgy and corrosion control;

iii. promoting the attachment of experts in existing training institutes; and

iv. collaborating with major shipbuilding countries in the upgrading of skills in marine transport.

Support services such as the supply of special grades and specifications of steel plates, manufacture of tools and dies, and machining and casting is strengthened by.

i. developing the skills and capabilities in marine designing and architecture, R&D and marketing;

ii. encouraging the upgrading of the machinery and equipment to produce parts and components of the required standards and quality; and

iii. identifying common parts and components which can be developed or multi-sourced to reduce the costs of production.

The offset programmes and cooperation projects are also expected to encourage indigenous designing capabilities. Financial aids and other forms of assistance will be provided for projects undertaken by domestic shipyards. The activities in offshore structures fabrication is expected to expand by:

i. promoting the development of skills in the design and fabrication of offshore production platforms for use in coastal and international waters; and

ii. encouraging domestic fabricators of offshore structures to participate in international projects.

Added to that, MIGHT, in its strategic plan for shipbuilding and ship repair, has targeted the Malaysian shipbuilding/ship repair industry to be a major player in the small to medium-sized shipbuilding market by the year 2020. The strategies drawn include the following:

i. Establishment of business-friendly policies that support the growth of the industry

ii. Strengthening the institutional framework

iii. Reinforcement of the regulatory framework assure the integrity of the shipbuilding/ ship repair local companies and the quality of their products

iv. Attracting and repairing adequate and capable workforce.

v. Applying local design and adopting new shipbuilding/ ship repair technologies

vi. Improving financial and incentive packages in addition to promotions of inward investments

vii. Upgrading competency and the level of sophistication of the industry

2.4.2 INDUSTRIAL ACTIVITIES

There are numerous companies in Malaysia in the shipbuilding and services business.

Labuan Shipyard and Engineering Sdn. Bhd. (LSE) core business is the oil and gas & the marine industries. This includes ship repair, shipbuilding, naval craft maintenance and power barge construction. The company has built a wide range of vessels with increasing sophistication and complexity. These include 16,500-DWT palm oil/chemical tankers. It also caters to the repairs and maintenance needs of the Royal Malaysian Navy especially those vessels stationed in East Malaysia, ranging from small assault crafts to the latest new generation offshore patrol vessels. Apart from that, the company builds power barges. To illustrate, a 103 MW power barge was built for the Philippines' National Power Corporation.

The Boustead Naval Shipyard Sdn. Bhd. is part of the Boustead Heavy Industries Corporation and provides shipbuilding, ship repair, electronics and weapons services. It has built new generation patrol vessel, fast troop vessel, ferry and anchor handling tug supply vessel. Ship repair is the core activity in the shipyard. It provides defence and marine electronics systems repair facility for the Royal Malaysian Navy fleet. It is one of the very few establishments in this region able to provide a complete package of providing service, maintenance, repair, and overhaul, for multiple types of naval and land-based electronics defence systems

Located in Miri, Sarawak, East Malaysia, theBerjaya Dockyard specialises in the construction of OSVs for the local and international offshore oil and gas industries, and high-performance utility vessels such as landing crafts, workboats, and multi-purpose tugs. It is also one of the few shipbuilders in Asia with the expertise and experience to build highly specialised ERRVs.

The Sealink Group is an Integrated Service Provider which builds, owns and operates a diverse fleet of offshore marine support vessels, serving mainly the global offshore oil and gas exploration and production industry. It provides marine support services, shipbuilding and repair.

The MSET located in Terengganu is capable of constructing steel vessels of above 1000 tones displacement, such as the Tug Boat, Anchor Handling Tug, Support Supply Vessel, Survey Vessel, Coastal product tanker and the Bunker Barge. They are also capable of building aluminium and wooden boats up to 40m in length, such as the patrol boat, crew boat, leisure boat, rescue boat and many more. Apart from that, they do repair and maintenance services. In short, there are quite a number of companies that have business related to maritime transportation particularly supply and services.

2.4.3 UNIVERSITY PROGRAMMES

The Universiti Malaysia Terengganu offers a wide range of programs both at undergraduate and postgraduate levels. At the undergraduate level courses that specifically address the maritime transportation sector includes a BSc (Nautical Science and Maritime Transportation), Bachelor of Applied Science (Maritime Technology) and Bachelor of Computer Science with Maritime Informative. However, there are no engineering courses offered. At the postgraduate level, MSc or PhD research programmes in Maritime Transportation and Maritime Law are offered which are considered relevant to the Maritime Transportation Sector. The Universiti Pertahanan Nasional Malaysia is currently offering a Bachelor of Mechanical Engineering in Marine, while UTM is offering a Bachelor of Mechanical Engineering in Marine Technology. Other universities are offering Bachelor of Science in Marine Science or Marine Technology. Thus, it can be observed that there seems to be a lack of marine engineering courses at the undergraduate level in IPTAs.

However at the Diploma level, UniKL offers a wide range of engineering technology courses in ship design, Construction and Maintenance of Ships, Marine Engineering and Electrical & Electronics (Marine). UniKL also offers a Bachelor of Engineering Technology in Marine Electrical and Electronics as well as Architecture and Shipbuilding.

2.4.4 RESEARCH IN LOCAL UNIVERSITIES AND INDUSTRY

UTM has extensive facilities for research in maritime transportation including a ship simulator. Some of the researches conducted include design and Construction of an Offshore Fishing Vessel, LNG Vessel Design, design and Construction of a 7 metre long Fibreglass boat and Manoeuvring Behaviour of MISC's Tenaga Class Vessel in Restricted Water. Research done by Universiti Malaysia Terengganu includes Efficient Ships, Sea's Pollution Prevention, Ship Production Technology and Marine Technology. UniKL conducts research in ballast water treatment system, marine construction-underwater glider and underwater vehicle. Apart from that, the University of Malaya, through UMPEDAC, is currently collaborating with UCTS in conducting research on solar-powered hybrid system for ships. Nonetheless, there are no indications that the research activities are supporting the industry.

2.4.5 CONCLUSION

Although there is a thriving shipbuilding industry, the scale is small. Most activities are focussed on maintenance repair and overhaul. There is a lack of human capital development in ship building pale in comparison with Korea and Japan. There is also little R&D being done in shipbuilding.

2.5 SAFETY AND ENFORCEMENT MANAGEMENT SERVICES: AN INTRODUCTION

2.5.1 ROAD SAFETY AND ENFORCEMENT

Since the launch of the United Nations Decade of Action for Road Safety 2011-2020 (United Nations 2011), the ambitious goals of the Decade — to save five million lives and avoid fifty million injuries — would represent one of the great public health achievements in the early 21st century. According to International Traffic Safety Data and Analysis Group (IRTAD), currently, nearly 90% of road accidents occur in low and middle-income countries (IRTAD 2013). With GDP loss per country pegged at between 1 and 3%, the economic and social cost of this epidemic can exceed the amount of overseas aid coming into countries.

The increase in road accidents are contributed by a number of factors, including geometric features of roads, road user and driver behaviour, vehicle design, traffic and pavement attributes, and environmental aspects. There tends to be a link between poor road conditions and the number of road crashes (e.g. the type of road, whether it is an urban or rural location, and the type of terrain) (Rohayu *et al.* 2012). Roads that are in capable of handling heavy traffic volumes, inadequate for the terrain, poorly maintained, and have poor visibility, contribute to road fatalities and injuries. Based on a survey done by WHO, poor road and land-use planning in South-East Asia often result in a hazardous combination of high-speed through traffic, heavy commercial vehicles, motorised two-wheelers, pedestrians and bicyclists on developing country roads. Facilities for vulnerable road users like sidewalks and bicycle lanes are often scarce (WHO 2009).

Hospital systems are clogged with traffic victims — increasingly, vulnerable road users such as pedestrians, cyclists, and motorcyclists — straining scarce medical resources. Without strong social safety nets to compensate victims or their families, road traffic injuries can thrust aspiring generations into a cycle of poverty. The recent Global Road Safety Status Report launched by the WHO identified road crashes as the major cause of death for youths aged 15 to 29. Faced with the prospect of rapid motorisation growth, the World Bank has stepped up efforts to help client countries strengthen their capacity to prepare, prioritise and implement cost-effective road safety programs.

Guided by the 2004 World Bank-WHO World Report on Road Traffic Injury Prevention and the core pillars of the Decade of Action Plan, the central focus has shifted to the Safe System approach where responsibility for reducing risk is shared across a wide swath of actors, and results are achieved in a process that is underpinned by targeted road safety interventions and robust institutions. Dedicated road safety funding is also instrumental to success. If developing countries are to create long term health and safety outcomes on their roads, they must find sustainable ways to fund enforcement, engineering, public awareness, and other road safety related activities through ring-fenced revenue streams.

The success of the Decade of Action may depend on our collective ability to achieve scaled-up investments to protect future generations. Development banks can play a role in setting high road safety standards and leveraging commensurate investments in the countries where they operate. Therefore, much more work will have to be done if the 2020 UN Decade of Action target, e.g. 50% reduction in the expected number of fatalities worldwide, is to be achived. In this case, the safety of vulnerable road users is of prime concern. Indeed, with the adoption in many countries of strategies to encourage active mobility, improving safety for pedestrians and cyclists is a priority.

2.5.1.1 GLOBAL TREND

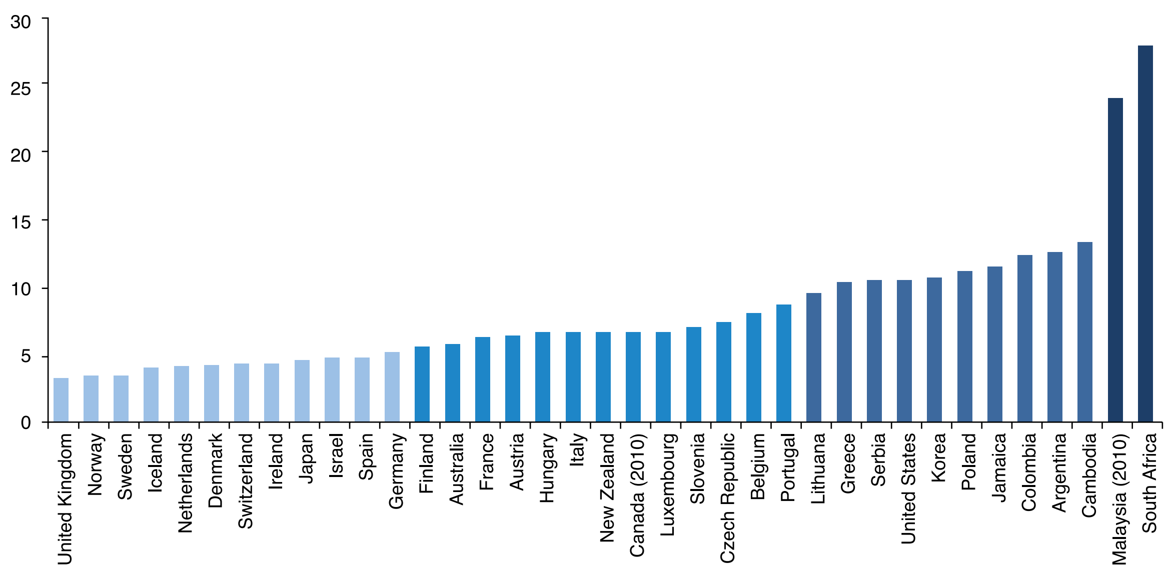


Figure 2.21 Road fatalities per 100 000 populations in 2011

Note: Data for Colombia, Jamaica, Lithuania, Malaysia, Serbia and South Africa are not yet validated by IRTAD

Source: IRTAD 2013

Figure 2.21 shows the top performing countries: United Kingdom, Sweden, Iceland and the Netherlands exhibited less than 5 road fatalities. In contrast, a developing country like Malaysia, shows 25 road fatalities per 100,000 populations.

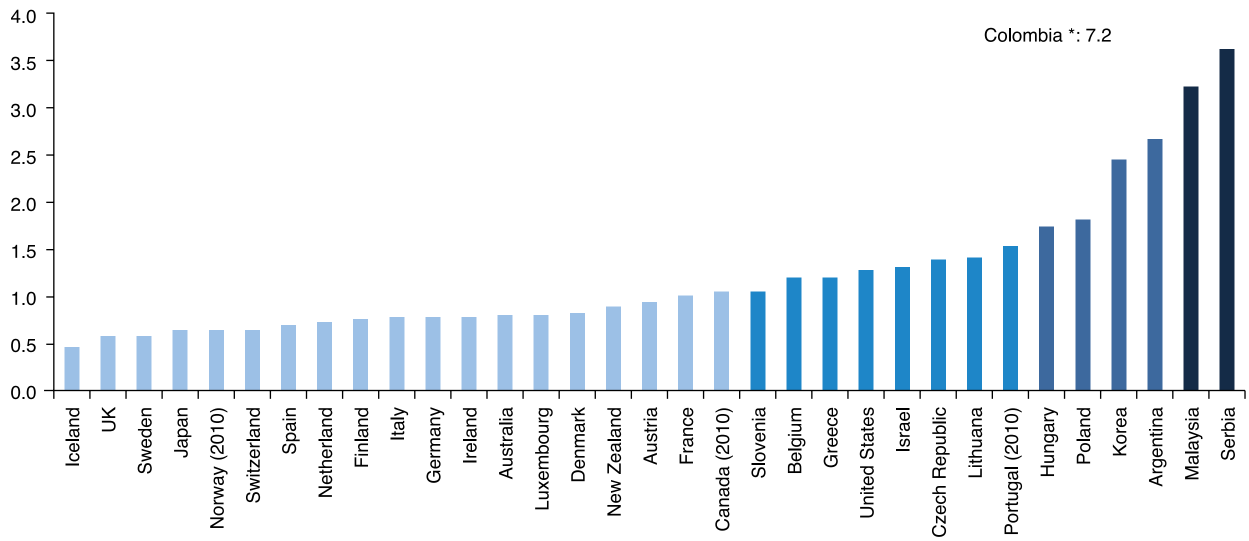


Figure 2.22 Road fatalities per 10 000 registered vehicles in 2011

Note: Data for Colombia, Jamaica, Lithuania, Malaysia, Serbia not yet validated by IRTAD * denominator also includes mopeds

Source: IRTAD, 2013

Figure 2.22 illustrates the risk exposure as expressed through the number of deaths per 10,000 registered vehicles. In the absence of data on vehicle kilometres for many IRTAD countries, the fatality rate per registered vehicles may be used as an approximation of exposure in order to describe risks and make comparisons between countries.

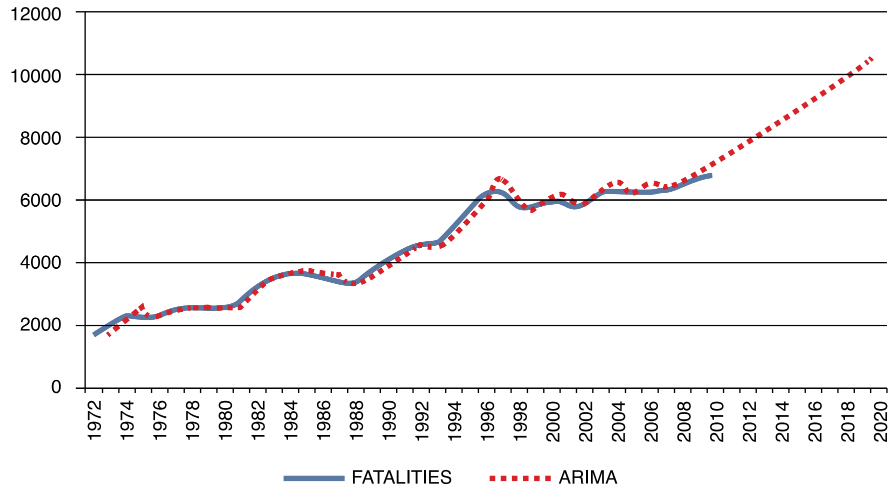


Figure 2.23 Fatality forecast for Malaysia using the ARIMA (Auto-Regressive Integrated Moving Average) model

Source: Rohayu Sarani *et al.* 2012

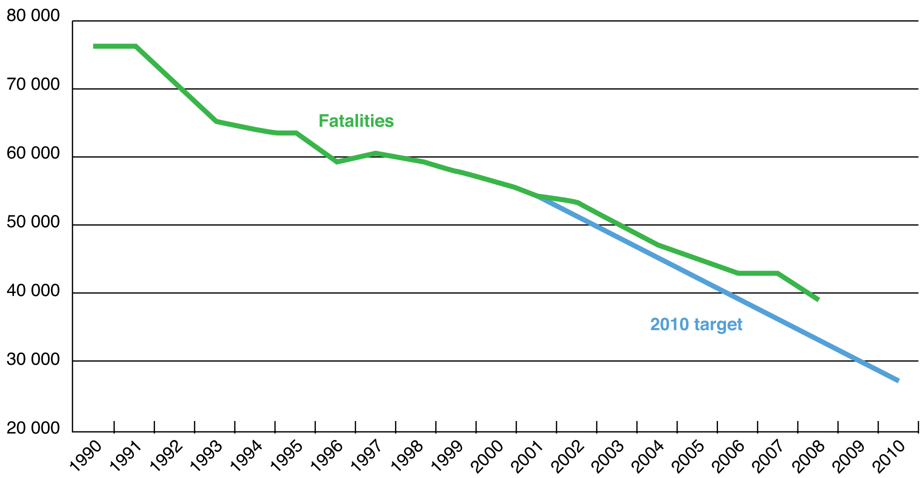


Figure 2.24 Road fatalities in the EU-27 since 1990

Source: European Commission 2009

Figures 2.23 and **2.24** reveal the comparison of road fatalities in Malaysia and EU, consisting of 27 countries, respectively. Since the EU has adopted UN Decade of Action movement, the number of road fatalities has reduced dramatically. In Malaysia, the road fatalities are predicted to increase by the year 2020, as shown in **Figure 2.10**. In Malaysia, all road crashes must be reported to the police. Therefore police data covers all types of crash: fatal, serious, slight, or damage only. To reduce the number of fatal road accidents, Malaysia is preparing a road safety plan in alignment with the UN Road Safety Plan for the Decade of Action for Road Safety with the target of 50% reduction in the forecasted number of fatalities by 2020.

Since 2000, a yearly increment of 6% on the number of registered vehicles has been observed. The high number of registered vehicles also increased the number of vehicle-kilometres travelled in the country. At the same time, fatalities increased by 14%, while the number of seriously injured road users decreased by 20.5%. Between 1990 and 2011, the number of fatalities increased by 70% (Rohayu *et al.* 2012). The increase in the number of fatalities and crashes can be associated with the rapid rise of motorisation in the country.

2.5.2 RAIL

The operation of railway involves the high speed travelling of heavy vehicles with long stopping distances. Recognising the obvious safety risks of such operations, elaborate control systems and technical standards have been developed to lessen such risks. These risk controls are complex and had become an embedded part of the railway organisations.

The safety risks that are related to privatisation or economic deregulation include the following:

i. There can be a separation of activities which were formerly within the same organisation, such as infrastructure provision and train operation, and the new safety responsibilities are uncoordinated or poorly defined.

ii. There can be attenuation in safety-critical information during its propagation across organisational boundaries.

iii. New companies entering the industry might have insufficient experience on railway operation safety and is not as safe as more experienced operators.

iv. There can be modifications in working practices which unintentionally compromises safety.

v. Profit driven private operators might reduce cost on safety to increase earnings.

In terms of the economic risk, it is possible that in an effort to protect their existing market share, main operators may claim that potential new operator are unsafe, or prevent them from gaining access to experience or information to be safe.

Usually, the performance data for railway safety are in the following form:

i. Counts of specified types of unintended events, or "occurrences" in a system; and

ii. Safety management related data.

Moreover, results from the investigations conducted on severe accidents and incident also form part of the safety performance data. There are various types of railway safety occurrences. The most serious case is train collisions and derailments with multiple deaths. Fortunately, such incidents are uncommon. Subsequently, there are less severe accidents of the same type, which cause less harm or no harm due to safety defences or sheer good luck.

Besides that, there are personal accidents involving moving trains where the victim is hit by or falls from a train; which are usually fatal. The victims of such accidents may be further divided between those who are legitimately on the railway and 'trespassers' who do not have authorised access. Then, there are many cases of suicides on railway system, which make it sometimes hard to determine whether a specific death was intentional or not. The least serious case is minor incident, including various kinds of irregular but harmless train operations, harmless infrastructure failures, and minor slips, trips and falls by people within railway property.

Of the countries within this study, long-term time series of safety performance data are available for the US, Japan and the UK, but not for the other countries and the EU-25. In particular, incidents and safety performance data on rail transportation in Malaysia are not available. In US, training/courses with certification in life-saving operation and crossing collision investigation are offered to law enforcement to help officers perform their jobs safely whenever they are required to be around railroad property.

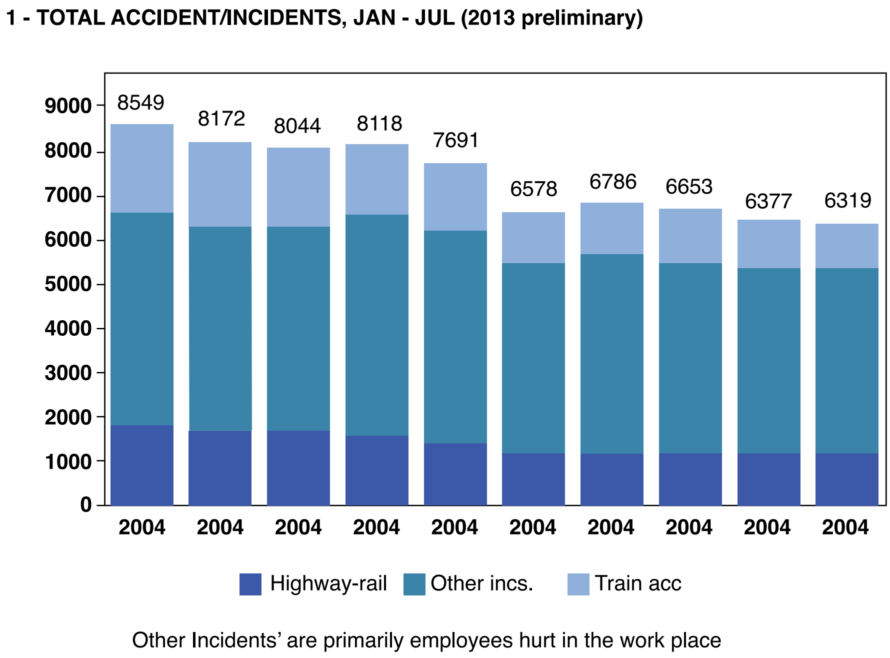


Figure 2.25 Total number of accidents in US, January-July (2013 Preliminary)

Note: Other Incidents' are primarily employees hurt in the work place.

Source: International Transport Forum 2010

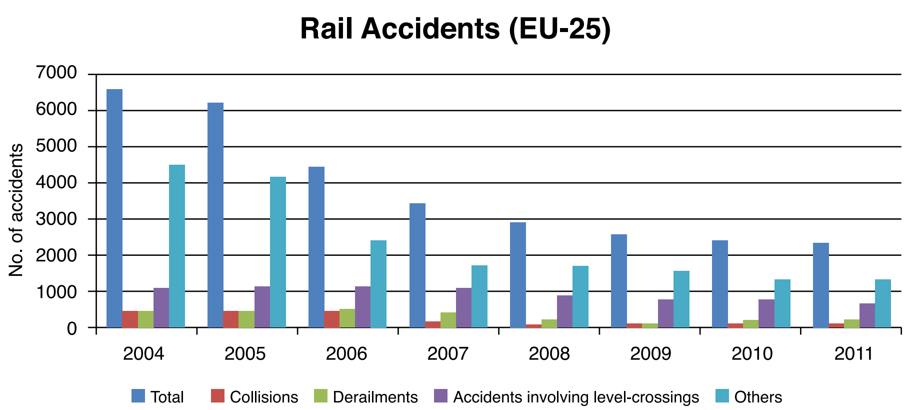


Figure 2.26 Number of rail accidents in EU-25

Source: OECD 2010

Figure 2.25 depicts the number of highway-rail and train accidents in US are lower than the number of personal accidents involving railway systems. **Figure 2.26** shows the number of accidents in EU-25. The trend shows declining number of accidents by years. A few factors contributed to rail accidents are collisions, derailments, accidents involving level-crossings and others (International Transport Forum 2010; OECD 2010).

2.5.2.1 SAFETY MANAGEMENT SYSTEM (SMS)

The European Railway Agency has started the SMS guidelines, Common Safety Methods on Risk Assessment (CSM on RA) framework, and monitoring of CSM since 2012 (European Railway Agency 2013). The SMS guidelines provide a knowledge-building base to be used by Railway Undertakings (RU) to design and implement their SMS in conformity with the requirements set up by the Safety Directive, based on the best practices adopted in the railway sector and in other high-reliability industries, also allowing for integration with other management systems. Among the general aims of SMS are:

i. Define roles and responsibilities for safety;

ii. Demonstration of how control of SMS by management at different levels is secured;

iii. Involvement of workers; and

iv. Continuous safety improvement.

Although mainly addressed to RUs that have to design and implement their SMS in order to obtain a safety certificate or authorisation, it is also useful to all those that have an interest in developing their knowledge in safety, or for integrated management systems (e.g. regulatory or supervisory bodies). The CSM on RA provide a harmonised framework for assessing significant changes. This harmonised framework will be mainly used in the risk assessment management process of operators' Safety Management Systems. The CSM on RA applies to a lot of actors – RU, manufacturers, assessment bodies and National Safety Authorities (NSA).

2.5.2.2 RAIL TRANSPORT IN MALAYSIA

Railway safety, such as accidents, offences and penalties in Malaysia, are covered in the Act 463 Railways Act 1991 (Department of Civil Aviation Malaysia, 2005) and the Land Public Transport Act 2010 (KTMB 2012). Any railway incidents would be investigated by the railway operator. A code of practice to ensure occupational safety and health in transportation sector is covered in the Safety, Health and Environment Code of Practice by Malaysian Institute of Road Safety Research (Laws of Malaysia 2010).

In 2012, KTMB had established the RMC to develop and supervise the implementation of a risk management framework for the whole organisation. Its purpose are to (Laws of Malaysia 2006):

i. assess and oversee management involving the identification and evaluation of major risks in KTMB's business operations, technology and network operations, finance and accounting, legal compliance, environmental impact, personnel policy, treasury, capital budgeting or any other areas that could create significant risks to KTMB's results, reputation or capacity to serve customers; and

ii. review and evaluate KTMB's actions to mitigate and manage risks

In addition, KTMB had also placed their auxiliary police personnel on commuter services to ensure safety of the passenger. To ensure safer and uninterrupted travel on train, KTMB also continued its awareness programme to educate the people living along the track. In the year 2012, a total of 3,334 KTMB employees attended training in various disciplines such as train operations, rolling stock maintenance, overhead line maintenance, track safety, signalling & communication systems and maintenance, occupational safety and health at workplace, computer system applications, customer service, leadership, team building and other management aspects (Laws of Malaysia 2006).

2.5.3 AEROSPACE

It is essential to have continuous improvement in global aviation safety, in order to ensure that the aviation industry continues to play its part in driving sustainable economic and social development around the world. With a projected 100% increase in air traffic over the next 15 years, measures should be taken to ensure that current and emerging safety risks are addressed proactively, and the huge capacity surge can be managed and supported via strategic regulatory and infrastructure developments. Regional and State aviation safety planning is critical to ensure continuous safety improvement that advances in pace with global air navigation modernisation. This also facilitates the safe and sustained development, improved efficiency and responsible environmental stewardship of the aviation industry, in accordance with the expectation from the society and economy. Following this, Global Aviation Safety Plan (GASP) has been released as a high-level policy, planning and implementation document guiding complementary and sector-wide air transport progress in conjunction with the ICAO Global Air Navigation Plan (GANP) (ICAO 2013).

The GASP sets out a continuous improvement strategy for states and regions to implement over the next 15 years through the establishment of core, and then more advanced, aviation safety systems. The following are target dates and the broad objectives set out (ibid.):

- Near-Term (by 2017): Implementation of an effective safety oversight system
- Mid-Term (by 2022): Full implementation of the ICAO State safety programme framework
- Long-Term (by 2027): Advanced safety oversight system including predictive risk management

The near-, mid- and long-term objectives reflect an evolution of the targets set out in the 2007 edition of the GASP. The current targets and objectives have been developed to provide a detailed path for globally coordinated safety improvements. The previous targets to reduce the number of fatal accidents and fatalities, to significantly decrease the global and regional accident rates and to improve cooperation between regional groups and safety oversight organisations remain inherent to the objectives.

2.5.3.1 GLOBAL TREND

In 2012, approximately 2.9 billion passengers travelled via air transport system, seeing a 5% increase since 2011. At the same time, there is a 21% reduction in the number of accidents with the global accident rate involving scheduled commercial operations decreased substantially to 3.2 accidents per million departures, as shown in **Figure 2.27**. Safety programs and management systems initiated by ICAO and stakeholders such as The Runway Safety Programme and Fatigue Risk Management Systems, have been set up to identify hazards and manage risk.

Table 2.5 indicates the distribution of accidents, fatal accidents and fatalities by region. While Africa accounted for only 5% of total accidents, 45% of all fatalities occurred in that region. Northern America experienced no fatal accidents while no accidents at all occurred in Oceania in 2012.

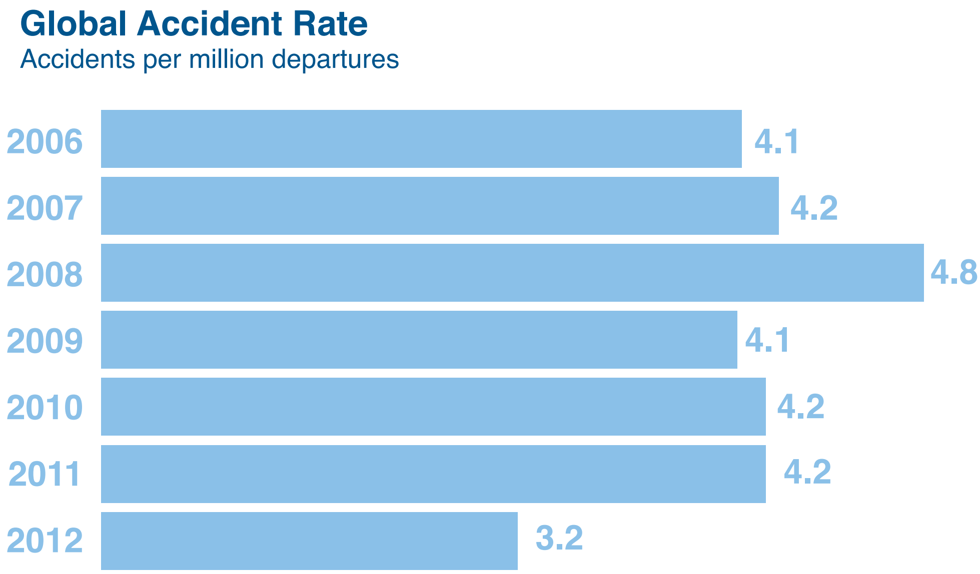


Figure 2.27 Global Accident Rate

Source: ICAO 2013

Table 2.5 Aerospace Accident Statistics and Accident Rates 2012

UN Region	Accidents	Accident rate[2]	Fatal accidents	Fatalities	% accidents	% fatal accidents	% fatalities
Africa	5	4.8	2	167	5%	22%	45%
Asia	23	2.7	3	161	45%	45%	45%
Europe	30	4.2	3	42	45%	45%	45%
Latin America and the Caribbean	12	3.8	1	2	45%	45%	45%
Northern America	29	2.8	0	0	45%	45%	45%
Ocenia	0	0.0	0	0	45%	45%	45%
World	**99**	**3.2**	**9**	**372**			

Source: ICAO 2013

Some of ICAO safety initiatives are:

i. Safety management – a new Annex 19, which has been adopted on 25 February 2013, will consolidate existing provisions related to State safety programmes and safety management systems into a single Annex. This Annex will be available in November 2013.

ii. Aerodrome safety

- Procedures for Air Navigation Services (PANS)

iii. Medical and health safety

- Collaborative Arrangement for the Prevention and Management of Public Health Events in Civil Aviation (CAPSCA)
- Upper age limits for pilots

iv. Flight operations

- Loss of control in-flight
- Recurrent simulator training
- Extended diversion time operations
- Fuel
- Cabin safety

v. Volcanic activity and ash

To create a Global Safety Information Exchange (GSIE), the Department of Transportation of the United States, the Commission of the European Union, the International Air Transport Association (IATA) and ICAO signed a Memorandum of Understanding (MoU) on a GSIE on 28 September 2010 during the 37th Session of the ICAO Assembly. The objective of the GSIE is to identify information that can be exchanged between the parties to enhance risk reduction activities in the area of aviation safety. The GSIE developed a harmonized accident rate beginning in 2011. This was accomplished through close cooperation between ICAO and IATA to align accident definitions, criteria and analysis methods used to calculate the harmonized rate, which is considered a key safety indicator for commercial aviation operations worldwide.

2.5.3.2 AVIATION TRANSPORT IN MALAYSIA

The Department of Civil Aviation and Marine Department of Malaysia are Government departments under the Ministry of Transport (MOT), which is the lead ministry for transportation in Malaysia. MOT develops policies on civil aviation and maritime transportation including safety regulations, licensing services, and monitoring of policies.

The Aviation Security Division in Department of Civil Aviation is responsible for protecting domestic and international civil aviation from acts of unlawful interference, based on the ICAO Annexes 9, 17 and 18. To ensure sufficient security measures within an airport and at vital installations, Aviation Security Programs which covers security requirements during airport construction and renovation, satisfy national laws and ICAO standards, were developed. Laws, standard and regulation of aviation security associated to Airlines Security Programme, which is based on NCASP and ICAO regulation, are defined here. At the same time, reviewed of standard operating procedure of security units and evaluation of contingency plans are also conducted by the Division.

The Airworthiness Sector in Department of Civil Aviation is responsible for regulating airworthiness through the setting of standards, recommended practices and guidelines, and their enforcement as required by the Civil Aviation Act (CAA) 1969. The main role of this sector is to improve and promote aviation safety through effective and up-to-date airworthiness regulation and by encouraging industry to deliver high standards of airworthiness. Various processes are used to regulate airworthiness activities, taking into account all aspects that can affect aviation safety. Examples of such processes include civil aircraft registration, aircraft design certification and built standards, aircraft maintenance engineers licensing, relevant organisations approval, standards developments and safety investigation.

In the case of aviation-related accidents within Malaysian airspace, all investigations are done following the procedures in the ICAO Manual of Aircraft Accident and Incident Investigation with the 'State of Occurrence' being Malaysia. The Inspectors of Air Accidents from the Ministry of Transport are responsible for the investigation of all accidents involving aircraft issued with Certificates of Airworthiness base on ICAO Annex 13. For an incident which takes place in Malaysian airspace but with the aircraft landing in another country, the investigation will be given to the State of Registry.

For an accident or serious incident involving aircraft with dangerous goods, it is the duty of the commander, operator or its representative to inform the Chief Inspector of Air Accidents and Director General of Civil Aviation regarding the presence of dangerous goods on the affected aircraft as soon as practicable, to secure the safety of the rescuers and investigators In the case whereby the investigation is not conducted by Malaysia, such information should be forwarded to the State conducting the investigation by the Chief Inspector of Air Accidents.

In the event of an accident which results in the closure of a runway or the affected airport, the Chief Inspector of Accidents must be informed by the most expedient mean so that next course of action can be decided. This includes removing any disabled aircraft and reopening of the airport. The Chief Inspector of Accidents or the Investigator-in-charge shall take in to account all prevailing circumstances before the decision of reopening the airport can be made. Air Traffic Control (ATC) units need to notify the Chief Inspector of Air Accidents of all incidents and accidents, in accordance to the Manual of Air Traffic Services. The ATC unit manager should also arrange a medical examination of the aircrew member after accident, while waiting for the arrival of the investigators. For fatal cases, conduction of autopsy examinations on the accident victims, usually with the help from the local police, is required. The medical report of the air crew and the autopsy report, if any, shall be acquired as part of the investigation process. The wreckage of the aircraft is to be secured for investigation purposes, and any unlawful interference of the wreckage will be reported to the aviation security authorities under Regulation 128 (5) of Civil Aviation Regulations (CAR) 1996 for further action (Department of Civil Aviation Malaysia 2005).

It should be highlighted here that the objective of the accidents investigations under the provisions of CAR 1996 and the ICAO Annex 13 is to identify the circumstances and causes of the accident. The investigation findings are to be used for the preservation of life and the avoidance of future accidents, and not to specify liability or blame. Statement to this effect must be included as part of the accident report by the Chief Inspector of Air Accidents, who is responsible for its presentation to the Minister of Transport, where it needs to be approved before being made public.

2.5.3.3 SAFETY MANAGEMENT SYSTEM (SMS)

It is understood that complete elimination of accidents or severe incident is unattainable due to the nature of the aviation industry. No human endeavour or man-made system can be risk free or error free and very often failures can still occur despite the most comprehensive prevention measures.

Taking into account the continuing growth of the industry, aviation organisations are encouraged to have their own Safety Management System (SMS) in order to improve the current aviation safety. A SMS is a systematic, explicit and comprehensive risks managing process which provides for goal setting, planning, and performance measurement. Annex 6 to the Convention on International Civil Aviation requires states to mandate the implementation of SMS by Approved Maintenance Organisations (AMO) by 1 January 2009. The SMS system is as crucial to business survival and the its implementation should lead to accomplishment of one of the key business goals in civil aviation industry, namely, improved safety performance targeting at best practices instead of merely being compliant with regulatory requirements.

The SMS implementation plans are as follows (Department of Civil Aviation Malaysia 2008):

1. The SMS implementation plan defines of the organisation's approach for managing safety such that the organisation's safety needs can be met. It includes the following:

    1.1 safety policy and objectives

    1.2 safety roles and responsibilities

    1.3 system description

    1.4 gap analysis

    1.5 SMS components

    1.6 safety performance measurement

    1.7 safety reporting policy

    1.8 safety communication

    1.9 means of employee involvement

    1.10 management review of safety performance

2. The SMS implementation plan needs to have the endorsement from the organisation's senior management.

3. An operator, as part of the development of the SMS implementation plan, complete a system description. It should include the following:

    3.1 the system's interactions with other systems in the air transportation system

    3.2 the system's functions

    3.3 required Human Factors considerations of the system operation

    3.4 hardware components of the system

    3.5 software components of the system

    3.6 related procedures that define guidance for the operation and use of the system

    3.7 operational environment

    3.8 contracted and purchased products or services

4. An operator, as part of the development of the SMS implementation plan, completes a gap analysis, in order to:

    4.1 identify the safety arrangements existing within the organisation

    4.2 determine additional safety arrangements required to implement and maintain the organisation's SMS

2.5.3.4 AIRBORNE COLLISION AVOIDANCE SYSTEM (ACAS)

A regulation issued by ICAO requires ACAS and pressure-altitude reporting transponder to be installed in all operating aeroplanes with mass excess of 5700kg. The purpose of ACAS is to act as safety equipment that alerts pilots on the presence of transponding aircraft in their vicinity and provides assistance on detecting and resolving potential conflicts. The equipment is designed to operate independently of the ground-based systems which are used by air traffic services for the prevention of collisions. The ACAS has been implemented in Malaysia since 2003.

2.5.4 MARITIME

The maritime industry is indeed the lynch pin of the global economy as the global economy is essentially facilitated by the transport of raw materials and process goods, by the means of shipping. At the same time, it is also one of the industries with the highest risk. It is well recognised that the best way for sea safety improvement is through the development of international regulations that are abided by all shipping nations. In the light of this, International Maritime Organisation (IMO) was established in 1959 as a specialised agency under the United Nations to regulate the maritime industry in terms of shipping safety and security as well as the prevention of marine related pollution.

With the increasing demanding nature of the global logistic industry, all modes of transportations, including maritime, have become an integral part of the global supply chain network. As a result, safety issue has an increasingly profound influence on the efficiency of the supply chain: accidents not only bring undesirable outcomes in themselves, but they also reduce the efficiency of the supply chain and affect the global economy. With this in mind, it is part of IMO's duty to ensure the most practicable, globally acceptable, standards that will improve maritime safety and security, while preventing the escalation of marine pollution.

In terms of maritime safety, the vessel's safety level can be affected by various factors, such as general ship particulars (flag, classification society, ship type, age, etc.), ship safety inspections and ship economic cycles, thus making it difficult to be measured. According to survival analysis based on ship life cycles, the shipping industry is considered a safe industry for its low hazard rate, where the hazard rate is defined here as the instantaneous potential per unit time for the event to occur, given that the ship has survived up to time varying from zero to infinity. The baseline hazard which when based on age of the vessel varies with different types of ship. Generally, the risk increases significantly for at vessel above 20 years but decreases in the first two age sets (5-10 and 11-15 years). In terms of the effect of ship economic cycles, it is worth highlighting that the hazard rate decreases with an increase in earnings for all ship types except container vessels (Maritime Knowledge Centre, 2012). The loss of ships according to IMO convention is shown in **Table 2.6**, while **Table 2.7** gives the number of lives lost at sea. It can be observed that the number of life lost at sea declined significantly in 2010, as compared with the previous year, and is the lowest figure since 2003.

Table 2.6 Loss of Ships According to Imo Convention

	2006	**2007**	**2008**	**2009**	**2010**
Ships of 500 GT and above	88	91	80	98	119
Ships between 100 and 499 GT	32	44	55	44	53
Ships of 100 GT and above	**120**	**135**	**135**	**142**	**172**
Loss rate (all ships)*	**1.3**	**1.4**	**1.4**	**1.4**	**1.7**

Source: IMO Document CWGSP 12/3

Table 2.7 Ratio of Lives Lost (Seafarers, Fishers and Passengers)
Due to Safety Related Accidents and Incidents on Ships Subject to IMO Conventions and Other Instruments, to Total Number of Lives at Risk

	2006	2007	2008	2009	2010
IHS Fairplay lives lost all ships	1,825	525	1,160	699	250
Estimated amount of passenger	1,232,000	1,277,000	1,246,200	1,266,200	1,371,000
Estimated total number of ferry seafares	1,629,573,558	1,681,931,684	n/a	n/a	2,056,062,948
Estimated total number of cruise passenger	16,927,718	17,857,711	n/a	n/a	20,775,922
Estimated total number of passenger	1,646,501,276	1,699,789,395	1,913,962,859	2,155,122,179	2,076,838,870
Total amount of passengers and crew	1,647,733,276	1,701,066,395	1,915,209,059	2,156,388,379	2,078,209,870
Ratio best estimate	1.11E-06	3.09E-07	6.06E-07	3.24E-07	1.20E-07

Based on the conditions in the international conventions, flag states are regarded as the first line of defence against substandard vessels, and followed by the port states as the second line of defence, where Port State Control inspections (PSC) are performed. Port State control was established as a legal institution for international maritime legislation enforcement, after the loss of the *Amoco Cadiz* off the coast of Brittany in 1978. Since then, the functionality of PSC has evolved to include maritime safety improvement and pollution prevention. PSC can best be described to be the right of a country to inspect a vessel coming into its port. Though there is no obligation to do so according to the IMO conventions (e.g. SOLAS, MARPOL, STCW, Load Lines, etc.), a country can still exercise this right by following a set of applicable IMO resolutions which lay the basic principles for identifying and handling substandard vessel.

IMO has recommended the establishment of regional port State control organisations and agreements on port State control. Memoranda of Understanding (MoUs) have been signed encompasses all of the world's oceans: Europe and the north Atlantic (Paris MoU); Asia and the Pacific (Tokyo MoU); Latin America (Acuerdo de Viña del Mar); Caribbean (Caribbean MoU); West and Central Africa (Abuja MoU); the Black Sea region (Black Sea MoU); the Mediterranean (Mediterranean MoU); the Indian Ocean (Indian Ocean MoU); and the Riyadh MoU.

Figure 2.28 shows the PSC detention rate from year 2002 till year 2009. During PSC inspection, a set of procedures is used to inspect if a vessel is compliant with the international conventions' standards. This is usually done in the form of surprised inspection carried out by inspectors who come on board. The first task of the inspectors is to check the certificates of the ship and the crew. The deviations or violations against a measure in the international conventions, also known as 'deficiencies', which are recorded after the inspection. The results, together with recommendations for rectifications, will be discussed with the master plan.

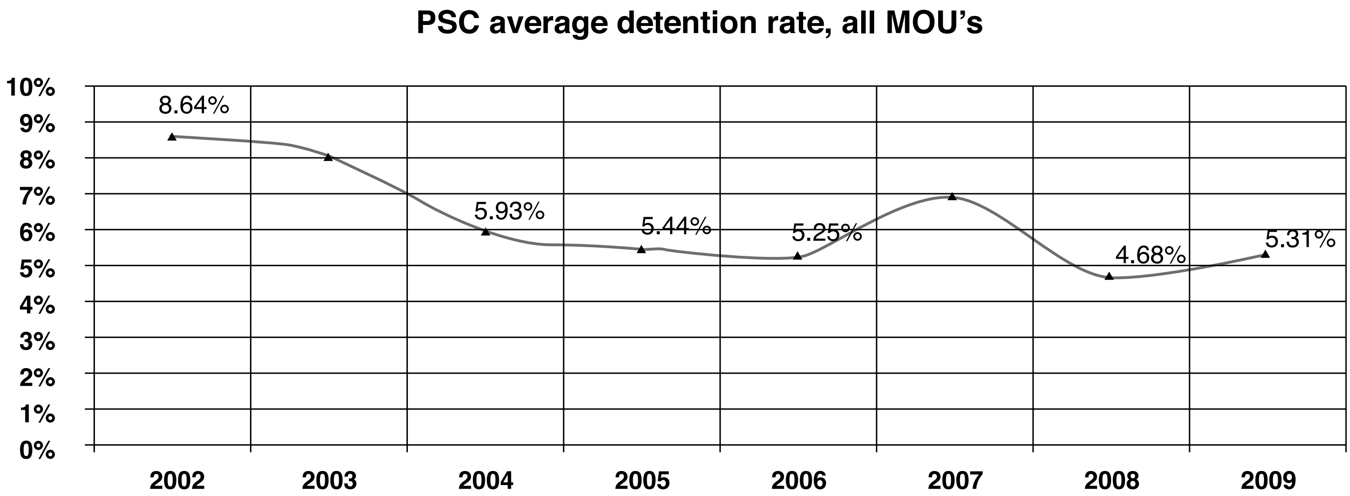


Figure 2.28 Average PSC detention rate for all PSC regimes (percentage rate) 2002-2009

Source: IMO Document C 105/3(a)/1

As mentioned earlier, maritime security is an essential part of IMO's responsibilities. On 1st July 2004, a comprehensive security regime for international shipping was enforced. Several amendments to the 1974 Safety of Life at Sea Convention (SOLAS) were included as part of the mandatory security measures which was adopted in December 2002. One of the most important changes is the enshrinement of the International Ship and Port Facility Security Code (ISPS Code). The mandatory section of the code enlists detailed security-related requirements for Governments, port authorities and shipping companies, while a second, non-mandatory section provide the guidelines for meeting these requirements

Another growing risk on maritime security is piracy. **Table 2.8** shows the number of ships and lives lost due to piracy and armed robbery, while **Figure 2.29** shows the number of missing ships from 2002-2009. The severity of the pirate problem has reached to such extent that IMO decided to set the 2011 World Maritime Day theme as "Piracy: orchestrating the response". During the launch of the IMO's action plan to promote the theme, the United Nations Secretary-General Ban Ki-moon has raised his concern on the piracy problem, describing it as unacceptable and requires an urgent and coordinated response.

Table 2.8 Number of Ships and Lives Lost Due to Piracy and Armed Robbery and Number of Such Incidents Against Ships Engaged on International Voyages (2006-2011)

Year	Number of acts	Lives lost	Wounded crew	Missing crew	Crew hostege/ kidnapped	Crew assaulted	Ship hijacked	Ships missing
2006	254	17	23	0	224	225	10	0
2007	310	22	75	57	223	39	18	0
2008	330	6	22	38	773	21	47	1
2009	406	8	57	9	746	2	56	2
2010	489	1	27	0	1,027	30	57	12
2011	544	0	3	0	569	3	50	0

Source: IMO-GISIS Database

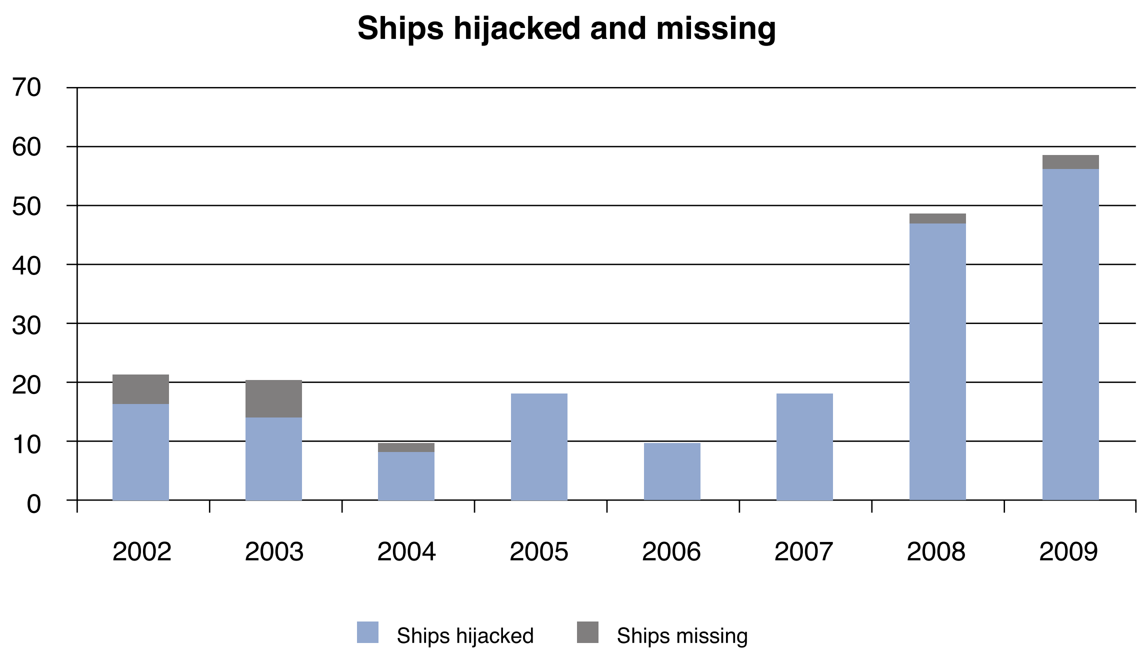


Figure 2.29 Ships hijacked and missing (2002-2009)

Source: IMO-GISIS Database

2.5.4.1 STOWAWAYS/TRAFFICKING OR TRANSPORT OF ILLEGAL MIGRANTS BY SEA/PERSONS RESCUED AT SEA

The International Ship and Port Facility Security Code (ISPS Code) has provided the procedures for preventing stowaways from boarding ships. According to the Standard Club, almost 50% of stowaways originated from West Africa. Stowaways are mostlydiscovered in container vessels, geared multipurpose ships,bulk carriers, car carriers, general cargo and ro-ro ships in containers, car decks, trailers, engine-rooms, hold ventilation, under or near the stern, ballast tanks, rudder trunks and lifeboats.

The IMO Conventions (Maritime Safety and Security) comprise of the following:

i. International Convention for the Safety of Life at Sea (SOLAS), 1974, as amended;

ii. International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto and by the Protocol of 1997 (MARPOL);

iii. International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) as amended, including the 1995 and 2010 Manila Amendments;

iv. Convention on the International Regulations for Preventing Collisions at Sea (COLREG), 1972;

v. Convention on Facilitation of International Maritime Traffic (FAL), 1965;

vi. International Convention on Load Lines (LL), 1966;

vii. International Convention on Maritime Search and Rescue (SAR), 1979;

viii. Convention for the Suppression of Unlawful Acts Against the Safety of Maritime Navigation (SUA), 1988, and Protocol for the Suppression of Unlawful Acts Against the Safety of Fixed Platforms located on the Continental Shelf (and the 2005 Protocols) International Convention for Safe Containers (CSC), 1972 Convention on the International Maritime Satellite Organisation (IMSO C), 1976 The Torremolinos International Convention for the Safety of Fishing Vessels (SFV), 1977;

ix. International Convention on Standards of Training, Certification and Watchkeeping for Fishing Vessel Personnel (STCW-F), 1995; and

x. Special Trade Passenger Ships Agreement (STP), 1971 and Protocol on Space Requirements for Special Trade Passenger Ships, 1973.

2.5.4.2 MARINE TRANSPORT IN MALAYSIA

For national security, the Malaysian Maritime Enforcement Agency (MMEA), which is established in 2005, is a maritime law enforcement agency under the Prime Minister Department. Its tasks are to maintain law and order, coordinating search and rescue operations in the Malaysian Maritime Zone and on the high seas. In 2011, MMEA is recognised as the sole Malaysian maritime agency. MMEA has taken over tasks and responsibilities of Marine Task Force and Jabatan Kastam Diraja Malaysia (MMEA, 2011).

Figure 2.30 shows the decrement of crimes from 48.06% in 2006 to 4.22% in 2011 due to the compliance of international regulations and standards such as IMO conventions. In **Figure 2.31**, robberies/piracy incidents that occurred in 2011 have the highest number in southern Johor. **Figure 2.32** shows incident categories involving boats and ships in 2011. 19 of the 65 cases (29.3%) involved missing boats and ships, and followed by 23% cases of boat/ship failure. The comparison between ships and boats (tug boat, ferries, fishing boats and recreational boats) reveals that boats contribute the highest to incidents, namely 75.4%, and followed by ships 10.8%.

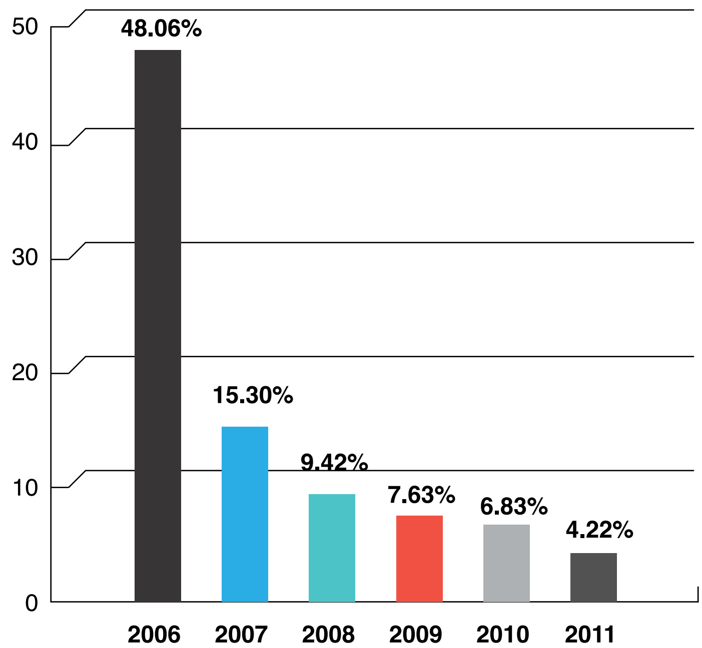


Figure 2.30 Maritime crime statistics in Malaysia

Source: Malaysian Maritime Enforcement Agency 2011

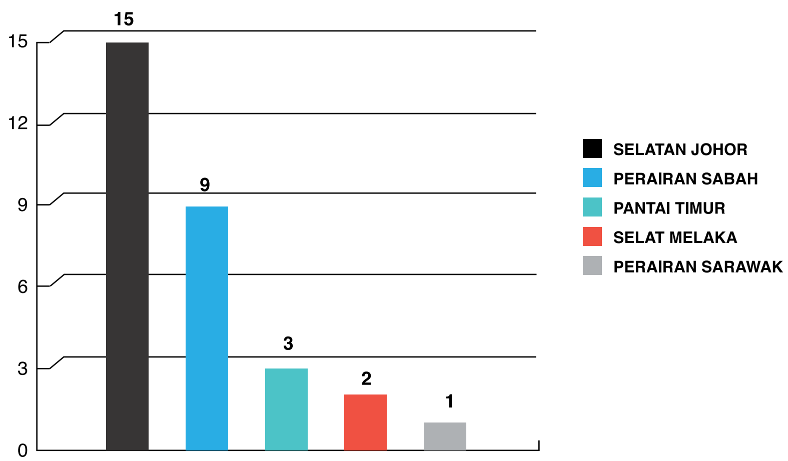


Figure 2.31 Piracy/Robbery incidents in 2011

Source: Malaysian Maritime Enforcement Agency 2011

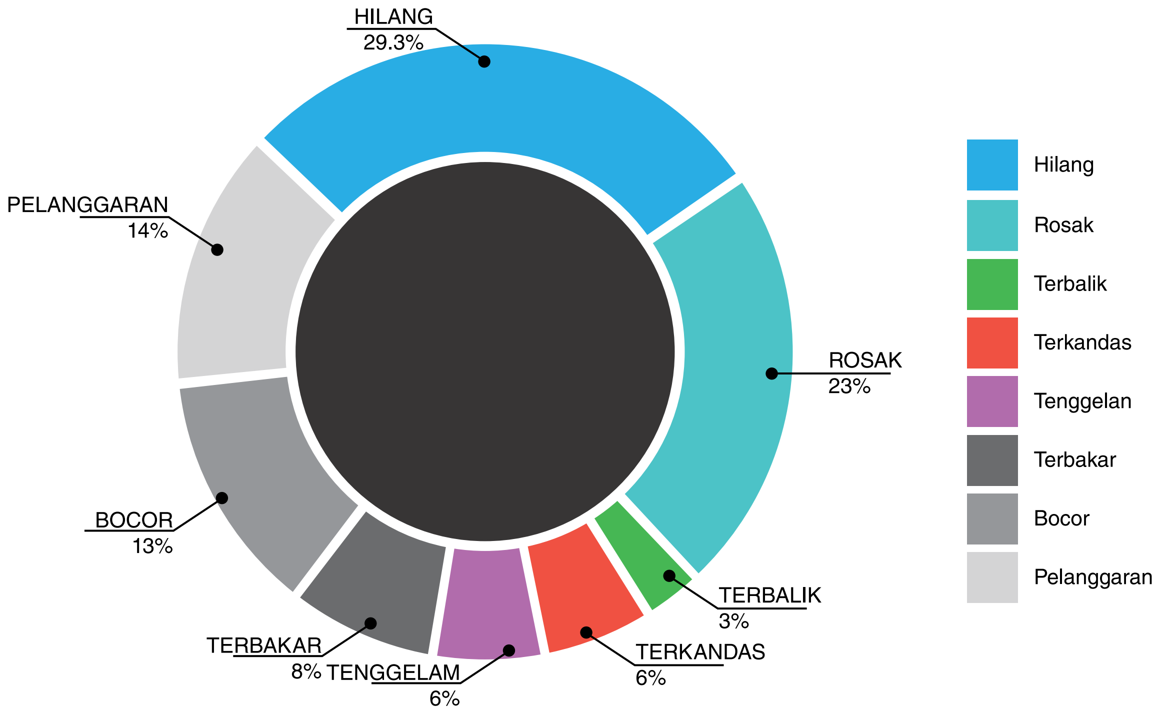
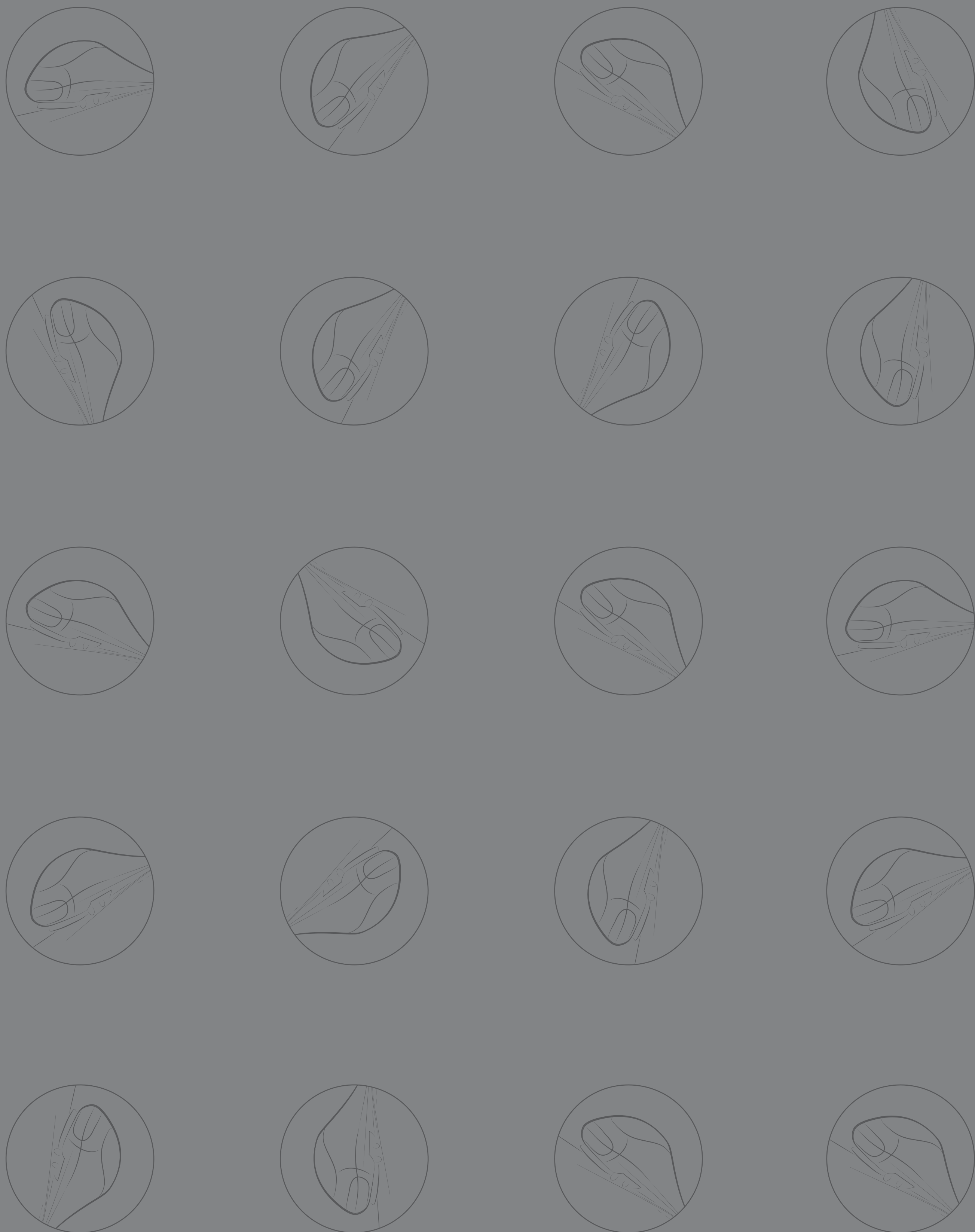


Figure 2.32 Maritime incidents involving boats and ships in 2011

Source: Malaysian Maritime Enforcement Agency 2011

2.5.5 CONCLUSION

Aviation and maritime are global transportation modes and must adhere to international laws and regulations on safety and security. Although, land transportation is based on regional framework. Although the safety issues on road transportation are addressed, there is lack of safety management and enforcement on public land transport. Currently, there is no Malaysian agency on transport safety that oversees safety management and enforcement on all transportation modes, and provides accident reports and statistics compared to other countries such as the US, Canada, Australian and Japan National Safety Board.



CHAPTER 3
CURRENT ISSUES AND BENCHMARKING

Transportation system currently exist in our country today is not sustainable in the long run. This is due to several issues that are yet to be addressed by the sector, issues such as the country's population growth and employment status, Gross Domestic Product (GDP), and tourist distribution. These issues will be discussed at length in this chapter.

3.1 POPULATION GROWTH

The population growth rate is defined as the average annual % change in the population, resulting from a surplus (or deficit) of births over deaths and the balance of migrants entering and leaving a country. The growth rate has important implications on the country's infrastructure (e.g. schools, hospitals, housing, roads), resources (e.g. food, water, electricity), and jobs. The average annual population growth rate of Malaysia has decreased from 2.6% in the period 1991-2000 to 2.0% in the period 2012 as shown in **Figure 3.1**. This growth rate is higher than its ASEAN neighbours such as Thailand (0.52%), Indonesia (0.99%), Vietnam (1.03%) and Singapore (1.96%). The total population has increased to 28.3 million in 2010 compared to 13.8 million in 1980 and is predicted to grow to a population of approximately 32.4 million in 2020, 37.4 million in 2035 and 38.6 million in 2040 as in **Figure 3.2**.

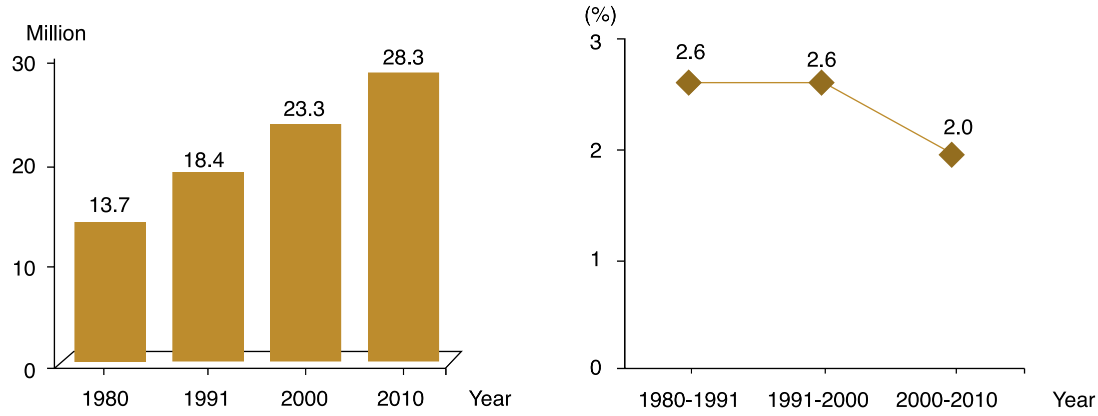


Figure 3.1 Total population of Malaysia in 1980, 1991, 2000 and 2010

Source: Deptartment of Statistics, 2010

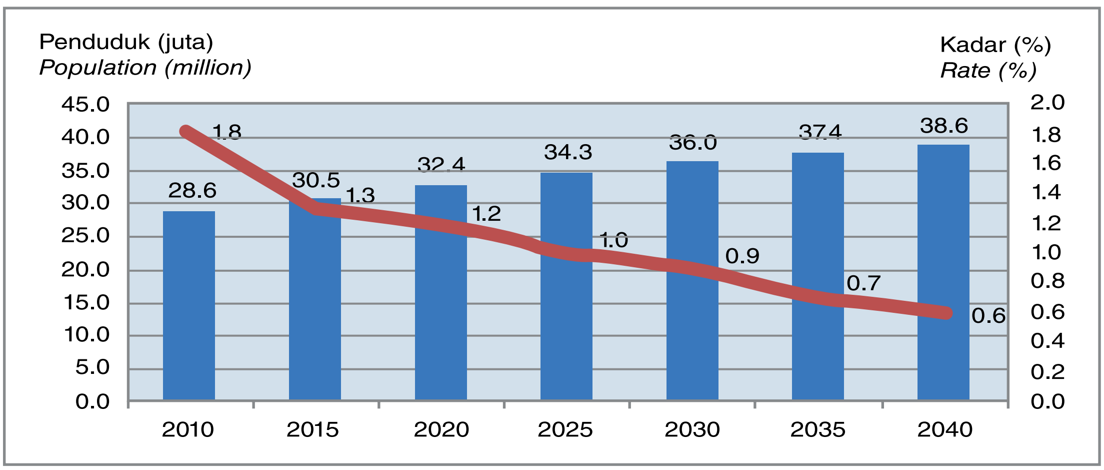


Figure 3.2 Malaysia population projection

Source: Deptartment of Statistics, 2010

When considered on a State-by-State basis (**Table 3.1**), population growth patterns are mixed. WP Putrajaya recorded the highest growth. This is primarily because of the federal Government ministries being relocated to Putrajaya. Neighbouring Selangor also recorded a high growth rate followed by Sabah and WP Labuan. Big states such as Johor, Terengganu and Sarawak grew at a similar lower rate followed by Pahang, WP Kuala Lumpur, Negeri Sembilan, Melaka, Kedah, Kelantan, Penang and Perlis. Perak despite being a big state recorded the lowest growth rate.

Table 3.1 Distribution of Population (Number And %) by State, 1980, 1991, 2000, 2010 and Future Projection

State	Population						
	1980	1991	2000	2010	2020	2035	2050
MALAYSIA	13,136,109	17,563,420	22,198,276	27,565,821	37,227,402	39,911,174	47,962,492
Johor	1,580,423	2,069,740	2,584,997	3,233,434	4,400,620	4,724,839	5,697,494
Kedah	1,077,815	1,302,241	1,571,077	1,890,098	2,464,335	2,623,846	3,102,377
Kelantan	859,270	1,181,315	1,287,367	1,459,994	1,770,722	1,857,036	2,115,576
Melaka	446,769	506,321	605,239	788,706	1,118,946	1,210,680	1,485,880
N. Sembilan	551,442	692,897	829,774	997,071	1,298,205	1,381,854	1,632,799
Pahang	768,801	1,045,003	1,229,104	1,443,365	1,829,034	1,936,165	2,257,556
Perak	1,743,655	1,877,471	1,973,368	2,258,428	2,771,536	2,914,066	3,341,656
Perlis	144,782	183,824	198,288	227,025	278,751	293,120	336,225
Penang	900,772	1,064,166	1,231,209	1,520,143	2,040,224	2,184,691	2,618,092
Sabah	929,299	1,734,685	2,468,246	3,120,040	4,293,269	4,619,166	5,596,857
Sarawak	1,235,553	1,642,771	2,009,893	2,420,009	3,158,217	3,363,275	3,978,449
Selangor	1,426,250	2,291,429	3,941,316	5,411,324	8,057,338	8,792,342	10,997,354
Terengganu	525,255	766,244	880,234	1,015,776	1,259,751	1,327,522	1,530,835
WP Kuala Lumpur	919,610	1,145,342	1,305,792	1,627,172	1,685,020	1,701,089	1,749,296
WP Labuan	26,413	54,241	70,871	85,272	111,193	118,394	139,995
WP Putrajaya	0	5,730	11,501	67,964	169,597	197,828	282,523

Source: Deptartment of Statistics, 2010

In terms of population distribution, the most populous states are Selangor, followed by Johor and Sabah. These three states contributed 42.5% to the total population of Malaysia, as in **Figure 3.3**.

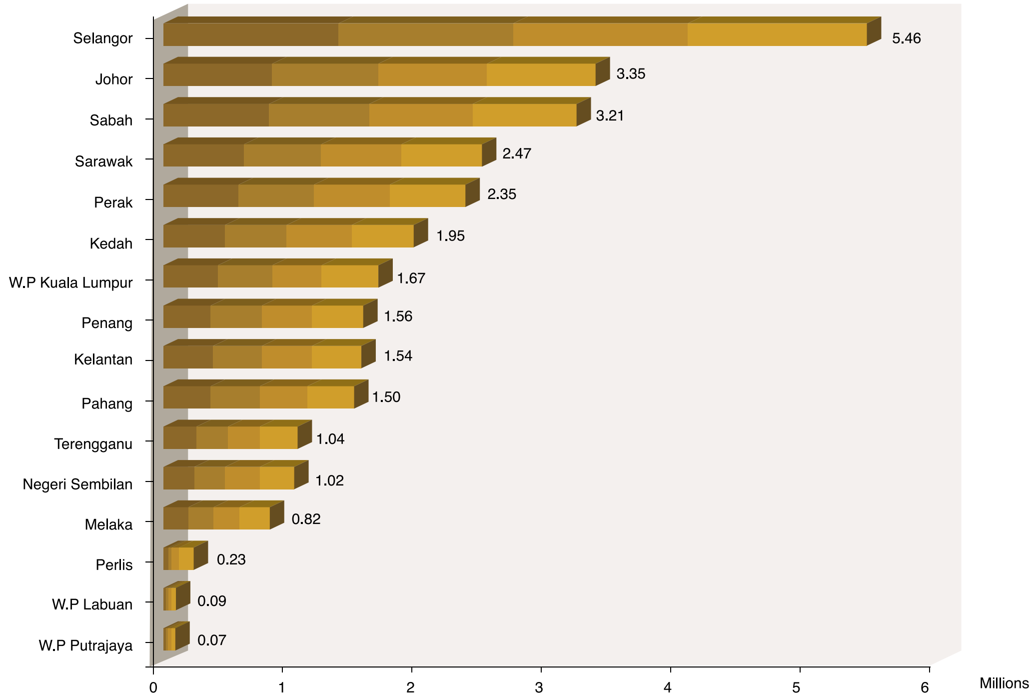


Figure 3.3 Population distribution by Malaysian States

Source: Department of Statistics 2010

The age group of 0-14 years is projected to decrease from 27.4% in 2010 to 19.6% in 2040 whilst the proportion of working age population (15 to 64 years) is expected to increase to 69.0% from 67.6% as shown in **Table 3.2**. This trend has important implications for the country's transportation system as there will be more persontravelling to work, etc.

Table 3.2 Projected Age Distribution of Malaysia Distribution

Year	0-14 ('000)	%	0-14 ('000)	%	65+ ('000)	%	Median age
2010	7,822.1	27.4	19,341.4	67.6	1,425.1	5.0	26.3
2015	7,733.4	25.4	20,971.9	68.8	1,779.9	5.8	28.2
2020	7,780.7	24.0	22,445.9	69.2	2,214.6	6.8	29.9
2025	8,009.5	23.4	23,533.4	68.6	2,751.3	8.0	31.5
2030	8,087.9	22.5	24,542.0	68.2	3,335.7	9.3	33.0
2035	7,893.4	21.1	25,606.1	68.5	3,889.9	10.4	34.5
2040	7,537.2	19.6	26,615.6	69.0	4,405.1	11.4	36.0

Source: Department of Statistics 2012

3.2 EMPLOYMENT GROWTH

From 2002 to 2012, the country added 3,233,400 jobs, representing growth of just over 24.6% as shown in **Table 3.3**. The growth in number of jobs was faster than the overall growth in country population.

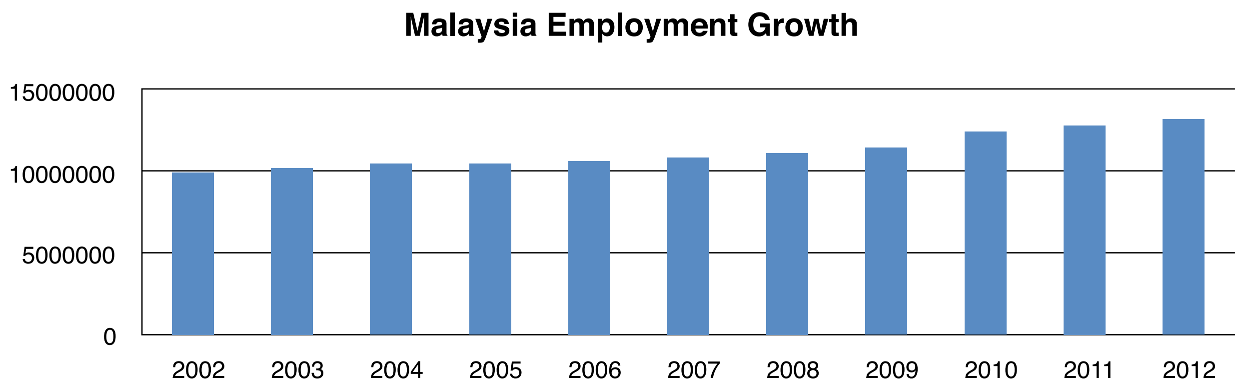


Figure 3.4 Malaysia Employment Growth

Source: Department of Statistics 2012

Table 3.3 Malaysia States Growth

State	Employment Growth (2002-2012)
Johor	20.7
Kedah	21.7
Kelantan	36.2
Melaka	36.2
Negeri Sembilan	34.8
Pahang	54.3
Penang	19.8
Perak	17.3
Perlis	52.6
Sabah	45.3
Sarawak	23.5
Selangor	57.9
Terengganu	40.0
WP Kuala Lumpur	3.75
WP Labuan	21.0

Source: Dept. of Statistics Malaysia, 2012

Selangor has the highest employment growth in the period of 2002 to 2012 at 57.9%. This is followed by Pahang at 54.3%, Perlis at 52.6% and Sabah at 45.3%. The States of Kelantan, Melaka, N. Sembilan and Terengganu saw a growth rate of between 35 to 40%. Johor, Kedah and WP Labuan employment grew by about 20%. States that saw an employment rate of less than 20% include Penang, Perak, and with the least being WP Kuala Lumpur which added only 30,000 jobs - a 3.5% increase.

3.3 GROSS DOMESTIC PRODUCT (GDP)

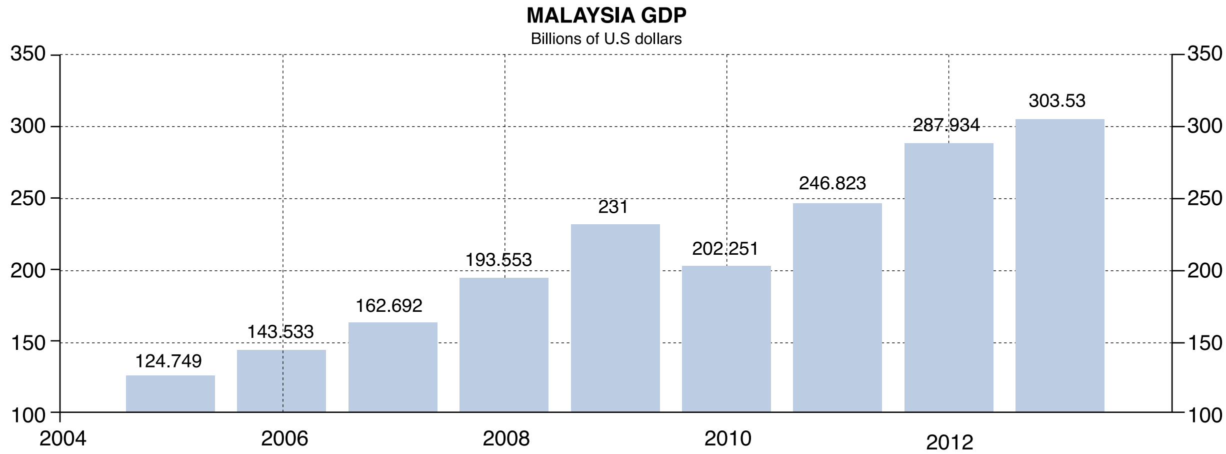


Figure 3.5 Malaysia Gross Domestic Product, GDP

Source: www.tradingeconomics.com

Malaysia's economy grew at a steady rate during the period 2005 to 2009, as shown in **Figure 3.5**. The Annual GDP climbed from $124.749 billion to $231 billion. However, in 2010, it suffered a setback dropping to $202.251 billion. From 2010 onwards, the GDP has been increasing steadily to $303.53billion, a growth of almost 50%.In 2012, fve states (Selangor, W. P. Kuala Lumpur, Sarawak, Johor and Penang) dominated the national economy with a share of 64.5%, as shown in Table 3.4. Selangor continued as the most signifcant contributor with 23.5%, followed by WP Kuala Lumpur (15.2%).

Table 3.4 Percentage Share of GDP by State

State	Share (%)
Selangor	23.5
WP Kuala Lumpur	15.2
Sarawak	9.6
Johor	9.2
Penang	7.0
Sabah	5.9
Perak	5.3
Pahang	4.1
Negeri Sembilan	3.7
Kedah	3.4
Melaka	2.9
Terengganu	2.6
Kelantan	1.8
Perlis	0.5
WP Labuan	0.4
WP Putrajaya	5.1

Source: Economic Planning Unit 2012

3.4 TOURIST DISTRIBUTION

Based on **Figure 3.5**, it can be seen the number of tourists visiting Malaysia has levelled out from 2010 onwards. But it is expected that it will continue to increase from year to year as the world economy improves. The income from tourist has steadily grown, and as a consequence there is an impetus to attract more tourists to Malaysia. The effect of this is the increase in congestion at the international airports.

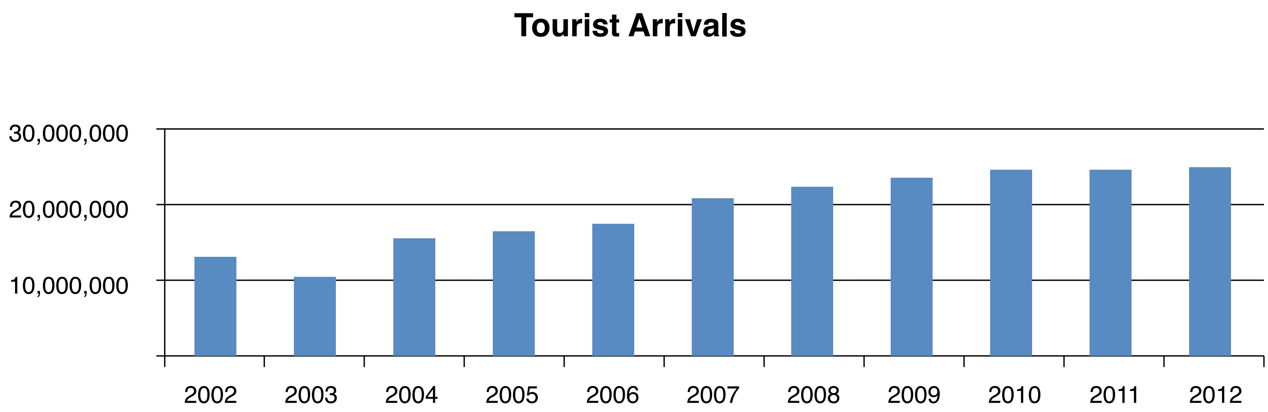
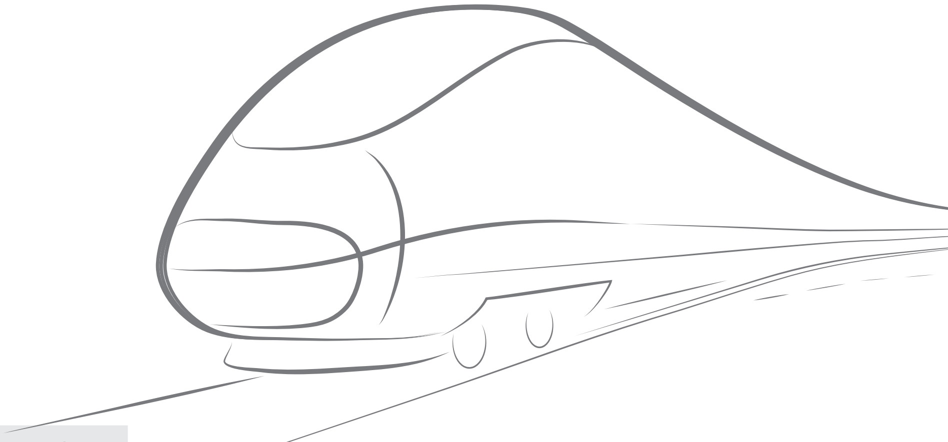


Figure 3.6 Tourist arrivals to Malaysia

Source: Tourism Malaysia, 2013

Figure 3.7 Tourist receipts to Malaysia.Source: Tourism Malaysia, 2013

CHAPTER 4
CURRENT ISSUES AND BENCHMARKING: LAND TRANSPORTATION



4.1 CURRENT ISSUES AND BENCHMARKING: LAND TRANSPORTATION

4.1.1 GLOBAL TRANSPORT TRENDS

Historically, cities were built in the form that enables easy access between places through walking, as this was the main mode of movement. Cities in these eras are densely built with tightly-packed, high-density housing with mixed land use such as Venice and Copenhagen. **Figure 4.1** shows pedestrian city of Venice.

Figure 4.1 Example of pedestrian city – Venice

Source: Airpano, http://www.airpano.com/360Degree-VirtualTour.php?3D=Italy-Venice

The invention of automobile brings about the change in perception and culture that people can now live in exclusive suburban area outside the city and they can commute to the city using their private vehicles. This brings about the change in urban form to automobile cities. This can be seen in most cities in the United States where people are highly dependent on their automobiles. Automobile cities are characterised with low-density development that forms suburban at the outskirts of the city with low-density housing. Wide highways and freeways are built in and around the city to accommodate the high number of automobiles.

Figure 4.2 Example of suburban area – Colorado Springs, Colorado

Generally, the level of development of a city and the urban land use form determines the structure of transport system in the area. The transport systems among countries often vary significantly, but a particular distinction can be made between those in the less developed countries, the developing countries and the developed countries. **Figure 4.2** shows the example of suburban area in Colorado Springs, Colorado, USA.

The transport system in the less developed countries are often characterised as having high modal shares of Non-motorised Transport (NMT) such as walking and cycling, very low vehicle ownership and having little to no formal form of public transport system. With the absence of formal public transport, informal public transport (paratransit) has a large modal share and forms a vital mode of transport in these countries. The paratransit service usually offers low quality of service and coupled with lax regulation and enforcement by the Government, vehicles used in paratransit often does not meet safety and environmental standards (GEF-STAP 2010).

Developing countries with emerging economies are showing signs of emulating the same pattern experienced during the development of what are now considered developed countries. With the increased wealth, cities are building out to accommodate the growth in population. Vehicle ownership (cars and motorcycles) is increasing rapidly and is aspired to as the wide-spread growth of income allows motorised vehicles to become affordable to a larger proportion of the population. Vehicle ownership is also viewed as a symbol of status. The focus of transport planning authorities shifts to providing more road infrastructure to meet the growing demand of private transport use. This trend of automobile dependency is also driven by the inability of the public transport system to cope with demand. Public transport is often seen as uncomfortable, inconvenient and unsafe. This is in part to the lack of consideration given to public transport service and NMT infrastructure in transport planning (GEF-STAP 2010; UNESCAP 2012).

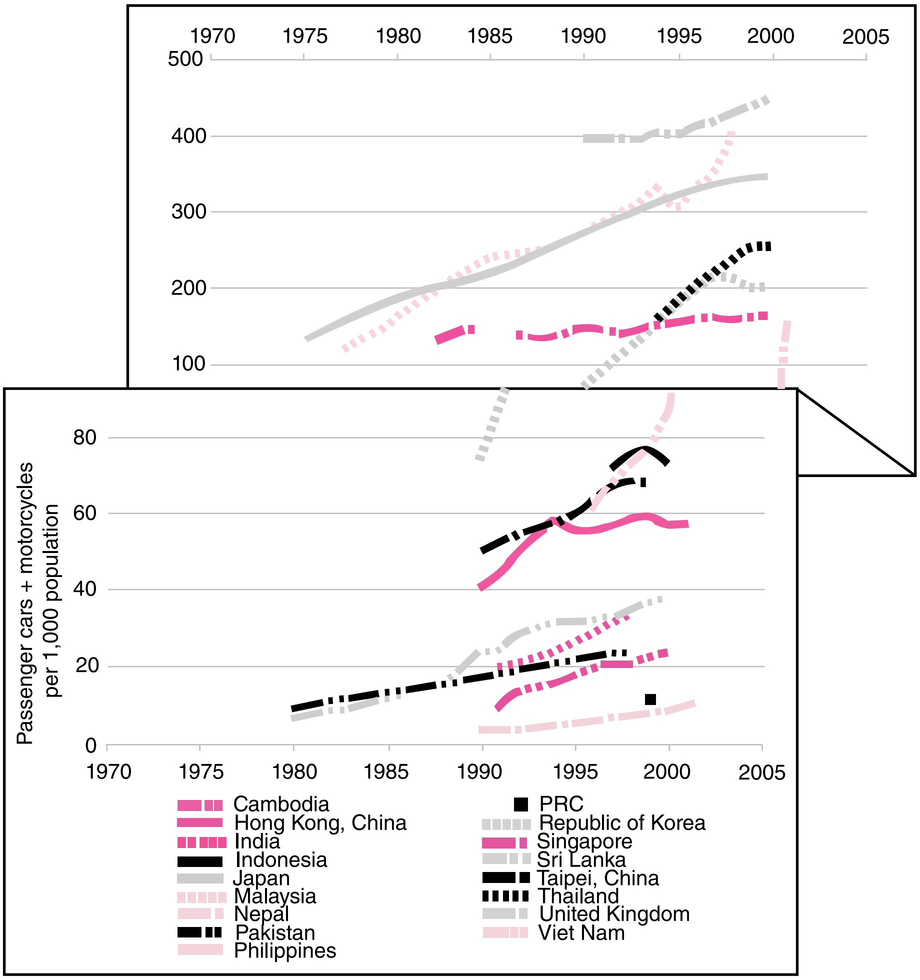


Figure 4.3 Growth in motorised vehicles in selected Asia and Pacific countries

Source: UNESCAP 2012

Increase in travel by private vehicles tends to be at the expense of demand for public transport and use of NMT. Transport in urban area is shifting away from NMT to motorised forms of transport. While public patronage is increasing in absolute terms, its overall modal share is decreasing. The inability of transport planning and environmental management to cope with this high level of motorisation creates congestion in urban areas which concurrently results in high level of air and noise pollution. It is expected that the modal share of public transport and NMT will decrease under a BAU scenario as users of these services grow wealthier and can afford their own vehicles (GEF-STAP 2010; UNESCAP 2012). **Figure 4.3** shows the growth in motorised vehicles in selected Asia and Pacific countries.

4.1.2 COST OF CURRENT TRANSPORT TREND

This over-reliance on private vehicle generates serious social, environmental and economic damage and is highly unsustainable:

(i) ***Energy consumption*** – Transport currently consumes more than 50% of the world's liquid fossil fuels (IEA, 2008).

(ii) ***GHG emission*** – Combustion of fuel directly translates to emission of GHG. The amount of GHG emission from transport is directly related to the distance travelled, vehicle load and fuel economy of the vehicle. The transport sector is currently responsible for 13% of GHG emission (IPCC, 2007) and 23% of CO_2 emissions from global energy consumption (IEA 2009). Land transport accounts for roughly 73% of the sector's total CO_2 emissions, followed by aviation at 11% and shipping at 9% (IEA 2005).

The Life-cycle analysis has found that vehicle operations only accounts for 65%-75% of total lifecycle emissions while the remaining emissions are attributed to the vehicle production, maintenance, transport of fuel and disposal (Chester & Horvath 2009). Emissions are projected to increase by 1.7% annually between 2004 and 2030 (IEA 2006). Of special relevance to the transport sector are short lived pollutants which contribute to global warming such as black carbon and tropospheric ozone. There are increasing scientific evidence suggesting that black carbon could be the second largest contributor to global warming after CO_2 and that its reduction could be the most rapid way of slowing climate change (IGSD 2008). Taking the impact of these short lived pollutants into consideration, Unger *et al.* (2009) came to the conclusion that globally, land transport has the highest overall global warming potential of all the economic sectors.

(iii) ***Traffic congestion*** - Increase in number of vehicles on the road leads to congestion which can be significant in urban areas. For example, the cost of congestion in Republic of Korea in 2008 was 2.62% of its annual GDP (UNESCAP, 2012). The amount of time spent in congested traffic is often cited as one of the main contributors towards low quality of life in cities.

(iv) ***Degradation of human health*** – Apart from greenhouse gas emission, use of vehicles also emits street level air pollutants, unwanted noise and vibration to the surrounding population which can cause direct harm to human population. Air pollutants from transport are the products of incomplete combustion of fuel which consists of Oxides of Sulphur (SO_x), Oxides of Nitrogen (NO_x), Carbon Monoxide (CO), Hydrocarbons (HCs), Volatile Organic Compounds (VOCs), Toxic Metals, Lead Particles and Particulate Matter (PM) which includes Black Carbon. Transport contributes more than 80% of air pollution in cities in developing countries. As an example, the health cost of local air pollution in Bangkok in 1995 was 2.56% of GDP (UNESCAP, 2012). Noise pollution generated by transport can be detrimental to health and well-being, particularly if it contributes to sleep disturbance, which can lead to increased blood pressure and heart attacks (WHO, 2009). A study on acoustic pollution shows that the economic cost of noise annoyance can reach nearly 0.5% of GDP for the European Union (Lambert 2002).

(v) ***Reduction in human security*** – High volume of traffic on the road leads to more road accidents, especially where cars, motorcycles and NMTs share the same road without dedicated infrastructure provision. There are more than 1.27 million fatal traffic accidents per year, with highest mortality rate among bike users and pedestrians (UNEP, 2011). It is estimated that the cost of traffic accidents worldwide is approximately USD518 billion, and represents between 1% and 1.5%of GDP in low-income and middle-income countries and 2% in high-income countries (World Bank and WHO, 2004). **Figure 4.4** shows the road traffic deaths by type of road users by WHO regions.

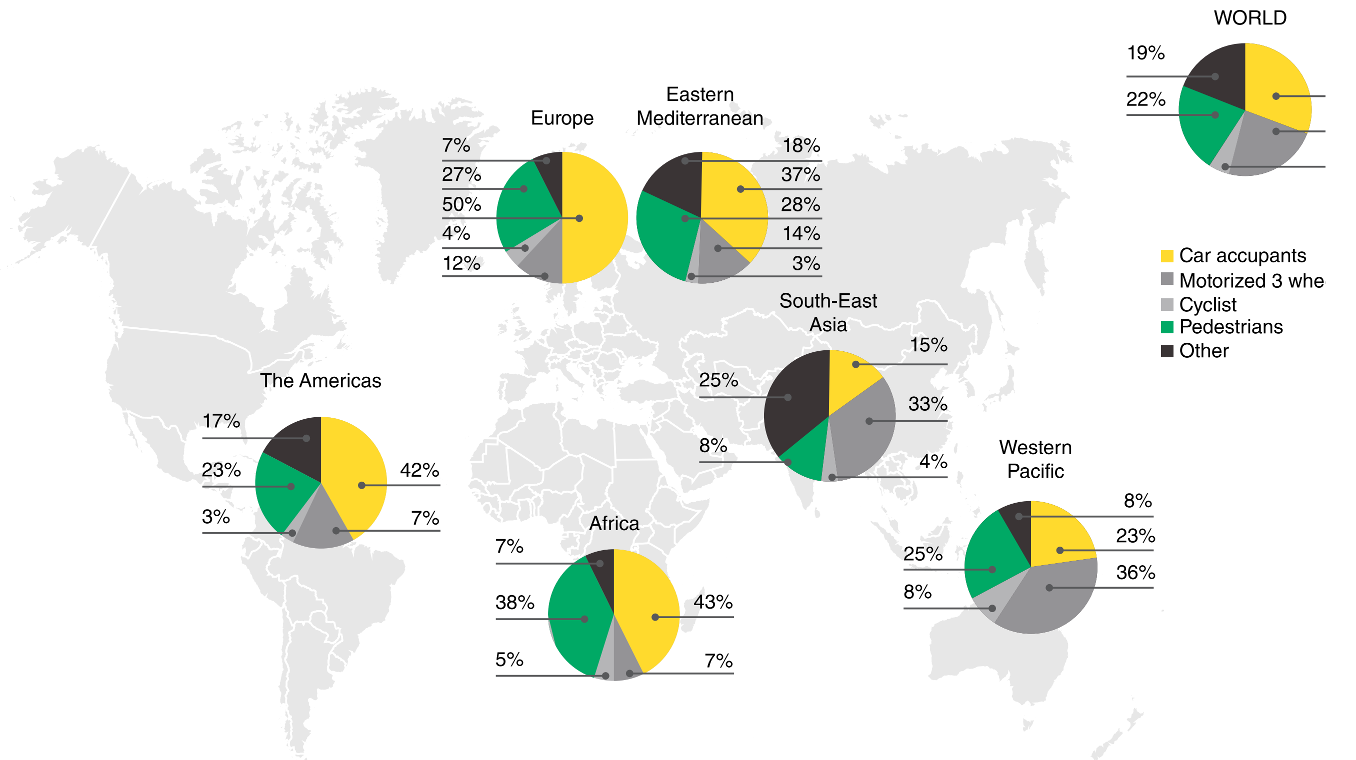


Figure 4.4 Road traffic deaths by type of road user by WHO regions

Source: WHO 2013

(vi) Reduction of accessibility — As roads and expressways are built wider to accommodate growing traffic, it creates a barrier that divides the areas that it crosses through and restricts direct access. Although the costs of this reduction is highly context dependent and differ greatly by region, study has shown that there is an extra cost of USD0.54-0.62 per mile of vehicle activity when travel is shifted from NMT to car (UNEP 2011).

These costs, which can add up to more than 10% of a country's GDP, are likely to grow, primarily because of the expected growth of the global vehicle fleet. If we are to continue on a BAU path, the global vehicle fleet is set to increase from around 800 million to between 2 to 3 billion by 2050 and most of this growth will take place in the developing countries (UNEP 2011).

4.1.3 OPPORTUNITIES

Studies also demonstrate that high levels of GDP can be accompanied by transport systems that rely less on private transport (UNEP 2011). **Figure 4.5** shows the percentage of modal share for motorised private mode and and the GDP per capita of major cities around the world based on year 2005 data.

Three patterns of city development were identified: *North American pattern,* where the urban form is an automobile city with high private transport dependency; *European pattern* comprises of mostly cities in Europe and Japan with relatively low modal share of private transport; and *most efficient pattern* with cities that have among the lowest private transport modal share. Cities having the *European pattern* and *most efficient pattern* consist of pedestrian city and transit city. As mentioned previously, pedestrian city is a form of urban land use that encourages walking and cycling through compact, high-density and mixed-use development. Long distance travel needs can be met by efficient public transport. Public transit system forms the backbone of transport system in transit city and development focuses around the concept of ToD, where compact, high-density and mixed-use development are concentrated around the public transit hubs and along the transit corridors.

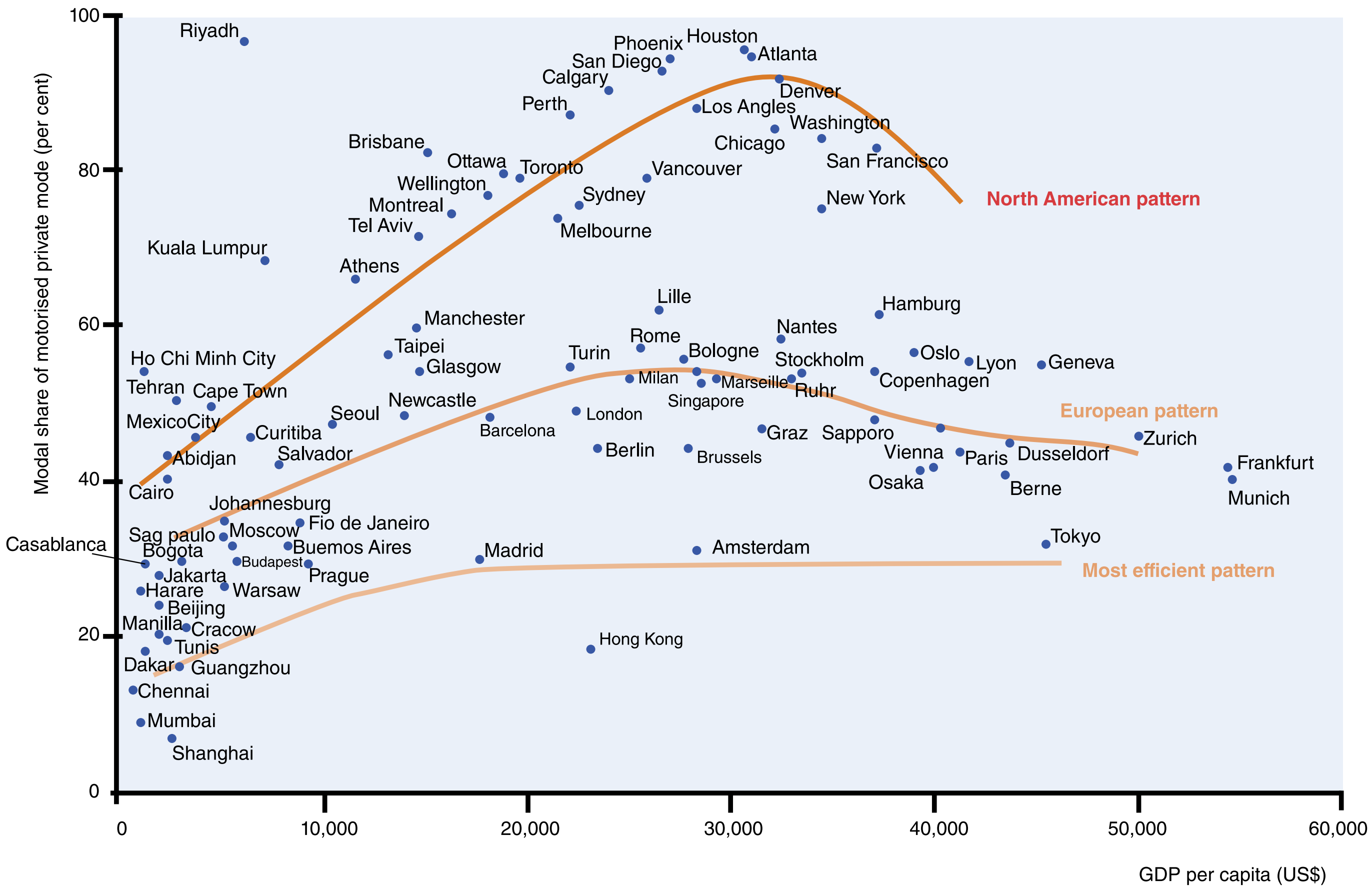


Figure 4.5 Pattern of private transport modal share

Source: UNEP, 2011

Action is required in all countries, but opportunities are greatest for developing countries, where future patterns of transport can be shaped by the investment and planning decisions made today. Developing countries will have to avoid creating the 'lock-in' of unsustainable travel behaviours that accompanied economic growth in developed countries. There is significant opportunity to develop infrastructure in a way that ensures green growth, allowing for the economy whilst maintaining environmental sustainability. The negative environmental, social and economic consequences of not doing so are already manifesting themselves around the world (GEF-STAP, 2010).

The traditional way of relieving traffic congestion by increasing capacity of the road network has been shown to only provide temporary fix. New development built around these new roads will eventually cause the roads to become congested again. The induced increase in vehicles in turn leads to an increase in the rate of accidents and emission of air pollutants and GHG. This method of providing mobility also only benefits those who can afford private vehicles from the high and middle-income population while neglecting the low-income population's travel needs. The traditional approach of increasing mobility by providing more road space is therefore neither economically productive nor environmentally sustainable. The environmental gains of improving the vehicular technology have been offset by the increasing number and travel distance of private transport activity. It is now a necessity for cities around the world to develop a green and sustainable transportation system to meet the growing transport demand to maintain the quality of living for the city residents (UNESCAP 2012).

4.1.4 MOVING TOWARDS SUSTAINABLE TRANSPORT

Transport is an induced demand for access and mobility to fulfil social and economic activities. Numerous factors affect the transport mode choice including land use form, distance of travel, parking availability, cost of travel, availability and level of service of public transport. Often a combination of these factors have resulted in the increase of number and use of private transport and pushing away from the use of public transport, culminating in the costs highlighted earlier.

Sustainable transport systems should be developed from a well thought out package of policies. A strategy is needed that uses a combination of measures to ensure a balanced approach between technological enhancement and changes in transport behaviour. In essence, the move towards green transport requires the following (UNESCAP 2012):

(i) Managing travel demand and reducing reliance on private vehicles (push)

(ii) Making sustainable form of transport such as alternative fuel vehicles, hybrid vehicles and public transport more attractive (pull)

(iii) Setting and imposing technological standards (vehicle, fuel, emission, etc.)

The strategy to achieve these aims should be based on the "Avoid, Shift and Improve" Strategy (Dalkmann & Brannigan 2007):

(i) Avoiding unnecessary journeys and reducing the length of trips – the key elements of this strategy are integrated land-use and transport planning around the concept of pedestrian and transit cities, designing more compact developments and utilising communication technologies to eliminate travel altogether. Transport demand management through congestion charging and parking management is a key part of this strategy. Freight transport volumes can be reduced by localising production and consumption and by optimising logistics. The "Avoid" strategy is strongly associated with the "push" approach, as most of the policy measures under this strategy are aimed at limiting the growth in private car use.

(ii) Shifting transport demand to and preventing the shift away from low-carbon modes – this strategy is related to modal choice. This emphasises a need to shift private car travel to lower carbon modes such as NMT and formal public transport options and also strengthening the attractiveness of these travel modes. Railways and waterways are generally greener methods of transporting freight, and shifting to them frees up road space. Encouraging development of transport networks combining different modes and enhanced possibilities of intermodal exchange facilities for movement of people (between NMT and formal public transport) and freight (between rail and road connection) for the "last mile" between origin and destination are important elements in the implementation of this pillar. This strategy is strongly associated with the "pull" approach.

(iii) Improving the environmental efficiency of all modes of transport – enhancing engine fuel economy, fuel quality and alternative fuels such bio-fuels and hydrogen, reduced vehicle weight and load optimisation, developing alternatives such as electric and hybrid vehicles, eco-diving styles, improved maintenance and better traffic management and route choice can help reduce the environmental impact of each kilometre travelled.

Figure 4.6 illustrates green transport as a goal and the actions and investments required in achieving this goal.

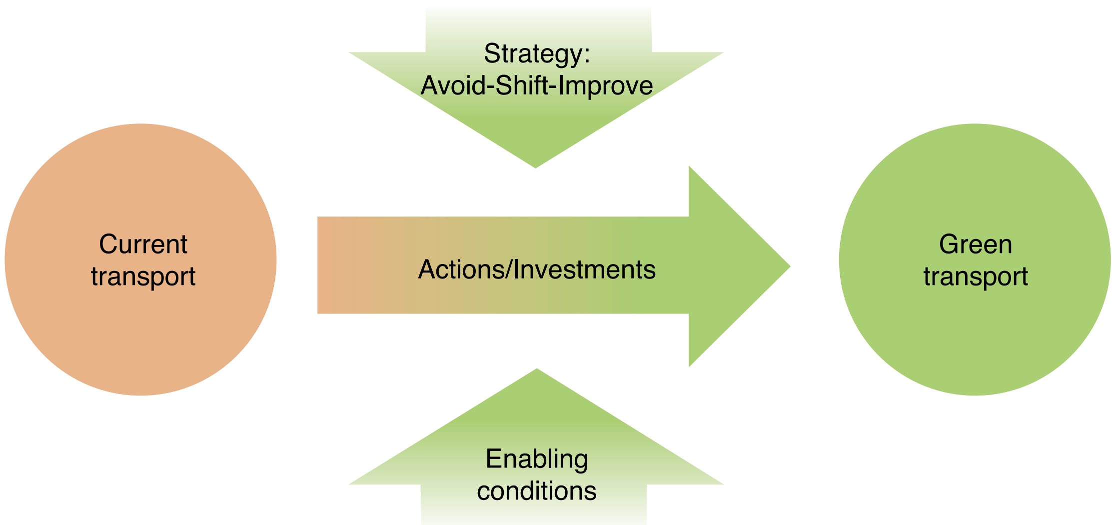


Figure 4.6 Image of green transport as a goal, and actions and investments to achieve this goal

Source: UNEP 2011

A comprehensive plan that combines these three strategies provides the best pathway towards green transport. **Figure 4.7** shows the effect of a combination of the three strategies to reduce CO_2 emissions in the European Union. Curve 1 shows the implementation of the Improve package: improved engine and vehicle design; electric cars; low-carbon fuels; and technologies encouraging behavioural change. The implementation of the Improve package can reduce CO_2 emission from transport by 44%. Curve 2 shows the additional 20%reduction of CO_2 through the implementation of the “Avoid and Shift” package: road pricing; increasing population density in cities and travel planning.

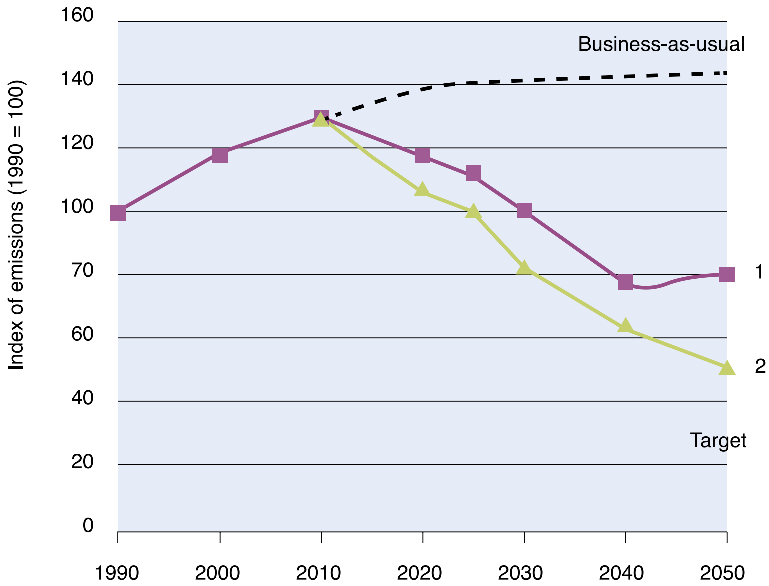


Figure 4.7 Effect of a combination of Avoid, Shift and Improve measures to reduce CO2 emissions from the transport sector in EU

Note: Each curve shows the additional effect of adding further instruments.

1. Improve package: Improve engine and vehicle design, electric cards, low-carbon fuels and technologies envouraging behavioural change. These measures lead to a 44% reduction in transport CO_2 emmissions.

2. Avoid and shift package: road pricing, car clubs, increasing population density in cities and travel planning. These measures lead to a 20% reduction in transport CO_2 emmissions.

Source: UNEP 2011

4.1.5 BENCHMARKING

There are examples of representative policy measures under the Avoid, Shift and Improve strategies in cities in developing and developed countries that have successfully managed to increase public transport patronage and the viability of more environmentally, socially and economically sustainable alternatives to private vehicles. **Table 4.1** gives an overview of the policy measures.

Table 4.1 Overview of Policy Measures Under the Avoid, Shift and Improve Strategy

Representative Policy Measure	**Key Stakeholders***	**Description**	**Good Practice**	**Bad Practice**
Avoid				
Develop integrated land use – transport masterplan	N, L	Consider land use planning and transport at the same time, through an integrated process. This develops compact, transit-oriented cities and avoid urban sprawl	Seoul's sustainable city plan	Lack of consideration of land use in most Asian cities
Parking management	L, P	Limit the number of parking places in the city centre, and price parking fees above the cost of taking public transport into the city centre to deter car use	Seoul's Parking policy used to support Travel Demand Management	Lack of adequate on-street parking prices and poor enforcement of parking regulation
Implement congestion charging/road pricing	L	Make car users pay for using the road and increase the charge at the most congested times of the day to deter motorists from driving excessively especially during peak hours	Electronic Road Pricing in Singapore	Failure to introduce Road Pricing in many cities
Promote car-free city areas, pedestrian zones and low emission zones	L	Identifying areas of the city where either no vehicle will be permitted, or permitting vehicles to only vehicles or classes of vehicles meeting a prescribed standard of emission to improve local air quality and cut congestion	Seoul's voluntary No Driving Day Car free day in Jakarta, Indonesia	Lack of low emission zones in majority of Asia and the Pacific countries
Set vehicle registration tax	N	Varying vehicle registration tax based on weight or fuel efficiency to increase the cost of purchasing fuel inefficient vehicles	Differentiated vehicle acquisition and ownership tax for low emission vehicles in Japan	Very low automobile registration fees to encourage car purchase
Remove fuel subsidies and tax fuel	N	Removing fuel subsidies and increasing fuel tax to reduce distance travelled, and to incentive consumers to purchase fuel efficient vehicles	G20 and APEC nations are planning to phase out support for fossil fuels	Fuel subsidies still exist in many Asian countries

Remove car-oriented subsidies	N	Remove subsidies for automobile manufacturing, and remove tax benefits for company cars to reduce the number of vehicles on the road	Higher corporate car tax in the UK for vehicles emitting greater levels of CO_2 emissions	Many countries continue to provide large subsidies to the automobile industry
Promote distance-based car insurance schemes	N, P	Vary the cost of car insurance based on the distance travelled to incentivize a reduction in vehicle kilometres travelled	Pay As You Drive (PAYD) car insurance schemes in North America	Many PAYD schemes have been short-lived demonstrations or limited to specific or limited to specific consumer groups such as young drivers
Shift				
Provide NMT infrastructure (accessible footpaths, cycleways)	L	Introduce new infrastructure for walking and cycling to ensure that new and existing cyclist and pedestrian facilities are attractive to existing and potential users	Bogota's "Ciclorutas de Bogota" cycle path networks that covers over 340km and connects with major BRT routes, parks and community centres	Bicycle use banned on major arterial roads and bicycle lanes removed in many cities
Introduce cycle sharing scheme	L, P	Introduce bike sharing schemes in urban areas to increase the share of bicycle trips for short distance journeys	Public cycle hire scheme in Guangzhou, China with docking stations at BRT stations	High level of bike thefts
Develop public transport	L, P	Ensure that public transport provision has the appropriate level of service and coverage to meet potential user demand to retain the modal share of public transport	High quality, frequent bus service to Beijing, China	Poor financial management of bus services in some Indian cities
Develop dedicated lanes for public transport (buses and BRT)	L	Introduce dedicated lanes for public transport in congested urban areas to help guarantee fast and reliable public transport service	Exclusive BRT lines in Beijing, Hangzhou, Guangzhou in China	Invasion of BRT corridors by general traffic, leading to speed reduction and service quality

Develop public awareness campaign	L	Inform the public about the travel alternatives available to them or about the environmental, economic and social impacts of motorised transport to encourage increased public transport patronage and public acceptance of sustainable transport interventions.	Advertising BRT in prime time television in Jakarta	Poor communication of the concepts and features of the BRT system and differentiation between BRT and conventional bus systems
Improve				
Promote and enforce vehicle efficiency standards	N	Set and enforce statutory vehicle efficiency standards to stimulate manufacturers to invest in and promote technological change and improve the fuel economy of vehicles.	South Korea's fuel economy rating scheme introduced in 2005	Industry bodies such as ACEA, JAMA and KAMA have so far failed to meet voluntary standards
Set fuel standards	N	Set statutory fuel standards to improve the quality of fuels.	Phasing out of lead from gasoline in Indonesia	Poor quality fuels continue to be used across Asia
Promote new vehicle technology and infrastructure	N, L, P	Support the development of new vehicle technology and infrastructure to reduce the level of GHG and air pollution emissions.	Alliance of 16 of the largest State-owned companies created in China to accelerate development of electric vehicles in China	Highly polluting two-stroke engines continuous to be used in many Asian countries
R & D and promotion of alternative fuels	N, P	Develop and invest in research and policies to support the uptake of lower carbon fuels such as methanol, natural gas, LPG, hydrogen and electricity.	EU's electric vehicle initiative which aims to ensure that additional electricity demand is met by renewable electricity	First generation bio-fuels with negative environmental impacts
Develop Intelligent Transportation Systems	N, P	Development and implementation of new technologies such as automatic toll collection, automated driving and automated vehicle weight sorting system.	ITS in Korea including more efficient toll collection systems	Limited technical expertise in developing countries could lead to the introduction of poorly designed schemes

* N: National Government, L: Local governments, P: Private sector

Source: UNESCAP 2012

These different types of instrument have to be implemented in coordination with each other and based on the local context in which they are being applied. It is important to understand the characteristics of the transportation system in each city so that interventions would match their characteristics and needs. Throughout the process, local stakeholders must be actively engaged to ensure that their current problems are identified and linked to the programme. This will also indirectly increase public acceptance.

4.1.6 SAFETY

This section presents the measures taken to reduce the number of accidents. As mentioned in **Chapter 2**, Malaysia is currently taking measures to prepare a road safety plan in alignment with WHO Road Safety Plan for the Decade of Action for Road Safety with the target of reducing 50% of the forecasted number of fatalities by 2020.

Generally, powered two-wheelers contribute to the highest number of road deaths in Malaysia as shown in **Table 4.2**. In 2011, they accounted for 61% of the road deaths. Bus occupant road deaths can be considered low, with twenty-nine cases only. Helmet wearing has been compulsory for motorcycles since 1973. In general, the helmet-wearing rates are higher in urban areas compared to rural areas. Studies found that the average helmet-wearing rate in the urban areas is about 90% while the average compliance rate in rural areas is about 50%. The overall national helmet-wearing compliance rate is about 70% (WHO 2013).

Table 4.2 Reported Fatalities by Road User Group 2003-2011

	2003		2010		2011	
Bicyclists	256	4%	192	3%	172	3%
Motorised two-wheelers	3548	56%	4036	60%	4169	61%
Passenger car occupants	1187	19%	1421	21%	1389	20%
Pedestrians	683	11%	626	9%	530	8%
Other incl. unknown	612	10%	597	7%	617	9%
Total	**6286**	**100%**	**6872**	**100%**	**6877**	**100%**

Source: Ahmad Noor Syukri Zainal Abidin et al. 2012; Ministry of Transport Malaysia 2011

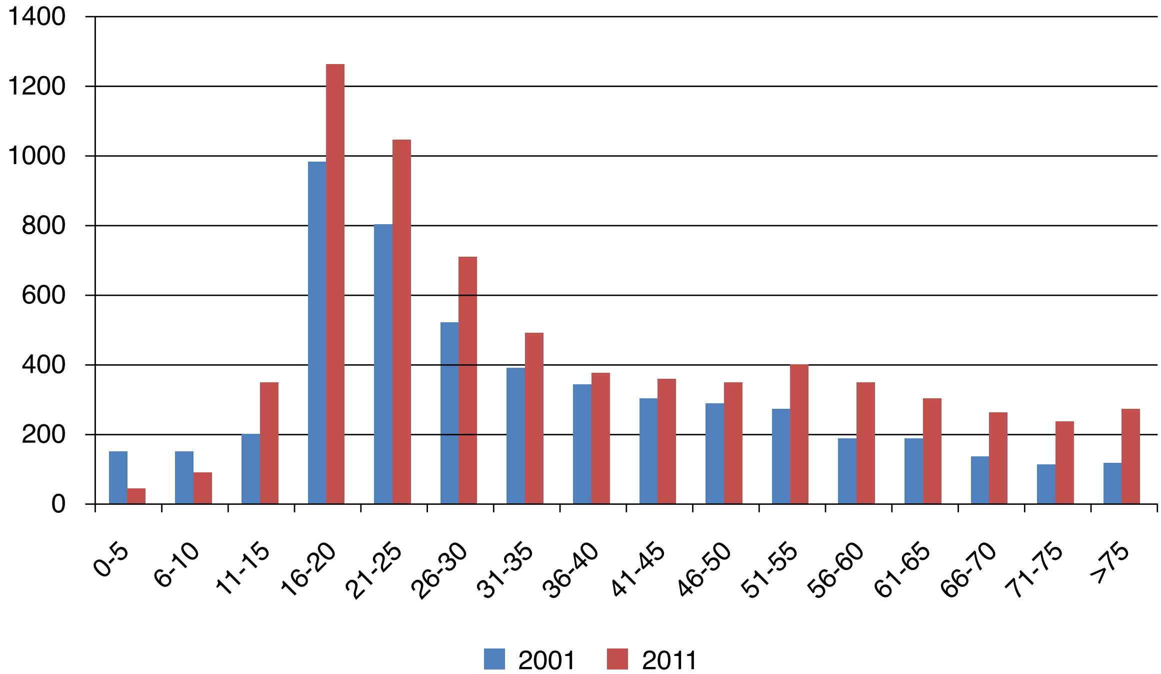


Figure 4.8 Reported death by age band (2001 and 2011)

Source: MOT 2011

Figure 4.8 shows young people pay a very heavy price on the roads. In 2011, 35% of persons killed in road traffic were in the 16-25 age group.

Table 4.3 Summary of Speed Limits in 2013

	General speed limint ***Passenger cars***
Urban roads	50 km/h
Rural roads	90 km/h
Motorways	110 km/h

Source: IRTAD 2013

Table 4.3 summarises the main speed limits in Malaysia. A recent study by Jamilah Mohd Marjan *et al.* (2012) shows that the compliance to 90km/h posted speed limit is about 74% among Malaysian drivers. Based on **Figure 4.9**, Malaysia has the second highest road traffic death rate among ASEAN countries.

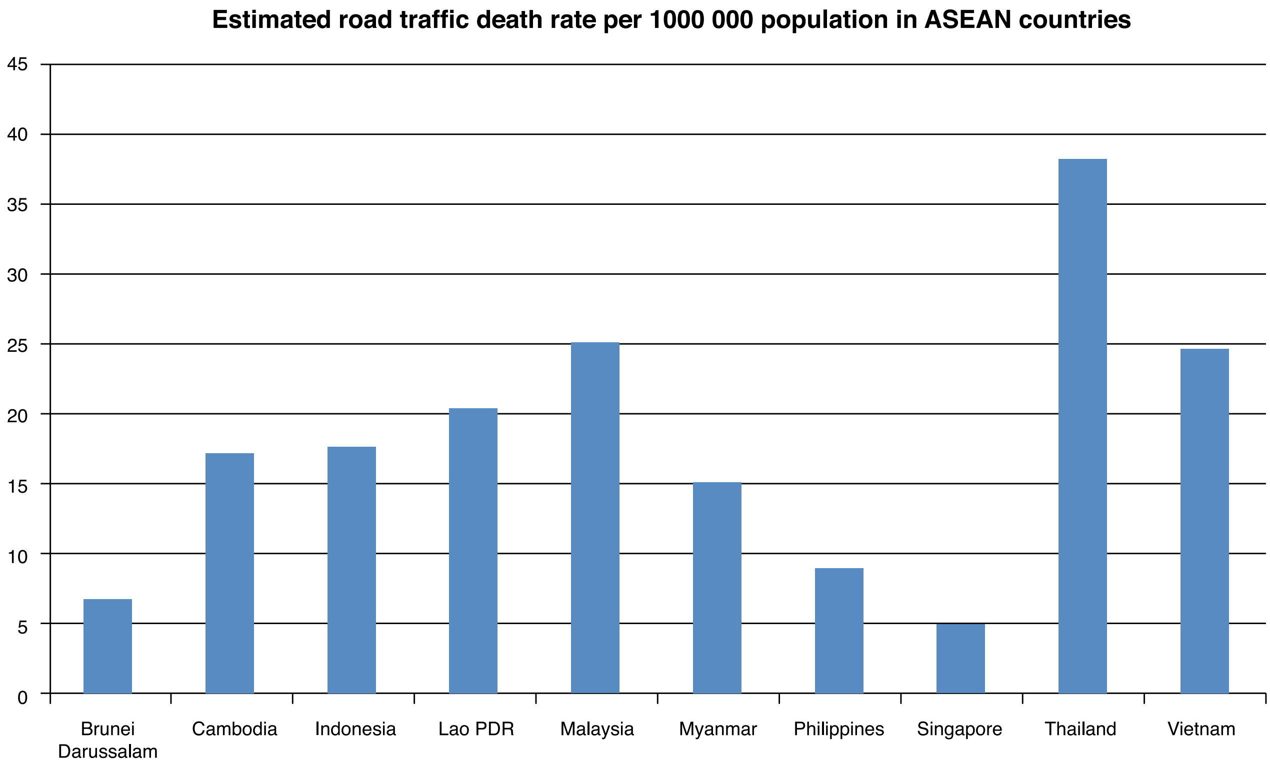


Figure 4.9 Estimated road traffic death rate per 100 000 population in ASEAN countries

Source: WHO 2013

The current policy in Malaysia shows seatbelt use has been compulsory in front seats since 1978, and in rear seats since 1 January 2009. Due to high awareness of the regulation, the compliance rates among drivers and front passengers are, respectively, about 85% and 75%. The compliance rate for rear seats was 40% after the law came into force in 2009, however the trend is now declining. The current rear seatbelt wearing rate is only 10% (Ahmad Noor Sykri *et al.* 2012). The use of hand-held mobile phone is also prohibited during driving. Despite that, its enforcement is weak. Furthermore, about 88% of high-income countries have child-restraint laws in place, while such laws are far less common in low- and middle-income countries, which is 30% and 43%, respectively (WHO 2004).

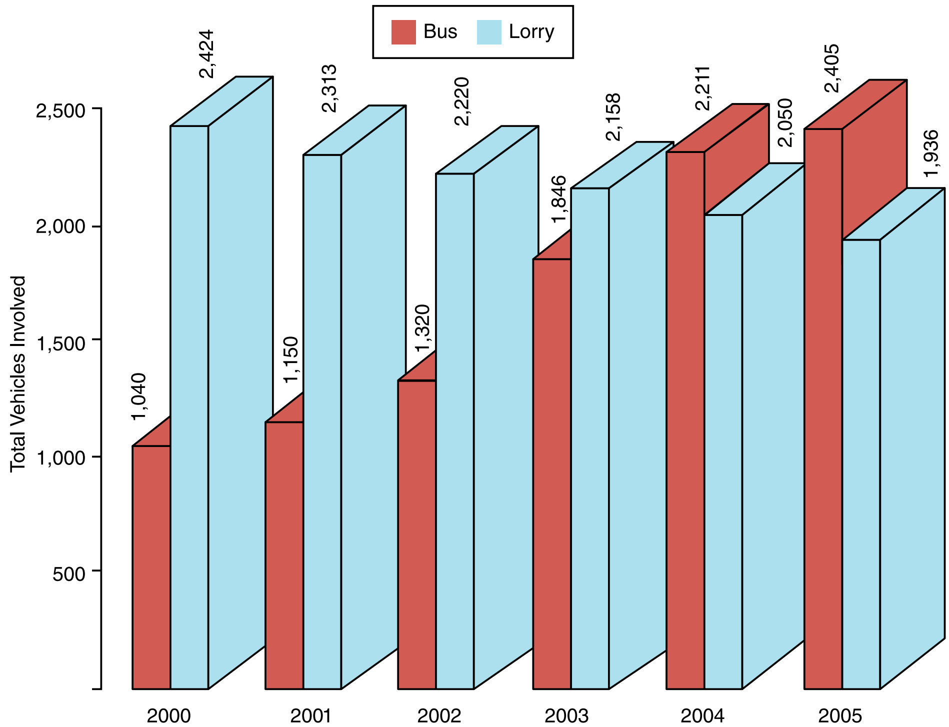


Figure 4.10 Bus and lorry accident statistics in Malaysia (2000-2005)

Source: Mohd Rasid Osman *et al.* 2009

Although motorcyclists accounted for majority of the fatal accidents, road crashes involving commercial vehicles are growing at an alarming rate. **Figure 4.10** shows that for the six-year period (2000 – 2005), there was a 25.35% increment in accidents involving buses and lorries, with buses experiencing more than a 100% increment, e.g. from 1,040 in 2000 to 2,405 in 2005. Tragically, most of the bus crash victims are innocent victims such as the passengers and other third party road users (PDRM 2007).

In order to help all organisations that wish to create safe traffic, or want to supply society with safe products and services, a new work item under International Standards Organisation (ISO) has begun. The aim is to develop a standard for management system for traffic safety. The standard should be close to ISO 9001 (standard for quality management) and ISO 14001 (standard for environmental management) to be easy to integrate into an organisation's overall management system. In ISO 39001, organisations can use all the common knowledge that has been developed over the years for safe traffic. This is a significant milestone in the history of traffic safety and will enable thousands and potentially millions of organisations to secure their own activities in the road transport system. ISO 39001 is aimed for organisations that wish to eliminate death and serious health losses due to crashes.

4.1.6.1 EXISTING PRACTICES AND CHALLENGES IN ROAD SAFETY MANAGEMENT

a. Human

i. Road user behaviour/human error

Current death rate due to road accidents is about 20 deaths/day, and is considered high. Most transport accidents/fatalities occur on roads is caused by human error such as motorcyclists entering highways instead of using motorcycle lanes. Drivers of commercial vehicles, such as lorries, buses and taxis do not comply to driving regulations (e.g. number of hours and number of drivers per vehicle). In addition, driver's attitude and condition such as changing lane as they like or cutting traffic queue, rushing to work, speeding, reckless driving, texting while driving, fatigue, and lack of focus contribute to the number of accidents in Malaysia.

There are several measures to prevent and reduce road accidents that are caused by drivers. The road safety plan in Malaysia can be categorised into three stages: pre-crash, crash, and post-crash. The pre-crash stage involves campaign of awareness to reduce accident to occur. In addition, road safety education is embedded in Bahasa Malaysia subject in primary schools, traffic wardens, and road safety club have also been implemented as other measures. Road safety education in secondary school are already planned to be implemented in future. The crash stage focuses on drivers' compliance to safety devices such as the proper use of helmet, child restraint, safety belt, etc. The post-crash stage depends on the skills of paramedics and the first responders to attend road accident victims. For drivers of commercial vehicles, policies are already in place by Department of Occupational Safety and Health (DOSH) but the lack of enforcement by authorities causes some drivers to be unaware of existing policies.

Beginner drivers of all ages lack both driving skills and experience in recognizing potential dangers. For newly-licensed young adult drivers, their immaturity and limited driving experience result in disproportionately high rates of crashes. Graduated driver licensing systems address the high risks faced by new drivers by requiring an apprenticeship of planned and supervised practice – the learner's permit stage. In addition, the driver is required to display 'L' sign on the front and back of the vehicle, and is prohibited from carrying passengers or goods. This is then followed by a provisional licence that imposes temporary restrictions on unsupervised driving. Commonly imposed restrictions include limits on the number of passengers, and a prohibition against driving after drinking any alcohol. These restrictions are lifted as new drivers gain a full licence. Hence, there are three stages to obtain a full licence: the learner's permit, the provisional licence and the full licence. Furthermore, improving driving school syllabus with the emphasis on ethical driving attitude and increased responsibility of drivers through educational measures should also be deliberated.

Road Safety Department has to add more effective awareness campaigns, and encourage more active participation from NGO/community. Hence, more funding for road safety measures and research intervention are required. A new module of road safety initiatives are also being planned by the Road Transport Department in the future. Consideration also needs to be given on conducting a psychological study of road users to address pre-crash and post-crash research; and the perception of personal safety among drivers.

ii.Heavy vehicle drivers

Current practice to be a heavy vehicle driver is one license for all types of heavy vehicle (E license). However, there is a shortage of skilled E license holder for transporting hazardous goods. In addition, different heavy vehicles require different level of driving skill, which is expensive and time consuming to obtain license. A different driving skills assessment for different types of cargo should be implemented before obtaining heavy vehicle licence. Due to the long hours of transit for logistic purposes, a stricter enforcement on the limitation on driving hours should also be in place by the operators. Currently, rest stops and rest areas have been provided to cater for fatigue drivers who had undergone long hours of driving.

iii. Road safety campaigns and laws

i. Media campaigns via television, radio, internet and newspapers;

ii. Community-based programmes;

iii. "Love Life – Advocating Road Safety via Music" – venturing into social marketing as opposed to traditional means of campaigning. A total of twelve popular Malaysian artists worked on the first Malaysian music album dedicated to road safety.

iv. Conducting a safety helmet programme at one of the districts in each state, including an advocacy programme each week and replacement of sub-standard safety helmets.

b. Vehicle

i. Malaysian Vehicle Assessment Programme (MyVAP)

From 2009 to 2011, Malaysian Institute of Road Safety Research (MIROS) established the Malaysian Vehicle Assessment Programme (MyVAP) to upgrade the degree of vehicle safety in Malaysia. This is done by promoting awareness among local car users, together with acquiring roadworthy and crashworthy vehicles via non-destructive techniques. The Proton Exora was the first car to be evaluated and managed to obtain the MIROS Safety Companion Status, equivalent to 4-star status. This programme is later superseded by the New Car Assessment Programme (NCAP).

ii. New Car Assessment Programme (NCAP)

New cars that are granted to enter the market might be "roadworthy" but not necessarily be "crashworthy" enough. Roadworthy means a car is fit to be used on the open road while crashworthy means how a car perform in the event of road crash to protect the occupant(s). In fact, crashworthiness criteria set in certain countries' legislation is inferior as compared to NCAP requirement. Due to weak local safety standards from producing and importing nations and insufficient harmonisation on available UN regulations, Malaysia has adopted and enforced car manufacturers to comply with United Nations Economic Commission for Europe (UNECE) regulations such as availability of airbags, Seatbelt Reminder (SBR), Collision Avoidance System, Electronic stability control (ESC) systems, and Alcohol-Interlock devices in vehicles.

MIROS is the lead agency for the ASEAN NCAP. The programme aims to develop a vehicle safety database to rate the make and type of vehicle in terms of safety. A full-scale crash laboratory facility in MIROS has since begun its operation in May 2012. Cars are tested at two labs – MIROS crash lab (MIROS PC3) in Melaka and the crash lab of Japan Automobile Research Institute (JARI) for Completely Built Unit (CBU) cars to ASEAN. NCAP, currently on its third phase of test, will award safety star ratings to new cars based on their safety performance in a crash test. This consumer-based programme will assist consumers in choosing a better car based on safety grading. Vehicle manufacturers have to ensure all vehicles meet safety standards and UN vehicle regulations. Further recommendation is to make it mandatory and enforcement placed for newer cars to get NCAP ratings. Currently, new vehicles that adopt NCAP ratings are on voluntary basis.

iii. Vehicle Road-Worthiness

Due to the irregular compliance to UN vehicle regulations, important safety features are still missing in new vehicles. In addition, the lack of safety features in old vehicles, and lack of maintenance of vehicles are also factors that cause road accidents. Installation of safety features in old vehicles should be mandatory to ensure the vehicle road-worthiness.

The Commercial Rebuilt Vehicles (CRV), in which vehicles that are rebuilt from second-hand parts without proper safety inspection and compliance to UN vehicle regulations, are available and used on roads. At the moment, no data are available on the safety and road-worthiness of these vehicles and the number of accidents involving CRVs in Malaysia. For recommendation, data collection on the number of CRVs on the road should be initiated.

Until recently, *Pusat Pemeriksaan Kenderaan Berkomputer* (PUSPAKOM), which was established in the early 1990s, is the only vehicle inspection company appointed by the Malaysian Government to undertake all mandatory inspections for commercial and public vehicles, as well as private vehicles for hire-purchase financing, ownership transfer and insurance purposes. However, the efficiency of PUSPAKOM needed to be improved based on the recent audit since its establishment. Commercial vehicles are mandatory to perform inspection every six months, while private vehicles are under voluntary basis. Hence, an awareness programme on the importance of vehicle inspection has been implemented at higher institutions and training centres.

Under the revised National Automative Policy (NAP) 2014, voluntary inspection of vehicles will not be performed strictly by one agency or company. New authorised and regulated vehicle inspection centres are to be introduced to perform similar inspections as practiced in UK, where these authorised centres are given a UK - MOT certificate (UK Government 2014). Annual vehicle inspection for vehicles older than five years is proposed to ensure the safety of vehicles and environmental conservation. For future recommendation, mandatory annual inspection for cars older than 15 years to be an additional requirement for road tax renewal based upon JPJ approval. Passing the vehicle inspection should be a compulsory condition for road tax renewal. Nevertheless, to support technologically advanced vehicles such as Energy Efficient Vehicle (EEV) and changes to UN vehicle regulations, the NAP is recommended to be revised every five years. Vehicle manufacturers need to comply with the Vehicle Type Approval (VTA) system; they are given the opportunity to improve the safety standard, e.g. moving towards higher safety standard from time to time. Labelling star-rating on new vehicle allows user to choose a car according to safety level.

- **(Case Study) Germany: Periodic Vehicle Testing (PVT)**

Periodic roadworthiness inspection to ensure safety and environmental quality is mandatory in Germany (Aubel 2009). The tests for brake system, steering system, lighting, axle, wheels, chassis frame, electrical equipment, exhaust-gas system, and noise emissions are mandatory for each vehicle. The PVT system has three stages:

- Legal basis is according to the law governing road traffic and vehicle safety and environmental quality.
- Responsibility of the operator or supplier's agent - permanent driver's responsibility for vehicle condition in accordance with regulations, and the owner's responsibility to submit the vehicle for periodic roadworthiness inspection.
- Surveillance by a qualified third party - periodic roadworthiness inspection as regulated, depending on vehicle type and age.

Based on the study by German Government, the vehicle sustainability chain involves five elements; active safety, passive safety, environmental quality, efficiency, driver skills and responsibility. The first four elements must be designed, produced, and maintained during service phase. The last element is a permanent learning process. Accident prevention and accident control strategies that have been initiated are enhanced active and passive vehicle safety such as PVT, improvement of driver skills and behaviour, and faster accident reporting and rescue operations.

Based on the strategies above, the statistics from 1970-2000 in **Figure 4.11** shows while the number of vehicles has tripled, the accidents remained unchanged and the death toll had dropped by more than 50% ever since the PVT was implemented.

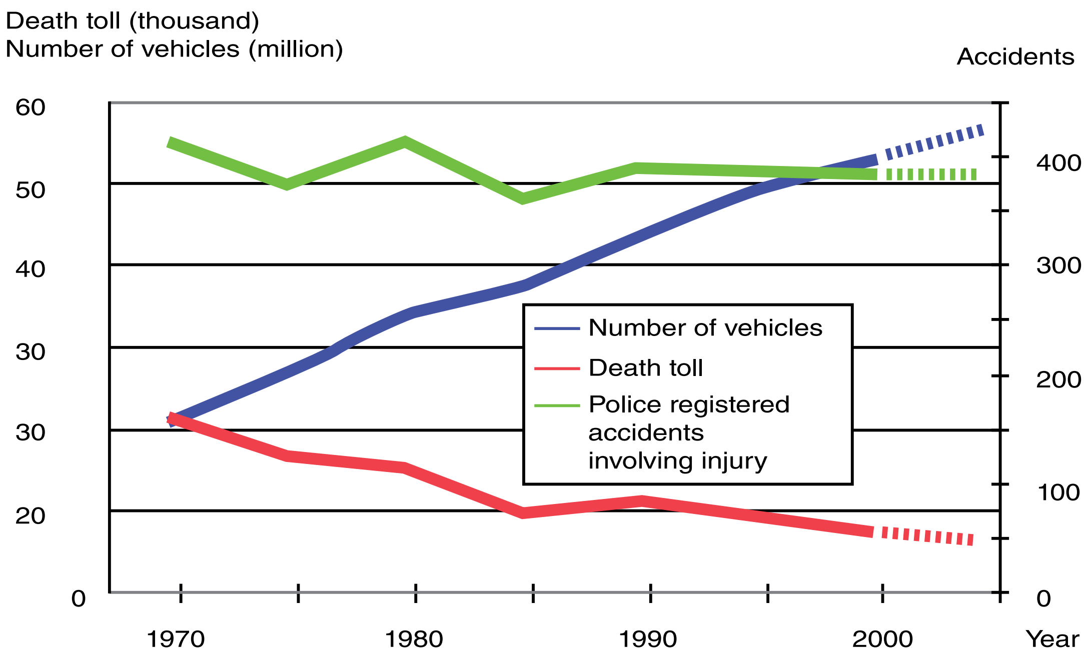


Figure 4.11 Vehicle accidents in Germany

iv. Motorcycle Safety

Motorcyclists demonstrate the highest number of fatalities amongst road users as shown in **Figure 4.11**. Various measures such as aggressive campaigns and continuous enforcement are being taken as this group is one of the most vulnerable road users in terms of accident fatalities.

The National Helmet Initiative is a community-based programme conducted by the Road Safety Department, especially in the rural areas. The department will exchange old, or low quality safety helmets with a helmet that meets the SIRIM compliance. Road users, especially motorcyclists, will be taught the importance of wearing helmets properly. In an effort to segregate motorcyclists, guardrail/chevron markings along motorcycle lanes have been set up. However poor design undulation (such as water collection after rain on the roads), limited stretches of motorcycle lanes on all types of roads, and lack enforcement of speed limit causes motorcyclists to enter highways instead of using dedicated motorcycle lanes.

v. Non-motorised and Pedestrian Safety

A fundamental factor is the modern traffic system is designed largely from the perspective of a motor vehicle user. The principal risk factor for unprotected road users is the mixing of unprotected people with motor vehicles capable of high speeds. The survival of unprotected users depends upon ensuring either that they are separated from the high speeds of motor vehicles or – in the more common situation of shared use of the road – that the vehicle speed at the point of collision is low enough to prevent serious injury on impact with crash-protective safer car fronts.

If separation is not possible, road management and vehicle speed management are essential to ensure secure walking routes. At low speeds, drivers have more time to react to unexpected events and to avoid collisions. Poor planning at crossings and junctions is also a feature of unsafe shared use. Safe crossing facilities for pedestrians and cyclists are likely not to be used if there are many steps that need to be climbed, if the crossings are poorly lit or if the underpasse badly maintained, or if long detours are involved. Many pedestrians who were hit by vehicles had chosen to climb over traffic-lane barriers, rather than climb a long flight of stairs to a footbridge that was poorly located or regarded as unsafe.

Other risk factors for pedestrians and cyclists include:

i. Poor street visibility: The mix of motorised and non-motorised traffic, together with frequent poor lighting, leads to a high risk for unprotected users if they are not seen by traffic. A review of European research found that one third of pedestrian casualties had difficulty in seeing the striking vehicle. Similarly, two fifths of drivers had difficulty in seeing the pedestrian (European Transport Safety Council 1999). The fitting of reflectors on the front and rear of non-motorised vehicles are required. Nevertheless, while all these aids to visibility would appear to have great potential, their actual effectiveness in increasing the safety of pedestrians and cyclists remains largely unknown and requires additional study (Kwan *et al.*, 2006).

ii. Poor understanding on the part of pedestrians of road safety;

iii. Alcohol impairment on the part of the cyclists or pedestrians;

Integration of safe travel path in mixed-mode commuting (intermodal transport) ensures safe travelling that covers the first mile and the last mile for pedestrian and non-motorised transport. Such example is the sky bridge facilities by Bangkok Mass Transit System (BTS) in Thailand. Ideally, intermodal transport provides pedestrians and businesses with seamless, safe and secure service anywhere anytime, on time. To encourage such trips, intermodal journey planning is often available for travellers to plan and schedule their journey.

Human-centred systems (Gasson 2003; Goodrich *et al.* 2000; Haberkorn *et al.* 2013) will allow transportation planners to assess the safety performance of intermodal transport by designing large-scale models and simulations, in which the concept has to take into account of human error, physical malfunction, and environmental disruptions. In other words, more research has to be done on human-centred systems.

c. Infrastructure and Land Use

i. Land Use Planning

Planning decisions regarding transport, land use and road networks have significant effects on public health – as they affect the amount of air pollution by vehicles, the degree of physical exercise undertaken by individuals, and the volume of road traffic crashes and injuries (WHO 2004).

Without the proper land-use planning, residential, commercial and industrial activity will evolve in a random pattern, and road traffic will evolve similarly to meet the needs of these various activities. This is likely to produce heavy flows of traffic through residential areas, high speed vehicles mixing with pedestrians, and heavy vehicles using routes not designed for such vehicles. The exposure to traffic injury can be high for car occupants, pedestrians, cyclists and motorised two-wheeler users.

In other words, there is generally no effective segregation of the different vehicle categories, or speed control. Land-use planning is often done with a view to creating efficient flows of traffic, resulting in major arterial, high-speed routes that cut off different urban sections, to the disadvantage of local residents (WHO, 2004).

The main aspects of land use that influence road safety are:

- the spatial distribution of origins and destinations of road journeys;
- urban population density and patterns of urban growth;
- the configuration of the road network;
- the size of residential areas;
- alternatives to private motorised transport.

Land-use planning practices and "smart growth" land-use policies e.g. development of high-density, compact buildings with easily accessible services and amenities, can serve to reduce the exposure risk of road users. The creation of clustered, mixed-use community services, for example, can cut the distances between commonly used destinations, curtailing the need to travel and reducing dependence on private motor vehicles.

ii. Road Network

In an efficient road network, exposure to crash risk can be minimised by ensuring that trips are short and routes direct and safe. Route management techniques can achieve these objectives by decreasing travel times on desired routes, increasing travel times on undesired routes, and re-directing traffic. Studies have shown that pedestrians and cyclists place a higher value on journey time than do drivers or those using public transport – a finding that should be reflected in planning decisions (European Transport Safety Council 1999; Elvik *et al*. 2009).

The framework for the systemic management of road safety in high-income countries is increasingly defined by the following activities (*Cities on the Move*, 2002; Ogden, 1996; Transport *et al.* 1991; Wegman *et al.* 1997):

1. Safety-awareness in planning road networks

- classifying the road network according to their primary road functions;
- setting appropriate speed limits according to those road functions;
- improving road layout and design to encourage better use.

These approaches can, in principle, be adapted to the contexts of middle-income and low-income countries. Within these general principles, safety engineering and traffic management should aim (Transport *et al.* 1991; WHO 2004):

- to prevent road use that does not match the functions for which the road was designed;
- to manage the traffic mix by separating different kinds of road users, so as to eliminate conflicting movements of road users, except at low speeds; and
- to prevent uncertainty among road users about appropriate road use.

2. Trip reduction measures

Studies in high-income countries indicate that for each 1% reduction in motor vehicle distance travelled, there is a corresponding 1.4–1.8% reduction in the incidence of crashes. Measures that may reduce the distance travelled include:

- making greater use of electronic means of communications;
- encouraging more people to work from home;
- better management of commuter transport;
- bans on freight transport at certain zones and time; and
- restrictions on vehicle parking and road use.

3. Restricting access to different parts of the road network

Two well-established measures for minimizing contact between high-speed traffic and unprotected road users are preventing pedestrians and cyclists from accessing motorways and preventing motor vehicles from entering pedestrian zones. Therefore, pedestrian zones are safer for travel on foot and also for bicycle travel.

iii. Road Safety Audit (RSA)

The Road Safety Audit on new projects has been implemented in Malaysia since 1994, and is mandatory for all Public Works Departments. It is carried out at five different stages of project implementation. Firstly at the feasibility stage, then preliminary design, detail design, construction and pre-opening stage and lastly at operational stage. Road safety audit is also carried out on existing roads.

The RSA should be performed periodically and when needed. Its efficiency can be improved further by using tools such as International Road Assessment Programme (iRAP) or similar alternative system. Each road is rated in accordance to each user type namely cars occupant, motorcyclist, bicyclist and pedestrian. More multidisciplinary road safety research (e.g. Road crash injury, post-impact care, biomechanics and vehicle design, behavioural studies, road safety engineering) are needed to address the gaps and to enhance safety.

Assessments of the impact on safety of transport projects usually focus on the individual project, with little consideration of the effect on the wider network. This can result in strategies for improving mobility, reducing congestion, and improving the environment that are incompatible with road safety. Area-wide safety impact assessments should be routinely conducted at the same time as other assessments of policies and projects related to transport and land use.

iv. Motorcycle Lane

There are two types of motorcycle lanes, exclusive and non-exclusive. Exclusive motorcycle lanes segregate motorcycles from mainstream traffic with a guardrail, while non-exclusive motorcycle lanes separate motorcycles from mainstream traffic using chevron markings only. With the implementation of the exclusive lanes, there is approximately a 30% reduction in motorcyclist crashes (Umar *et al.* 1995).

v. Road Conditions and Capacity

Defects contributing to crash risk can appear in road designs. Such defects are frequently caused by the poor design of junctions or by design that allows for large differences in the speed and the mass of vehicles and in the direction of travel. Bad road surface conditions are a particular risk factor for users of motorised two-wheelers. Often, where there is no safety impact study to assess the effects of a new road scheme on the existing network, a new road scheme can have an adverse impact on large areas (WHO 2004).

In the planning, design and maintenance of the road network, four particular elements affecting road safety have been identified. These elements are:

- safety-awareness in the planning of new road networks;
- the incorporation of safety features in the design of new roads;
- safety improvements to existing roads;
- remedial action at high-risk crash sites.

The absence of any of these elements, are risk factors for crashes. Specific situations related to road conditions that are risk factors for crashes include:

- through-traffic passing through residential areas;
- conflicts between pedestrians and vehicles near schools located on busy roads;
- lack of segregation of pedestrians and high-speed traffic;
- lack of median barriers to prevent dangerous overtaking on single-carriageway roads;
- lack of barriers to prevent pedestrian access onto high-speed dual-carriageway roads; and
- Poorly maintained road (e.g. potholes, uneven surface) are potential dangers which may cause

drivers to lose control of vehicle. Major unevenness in the road surface increases wear and tear on vehicles and can also damage vehicles.

- Poor visibility (lack of street lamps)

Uncertainty among road users about the layout of roads from the absence of clear and unambiguous line markings and signs is also a particular risk factor for crashes. Similarly, the lack of self-enforcing measures to reduce speed will increase the risk. Straight, unmarked single-carriageway roads encourage drivers to speed.

d. Intelligent Transport System (ITS)

The Transportation Research Board defines Intelligent Vehicle Highway Systems (IVHS) as "the application of advanced information processing and communications, sensing, and control technologies to surface transportation," noting that the objective is "to promote more efficient use of the existing highway and transportation network, increase safety and mobility, and decrease the environmental costs of travel" (Brand 1993). Several of the problems with sustainable transport are problems that can be resolved by IVHS or now known as ITS. In general, there are six recognised areas of ITS types of systems.

The first set of three is primarily technology-oriented, while the second set is applications-oriented. To increase the efficiency of transport system, ITS can be employed in order to improve the flow of traffic, reduce congestion, and increase safety. In other words, communication with the driver is more effective than is possible with the occasional passive road sign (Black, 2010). Advanced Traffic Management Systems (ATMS), Advanced Traveller Information Systems (ATIS), and Advanced Vehicle Control Systems (AVCS) are the three main areas in ITS. The specific application areas for ITS are generally organized around three types of systems, namely, advanced public transportation systems, commercial vehicle operations, and advanced rural transportation systems (Black, 2010).

- **Current ITS Technology in Malaysia**

  - Integrated Transport Information System (ITIS): to support one of the objectives of the Structural Plan Kuala Lumpur 2020, which is to improve the management of the Klang Valley's transport infrastructure system, City Hall Kuala Lumpur (CHKL) has selected Integrated Transport Information System (ITIS) to improve the planning and traffic flow in the city.

  - Real time measurement of congestion (e.g. Waze, Variable Message Sign).

Other urban areas still lack the technology and enforcement of ITS. Such technology will help facilitate the measurement and real time data collection of impact on traffic (spillovers onto other roads), congestions, etc. The traffic flow in Malaysian rural areas can also be studied when ITS system such as advanced rural transportation system is integrated as well.

e. Enforcement

i. Strengthened enforcement activities during festival periods. There are two major festivals in Malaysia: Hari Raya and Chinese New Year. During these periods, people usually travel to their home-towns and the traffic volume on the roads increases. In order to reduce fatality during this period, a concentrated effort on enforcement, named *Ops Sikap*, has been carried out for several years (Jamilah Mohd Marjan *et al.* 2012).

ii. Automated Enforcement System (AES): The AES uses automated cameras to capture images of vehicles exceeding speed limits and running red lights. These images are transmitted immediately to a control centre to be processed. Once an offence has been identified and verified by Jabatan Pengangkutan Jalan (JPJ) officers, summon will be issued through registered mail. Traffic offences such as speeding and running red lights are more effectively enforced using automated means as there is the ability to enforce via fixed cameras 24/7 and during all weather conditions.

Previously, the summons imposed by AES might duplicate the police summons system, doubling the amount of traffic summons to the traffic offender. The police, who enforce the speeding laws, would continue the enforcement and put up mobile speed traps near the AES cameras, raising the prospect of dual fines for errant motorists. In addition, the implementation of AES resulted to the privatisation of the enforcement, and the fines would benefit private companies that implemented the system. The management of AES was under the jurisdiction JPJ before the Ministry of Home Affairs took over in September 2013 (Malay Mail Online 2013). A study on the effectiveness of AES implementation has to be done in order to review current penalty/punishment/ fine. Other offenses to be enforced in the future using AES include double line crossing, overtaking on the left side of the road, overloading, cutting the queue, restrictions on heavy vehicles entering the city, and enforcement of bus routes. The following are examples of the effectiveness of AES in other countries:

- France - The mortality rate went down 27% in the first 3 years of the AES implementation.

- Germany - In the installed locations, speed reduction has become a culture (vehicle speed reduction and compliance of 80% at locations where speed sensor cameras are installed).

- Kuwait - Accidents decreased by 48%.

- United Kingdom - Traffic violations decreased by 6% from the total number of registered vehicles.

iii. Speed management is the transition from high-speed roads to lower-speed roads. When a vehicle leaves a highway, it enters a winding stretch of narrow road after a long, straight stretch of road. The creation of transition zones on busy roads approaching towns and villages can reduce crashes and injuries for all types of road user. The consultation process of amendment to Highway Code is ongoing for speed enforcement by municipalities. National speed limit for federal road is 90km/hour. Nevertheless, some locations where there is school, hospital or small township, the speed is reduced. The default National Speed Limit on Malaysian expressways is 110km/h, however certain areas a lower speed limit (such as 90km/h or 80km/h) is applied, especially in large urban areas, crosswinds, heavy traffic and in dangerous mountainous routes, and 60km/h is applied 1km before the toll plaza. Speed traps are also deployed by the Malaysian police at many places along the expressways.

Hence, highly-prone crash areas need to be identified. Following that, post-crash management such as preparing standby ambulances at these locations for swift rescue operation is also crucial. Ambulance, complete with medical equipment and trained personals should be required to arrive at accident scenes within 10 minutes, and the injury data can be collected as an input into road safety research.

The Dutch policy of sustainable safety divides roads into one of three types according to their function, and then sets speed limits accordingly (WHO 2004):

- **Flow roads** (or through-roads). For such roads, through-traffic goes from the place of departure to the destination without interruption. Speeds above 100–120km/h are not permitted, and there is a complete separation of traffic streams.

- **Distributor roads**. These roads enable users to enter or leave an area. Speeds on distributor roads should not exceed 50km/h within built-up areas or 80 km/h outside such areas. There should be separate paths for pedestrians and cyclists, dual carriageways with separation of streams along the full length, speed controls at major crossings, and right of way.

- **Residential access roads**. These roads are typically used to reach a dwelling, shop or business. The needs of non-motorised users are predominant and speeds above 30km/h are not permitted. In rural areas, no speeds over 40km/h are allowed at crossings and entries – otherwise 60km/h may be acceptable.

iv. The Polis Diraja Malaysia (PDRM) enforcement include the following: stopping obviously impaired drivers, stopping drivers at roadblocks or sobriety checkpoints and testing only those suspected of alcohol impairment, stopping drivers at random and testing all who are stopped, speed enforcement, enforcing seat-belt, child restraint and helmet use, rear seat-belt enforcement, and road tax inspection. However, some regulations are not adequately enforced and some enforcement is interfered by political interventions. Enforcement levels need to be high and maintained over a period of time, so as to ensure that the perceived risk of being caught remains high. An urgent need of up-to-date database integration is required so all agencies can access and perform enforcement on the offenders.

v. Enforcement of all UN vehicle regulations: to ensure vehicles meet the international safety standard, an enforcement is needed to comply with all UN vehicle regulations. This measure can be realised by improving JPJ current monitoring of PUSPAKOM due to irregular audit by JPJ to PUSPAKOM. Stricter monitoring of PUSPAKOM operations by JPJ can be implemented by performing annual audit.

vi. Demerit system: KEJARA (*Keselamatan Jalan Raya*) System is aimed towards drivers with provisional licence and full licence. Demerit point system is given to drivers who have been fined or summoned for traffic offenses. The KEJARA System is covered by Road Transport Act (1987) 35,35a, 37 and 38, and Motor Vehicles (Demerit Points) Rules 1997. Drivers who had their licences revoked are not allowed to drive for twelve months. Drivers are allowed to drive again provided they have passed successfully on the rehabilitation course.

(Case Study) Reducing traffic fatalities in Bogotá, Colombia (WHO, 2004)

A programme launched by the city's mayor, was aimed at changing people's behaviour on the roads. Measures promoted included the wearing of safety belts and observing pedestrian crossings. Although the rules are already in place, most people had failed to observe them and the authorities had generally failed to enforce them. Hence, mime was used on numerous sites throughout Bogotá. The mime actors working for the programme used sign language to point out to drivers that they were not wearing seat-belts, or that they had failed to give way at pedestrian crossings. At first, drivers were simply warned and told to change their behaviour. If this failed, a traffic policeman stepped in and handed out a fine, to the applause of onlookers. Nowadays, over 95% of drivers have been found to observe these rules. To illustrated, 500 guides are employed in the Bogotá Mission programme, in which young people trained in traffic regulations, first aid, preventive safety measures and the detailed layout of the city, are tasked to encourage safe behaviour on public roads.

f. Environment

Impacts between vehicles leaving the road and solid roadside objects such as trees, poles and road signs are a major road safety problem worldwide.

i. **Landslides**

Frequent landslides on embankments obstruct traffic on major roads and highways. A road user has no chance on his own of preventing landslides and few chances of avoiding being hit by a landslide if he happens to find himself at a place where a landslide is occurring. As a result, landslides are often regarded as a hazard from which people should be totally protected when travelling on public roads.

Landslide protection is to reduce the probability of the road being exposed to landslide and reduce the damaging effects of landslides by protecting road users from being caught by landslides, which cannot be prevented. Current practices are to reroute the road into terrain which is safe from landslides, and landslide screens and walls are built to prevent further landslides. Stretches with dangerous embankments are to be identified and strengthened them. Further studies need to be carried out on the effects on the environment of landslide protection, and real time warning system on landslides such as planting seismometers on identified embankments.

ii. **Flashfloods**

Flashfloods are caused by heavy rain associated with a severe thunderstorm. In urban areas, flashflood can impose risk on the drivers, vehicles, traffic and roads. The Stormwater Management and Road Tunnel or (SMART Tunnel) is a storm drainage and road structure in Kuala Lumpur, Malaysia. The main objective of this tunnel is to solve the problem of flash floods in Kuala Lumpur and also to reduce traffic jams along Jalan Sungai Besi and Loke Yew flyover at Pudu during rush hour. There are two components of this tunnel, the stormwater tunnel and motorway tunnel. For other areas, current measure is to identify flashflood areas and improve the drainage system, as well as providing flashflood warning system to divert traffic from the affected roads.

iii. **Crosswind**

A crosswind is any wind that has a perpendicular component to the line or direction of travel. Crosswinds can also be a difficulty when traveling on wet or slippery roads especially with gusting conditions and vehicles that have a large side area such as vans. This can be dangerous for motorists because of the possible lift force created as well as causing the vehicle to change direction of travel. The safest way for motorists to deal with crosswinds is by reducing their speed to reduce the effect of the lift force and to steer into the direction of the crosswind. Signage and crosswind indicator have been set up along roads and highways to warn drivers to reduce speed at these spots.

iv. **Blackspot**

In urban areas, traffic accidents tend to cluster at specific places. The concentration of accidents may be due to inappropriate road design, traffic control, or obstruction of vision at junctions from bushes, branches, or illegally-parked vehicles. The clustering of accidents is known as blackspots. The major road safety programs being carried out by Ministry of Works Malaysia are blackspot treatments, overtaking lanes, motorcycle lanes, junction improvements and curve improvements. The effectiveness of blackspot treatment depends on the measures used. Measures that improved visibility include clearing the obstructions at junctions; placing the correct sign board at the correct location of the road; for mobility, the measures include upgrading traffic signals, improving friction on the road surface, and traffic control signal at intersections.

v. **Wildlife Crossings**

Wildlife crossings are structures that allow animals to cross human-made barriers safely. Wildlife crossings may include: underpass tunnels, viaducts, and overpasses (mainly for large or herd-type animals), and signage. Wildlife crossings are a practice in habitat conservation. They also assist in avoiding collisions between vehicles and animals, which in addition to killing or injuring wildlife may cause injury to humans and property damage.

g. Institutional

The Road Safety Department (RSD) is the lead agency for road safety in Malaysia and MIROS provides support by conducting road safety research to assist in elaborating strategies to reduce road traffic deaths. The main stakeholders involved in road safety in Malaysia are principally the Public Work Department (PWD), the Road Transport Department (RTD), the Royal Malaysian Police (RMP), the Malaysian Highway Authority (MHA), the Ministry of Transport, the Ministry of Health, the Ministry of Education, the Land Public Transport Commission and other road related agencies. In addition, several NGOs are actively involved in road safety in Malaysia.

Weaknesses in the communication and coordination procedures between agencies - PWD, SPAD, RTD, RMP, local authorities - such as in the approval of vehicles, number of passengers allowed in a bus, blacklist system and vehicle permits, allocation of maintenance and safety funding – contributed to the inefficiency of the transportation system. There should be a clear definition of responsibilities and funding management of each agencies to improve efficiency.

The development of traffic safety policy involves a wide range of participants representing a diverse group of interests as presented in **Figure 4.12**. Responsibilities for road safety are spread over different levels of Government with policy being decided at local, national and international levels. The construction of multisectoral institutional capacity, both in the governmental and nongovernmental spheres, is a key to developing road safety, and can only be delivered by a national, political commitment.

Figure 4.12 The key organisations influencing policy development

Source: WHO 2004

The provision of safe, sustainable and affordable means of travel is a key objective in the planning and design of road traffic systems. To achieve the objectives requires firm political will, and an integrated approach involving close collaboration of many sectors. Furthermore, current transportation planners in Malaysia rely too much on foreign experts, who understand less on the local culture and local problems. The consultation on foreign experts must include the transfer of knowledge and technology. This will provide local experts with skills and knowledge, while promoting them as advisors to local problems. The Malaysian government can identify centres of excellence, which can deliver quality research and consultancy services.

h. Others

i. **Hazardous Goods**

Hazardous goods are a generic term for materials which, by their very nature, represent particular risks to life, health, environment and material goods. The negative consequences of crashes and incidents can extend beyond deaths and injuries when hazardous materials are involved. Hazardous goods are formally defined as those materials which are regarded as hazardous goods in accordance with the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR) Convention, and the transit of dangerous goods are covered in ASEAN-Brunei protocol. ADR divides hazardous materials and objects into hazard classes on the basis of their characteristics.

Safety measures for the transport of hazardous materials are given in international agreements and the SHE code of practice. The driver must have proof of competence where this is required. Special training for the drivers (knowledge about content and label of the goods carried) should be mandatory to ensure the goods are transported and handled in a responsible manner. In addition, the vehicles for transportation must be in first class condition. Safety measures for hazardous goods may reduce the extent of discharge of hazardous materials in accidents. In the event of accident, the efficiency of emergency response team (HAZMAT) for help-and-rescue can be organized in a timely manner by setting up regional teams to reduce response time instead of centralizing in one area.

4.2 CURRENT ISSUES AND BENCHMARKING: RAIL TRANSPORTATION

Without controlling the land use development, over 68% urban area in Iskandar Malaysia will be sprawling. Unregulated public transportation services will reduce their efficiency and lead to high dependency on private car. Furthermore, car ownership is rapidly increasing and expecting from 500 cars per 1,000 populations to more than 800 by 2025 (TBIM 2011). Rapid urbanisation and motorisation is the main reason of the huge migration to the cities (Peng, Sun & Lu 2012), as a result, facing lot of challenges (e.g. congestion, air pollution, energy security) (Yulin & Zhenyu 2010). Major roads to all 5 flagships of Iskandar Malaysia will be flooded with cars and is over its capacity during peak hours.

Hence, more than 1,864km road needs to be constructed for the next 20 years (2.5 times investment as compared to current road infrastructure) if nothing is done (TBIM 2011). More sustainable approach is needed to strategically change the 'hopeless' scenario now for better future, let us go green with public transport (TBIM 2011). The railways are the one of the important parts of the transportation section that carry a large percentage of travelers and freight in busiest routes in a countries. As the economy is growing, the demand for travel is going and the railways can play an important role to meet the demand instant of travelling by road (Pan 2011). To further understand the issues faced by rail transport in Malaysia, a workshop was conducted by the Academy Science Malaysia (ASM) on January 2014. Representatives from the transport sector stakeholders, including government bodies, industry and academics have participated in the discussion. From the workshop, several issues faced by the rail transport have been identified:

4.2.1 LIMITED CONNECTIVITY

a. Current Status

It was concluded that the current railway network in Malaysia has limited connectivity. In terms of intercity train, many important cities on the Peninsular Malaysia, such as Melaka, Kuantan, Kuala Terengganu, George Town etc., are not directly accessible through rail. Poor connectivity between East Coast and West Coast of the Peninsular Malaysia is also evident, where train needs to travel to Gemas in the southern part of Peninsular Malaysia, in order to commute between East and West Coast. On East Malaysia, the railway coverage in Sabah and Sarawak is even more limited.

As part of the Sarawak Corridor of Renewable Energy (SCORE), the Sarawak Government has revealed their plan to build a railway linking Limbang and Tanjong Manis in Sarawak. However, till date, the timeline and costing for the project is yet to be announced (The Star Online 2013). In terms of intracity rail, currently only Klang Valley area has incorporated rail transport as part of its working public transport system. All these have hindered the use of rail as the main mode of transport in Malaysia.

ii. Challenges

Improving the connectivity of the rail network system in Malaysia will require the construction of new railways to supplement the current rail network. The first challenge to this will be the funding of such projects, as initial investment for railway construction is relatively high. Geographical limitations can also be a challenge in building new railways. For instance, the proposed East Coast Rail Link (ECRL) is expected to cut through the Titiwangsa mountain range, connecting Kuala Lumpur to Tumpat, and all the way up to Kota Baru.

iii. Future R&D Needs

It is well aware that improving rail connectivity in Malaysia has been proposed in NPP 2, where the railway network is expected to be expanded with the introduction of new rail links, such as ECRL. At the time where this report is being prepared, a feasibility study on the construction of a 620km ECRL is being conducted by the East Coast Economic Region (ECER) (Intan Farhana Zainul 2013). Based on the outcomes of the workshop, it is felt that there is a need to conduct more R&D on transport system planning, to allow scientific evaluation of master plan for future rail network in Malaysia, such as that proposed in NPP 2. Research on civil and construction technology, capable of mitigating local geographical and environment limitation is also necessary, in hope to reduce construction cost and increase connectivity.

iv. Benchmarking

Growth in rail usage has been marked in recent years such that the annual figures published by the Office of Rail Regulation show the number of passengers is going to be double as from 735 million in 1994/95 to 1.5 billion in 2012/13 in UK. The National Travel Survey (NTS) estimated that averages about 50% of rails are used commuting purposes in the weekdays, 9% for business travel. Because this release focuses on travel into cities, commuter journeys are likely to account for a much higher percentage of trips (RPNCS, 2012). The Railways White Paper1 gave an outlines for the new structure to tackle challenges that the railways facing.

The new structure has been developed by consulting with key industries and regional players. The light rail has been used significantly and the demand increased over the last several years. Performances of the individual schemes are different where some schemes are very successful. The Docklands Light Railway carries about 46 million passengers annually where the passengers increasing as well. Manchester Metrolink has attracted more passengers and often operated at over capacity. Nevertheless, some schemes are not really too successful in term of passengers and economy. Passenger's number on Sheffield Supertram, Croydon Tramlink and Midland Metro are significantly lower than the expectation. Light rail is good for the routes where traffic and passenger flows are high. Some schemes still can be improved by integrating with other types transports (e.g. integrated ticketing, good bus service, parking policies) (FTN 2004).**Figure 4.13** shows the map of the National Rail network in the UK.

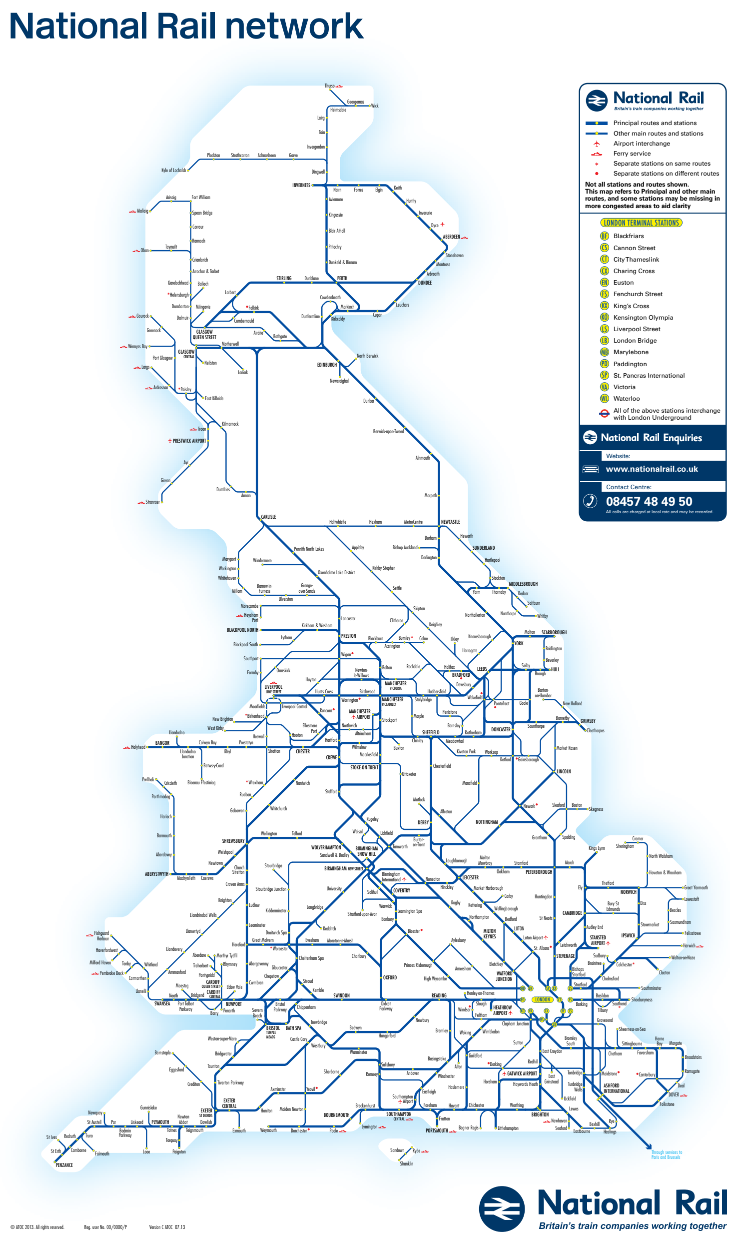


Figure 4.13 Map of the National Rail network in UK

Source: MNRN (2013)

To increase the economic growth in the North of England, they plan for better connections between key towns and cities by upgrading the railway as shown in **Figure 4.14**. Their target up to 700 trains daily, serves annually more than 44 million passengers which will be completed by 2019. The railways reduce journey times between Leeds and Manchester by about 10 minutes, Liverpool and Manchester by 10-15 minutes.

Figure 4.14 North England connections between key towns and cities

Figure 4.15 shows the China rail network. China is the second biggest length of railways operation the world and about 93,000km in 2011 with the increasing rate of 2.2%. The railway has carried about 1,862 million passengers in 2011, with the increasing rate of 11.1% as in **Figure 4.17**. Nonetheless, the Eastern region had the highest of railway passengers (about 498 million) in 2011, with the increasing rate of 9.9%, as shown in **Figure 4.18**.

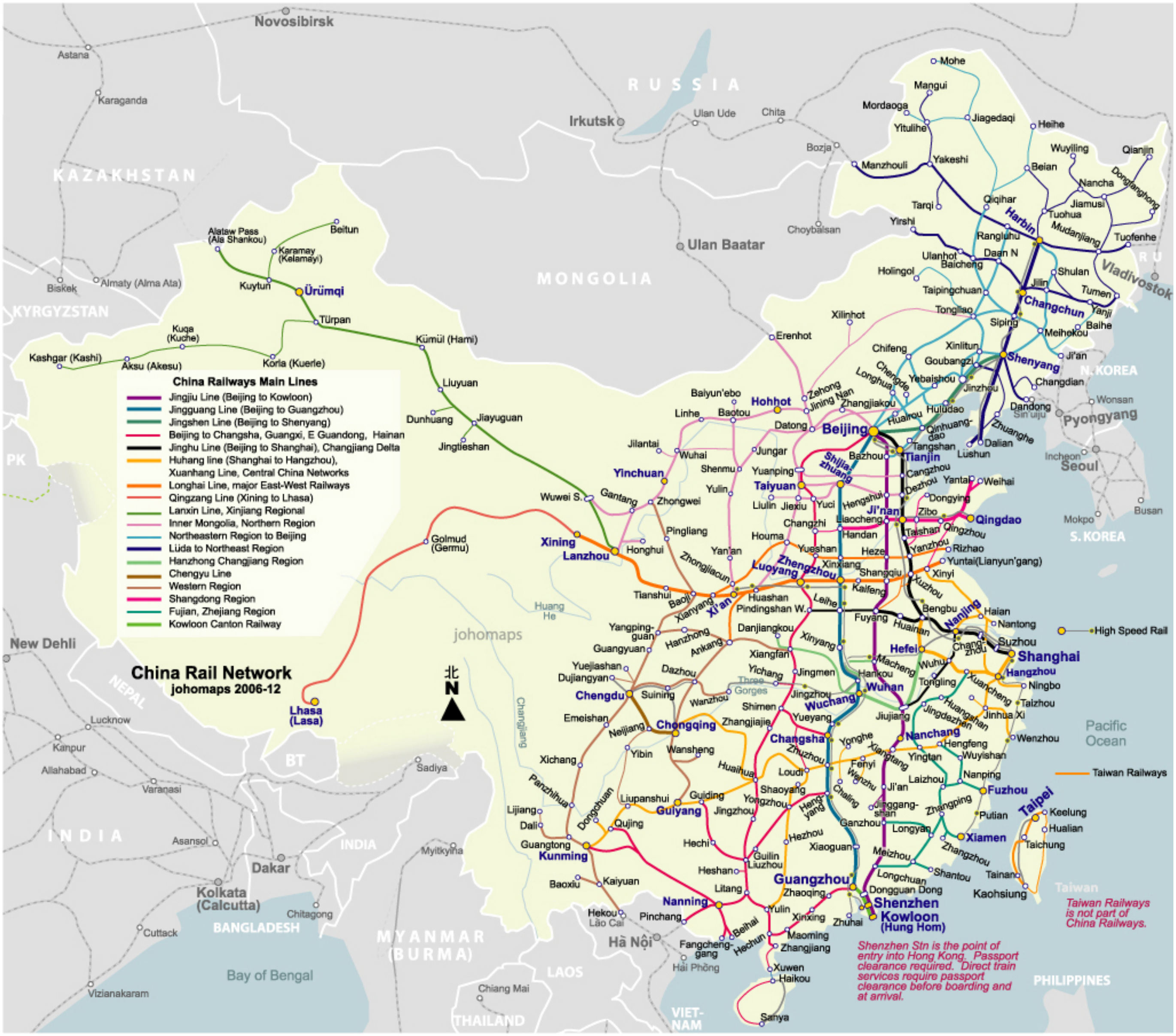


Figure 4.15 China's rail network

Source: www.sheepish.org.

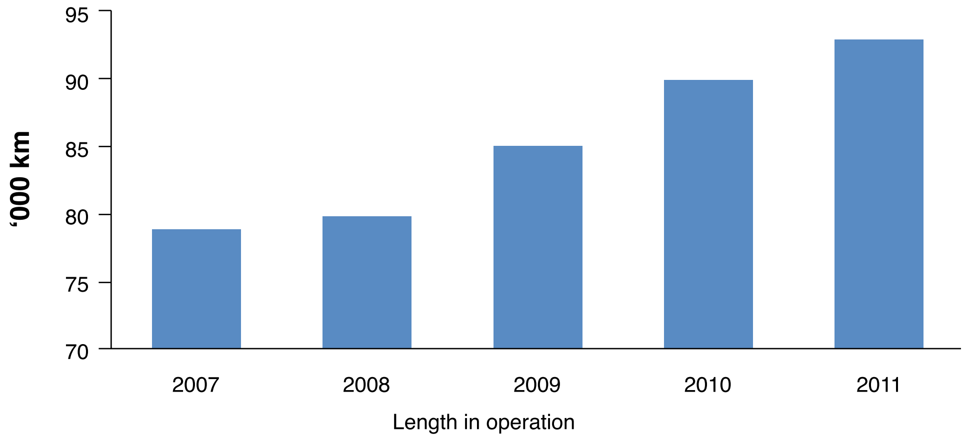


Figure 4.16 Railway in operation in China, 2007-2011 ('000km)

Source: LFRC 2012

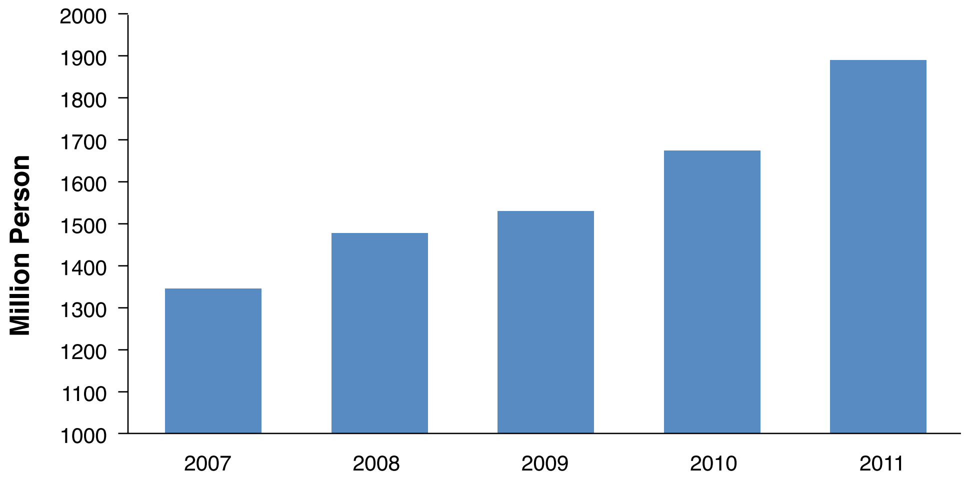


Figure 4.17 Railway passenger traffic in China, 2007-2011

Source: LFRC 2012

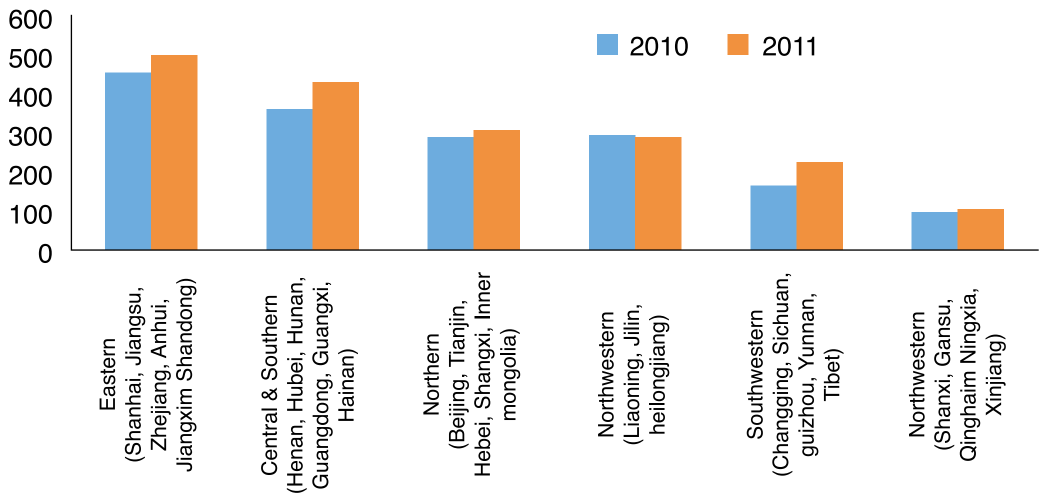


Figure 4.18 Railway passenger traffic by region, 2010-2011 (million passengers)

Source: LFRC 2012

Thus, to increase the connectivity, urban metro rail system has been developed quickly in many cities in China in the recent year. Annual average investment in rail transit USD1 billion in Beijing and USD1.7 billion in Shanghai for the last 10 years (e.g. from 2001 to 2010). The Beijing's Government has plans to invest USD50 billion more on rail transit construction in the next 5 years. Currently, six cities (Beijing, Shanghai, Tianjin, Guangzhou, Shenzhen, and Nanjing) have metro rail where the operated lines of total length 1,395km. More than 158 new rail lines (6,100km) in 10 Chinese cities (Beijing, Shanghai, Tianjin, Guangzhou, Shenzhen, Nanjing, Wuhan, Zhengzhou, Hefei, and Guiyang) will be completed by 2020 where the investment will exceed USD140 billion (Peng *et al.* 2012).

4.2.2 LACK OF HIGH SPEED TRAIN

a. Current Status

High speed trains are defined as trains which are operating above 200km/h. Currently the railway in Malaysia is being upgraded from single track to double track system, under the Electrified Double Track Project (EDTP). The project involves the design and construction of two new parallel railway tracks and the related facilities, to replace the old single track railway on the West coast of Peninsular Malaysia. The EDTP from Ipoh to Padang Besar, awarded to MMC-Gamuda joint venture in 2007, is schedule to complete in June 2014. Another stretch of the EDTP, running between Gemas-Johor Baharu is expected to commence in 2014 (Kaur 2013). The double track railway allows trains to operate at a top speed of 180km/h, but for safety reason, the trains are currently running with a speed of 140-160km/h.

Lack of high speed train greatly reduces the modal split of rail for both passenger and freight transport. For instance, travelling from Kuala Lumpur to Butterworth on train will take approximately eight hours. Even though the EDT project, when completed, is expected to half this travel time to 4 hours (EDRP 2013), it may still not be attractive enough to encourage significant modal shift from road to rail. The effect of slow train is especially obvious for trans-national train ride. At the moment, travelling from Kuala Lumpur to Woodlands (Singapore) on train will take approximately 8 hours, while train ride from Kuala Lumpur to Bangkok (Thailand) will take almost one day.

b. Challenges

Even though high speed train system can further improve the rail transport in Malaysia, there are several challenges to the implementation of such system (Chen 2010). Firstly, high speed train is technology and capital intensive. Success of such project will require not only the commitment from the Government, but also participation from the industry. Secondly, the effect of modal shift from other transportation needs to be considered. Based on the experience from other countries with high speed trains, it is expected that the development of high speed train will cause the reduction of ridership in other modes of transportations. This can affect the revenue and sustainability of companies such as bus operators and airline companies. Furthermore and perhaps most importantly, Malaysia has a relatively low density population of 28 million, compared to other countries which uses high speed rail. Such low population count will affect the ridership and the collectable revenue for the high speed train operator, and raise questions on the sustainability of the high speed train system.

c. Future R&D Needs

As suggested in NPP2, a high speed rail network should be integrated into the current transport system in Malaysia, providing high speed train ride not only between cities in Malaysia, but also to neighboring countries like Singapore and Thailand. The first concern of this will be the sustainability of the train operation, as high ridership is necessary to maintain the profitability of the high speed train business.

This will raise serious concern on the feasibility of such system in Malaysia, considering that Malaysia has a relatively low population density. In the light of this, there is necessity of research on the feasibility of high speed train or even look for alternative solutions which allows the establishing of fast, reliable and sustainable rail transport in Malaysia. If the high speed train is to be implemented in Malaysia, there will be a need to have research centre designated to conducting R&D on high speed train technology.

d. Benchmarking

Long distance rail travel demand has been increased and has doubled in the past 15 years. Better transport links make economy stronger and lives easier. The congested transport networks are unreliable and constrain travel opportunities, restricting growth. New lines increase rail capacity and drive economic growth but Britain is falling well behind (Higgins 2013). **Figure 4.19** shows the high speed lines existing and under construction in selected European countries in 2011.

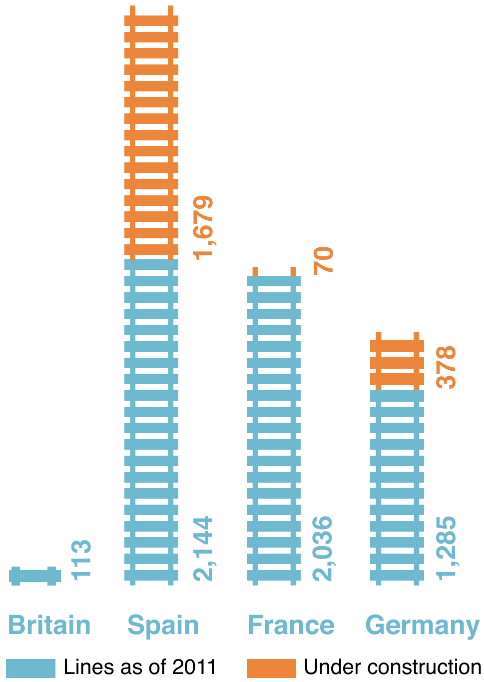


Figure 4.19 High speed lines (km), high speed = 250km/h

Source: Higgins 2013

High Speed 1 (formerly the Channel Tunnel Rail Link), is 109km of track link with London and Channel Tunnel, that is whisked passengers between London and Paris (or Brussels) in travel time within just 2 hours and 15 minutes, where the speed goes up to 300km/hr. Construction from the Eurotunnel terminal (Channel Tunnel entrance) to north Kent connection to London's Waterloo Station was launched in late 2003 (HS1UK). Britain's existing high speed rail line connects St. Pancras International station in London with Kent, the Channel Tunnel and Europe. The first carried trains from the Channel Tunnel to Fawkham Junction in Kent and the second connected the brand new Ebbsfleet station with St. Pancras (full HS1) service launched in December 2009 (BN 2011).

UK has a plan to invest more than £70 billion in transport sector by 2021. High Speed 2 (HS2) is the part of the investment and accounted about £16 billion.

HS2 will provide Britain's railways with a new capacity, better connectivity, quicker journeys and allows more passengers to use its trains as well as more freight operators to use rail rather than road. The HS2 phase 1: links London Euston, new station at Birmingham Curzon Street, Old Oak Common in west London and Birmingham Airport. The HS2 phase 2 will divide into two lines, Line 1: Manchester Piccadilly via Crewe and Manchester Airport, line 2: Leeds via the East Midlands and Sheffield Meadowhall. HS2 will be integrated with the existing national railway network so that the cities beyond the new network (e.g. as Liverpool, Glasgow, Edinburgh, Newcastle, York, Preston, Warrington, Lancaster, Carlisle, Durham and Darlington) will also benefit from HS2. The construction will begin in 2017 and be completed by 2025, where services will be launched between London and Birmingham from 2026 (Qi 2011). **Figure 4.18** shows the network of High Speed Rail 2 in the UK.

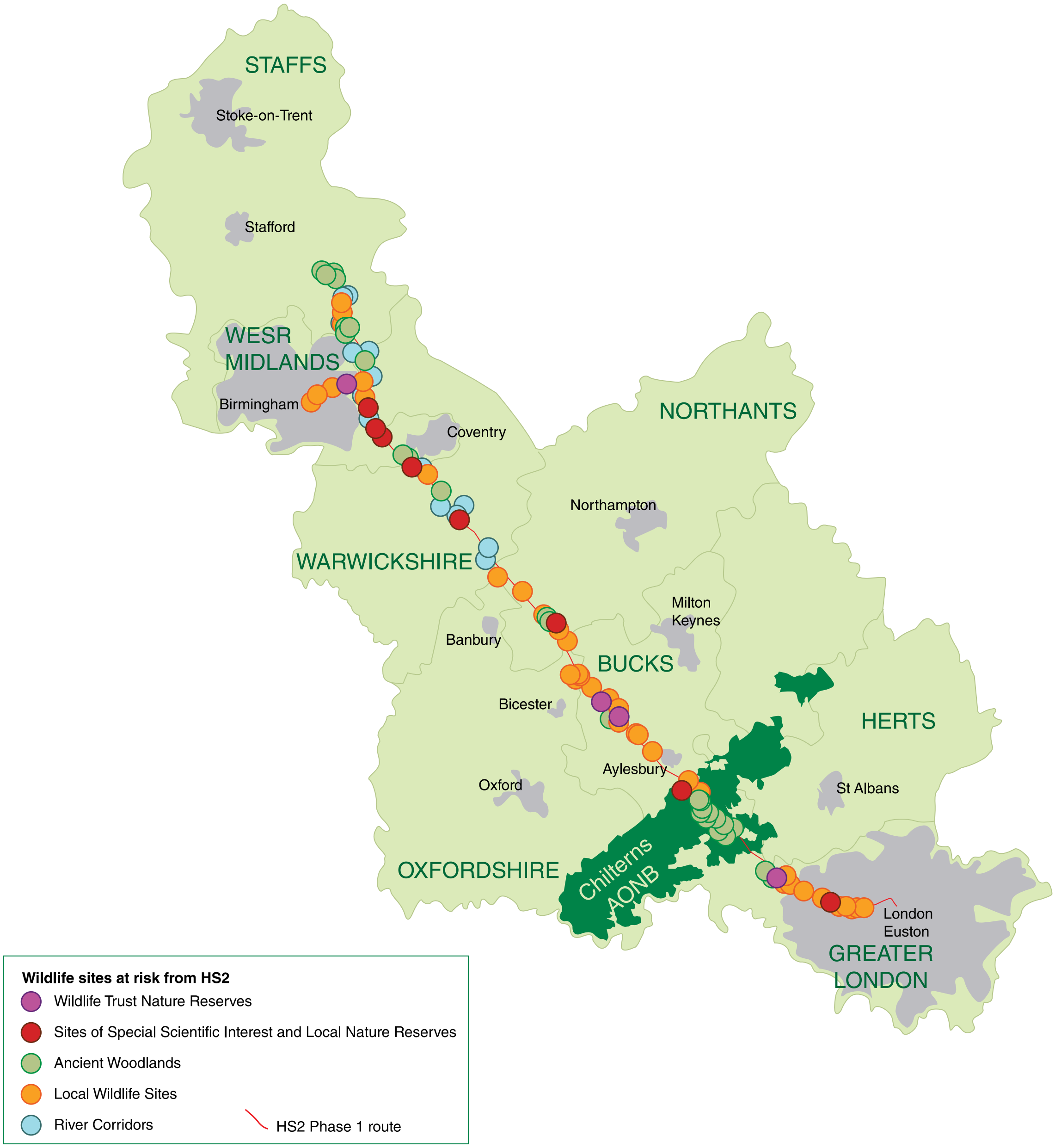


Figure 4.20 The network of High Speed Rail 2 (HS2)

Source: Zhu & Song 2008

There is a rapid development in High Speed Eailway (HSR) in China. The operation length and speed of lines in China already exceeded Japan's HSR operation. Now the China's HSR network is the world's best because of the technological development, station positioning as well as urban planning (Takagi 2011). China's HSR construction plan was declared in 2004 as a mid to long term plan. Following that, the plan also has been reviewed and adjusted. The HSR network is excess of 200km/h and covers around 4900km in 14 sections which is the world's longest. As part of this HSR network, the section offer high speed services of 350km/h which are the world's fastest. Two more ultra-high-speed lines will be added Beijing–Shanghai (1318km) and Beijing–Wuhan (1119km) lines (Takagi 2011). **Figure 4.21** shows a high speed train in China based on Japanese technology transfer.

Figure 4.21 High speed trains based on Japanese technology transfers

Source: Takagi 2011

China's high-speed railways are started to construct at a "breakneck" pace in mid-2000. By 2011, high speed railway in China is larger than the rest of the world's high speed rail combined. In 2010, about 8,538km high speed rail operated in inter-city rail in china, whereas another 5,000km by 2011. At the end of 2015, the rail lines in China will reach 120,000km with the high speed rail more than 16,000km. The passengers flow in the urban public transportation system is increasing rapidly because of the rapid development of high speed rail between cities (Peng *et al.* 2012).

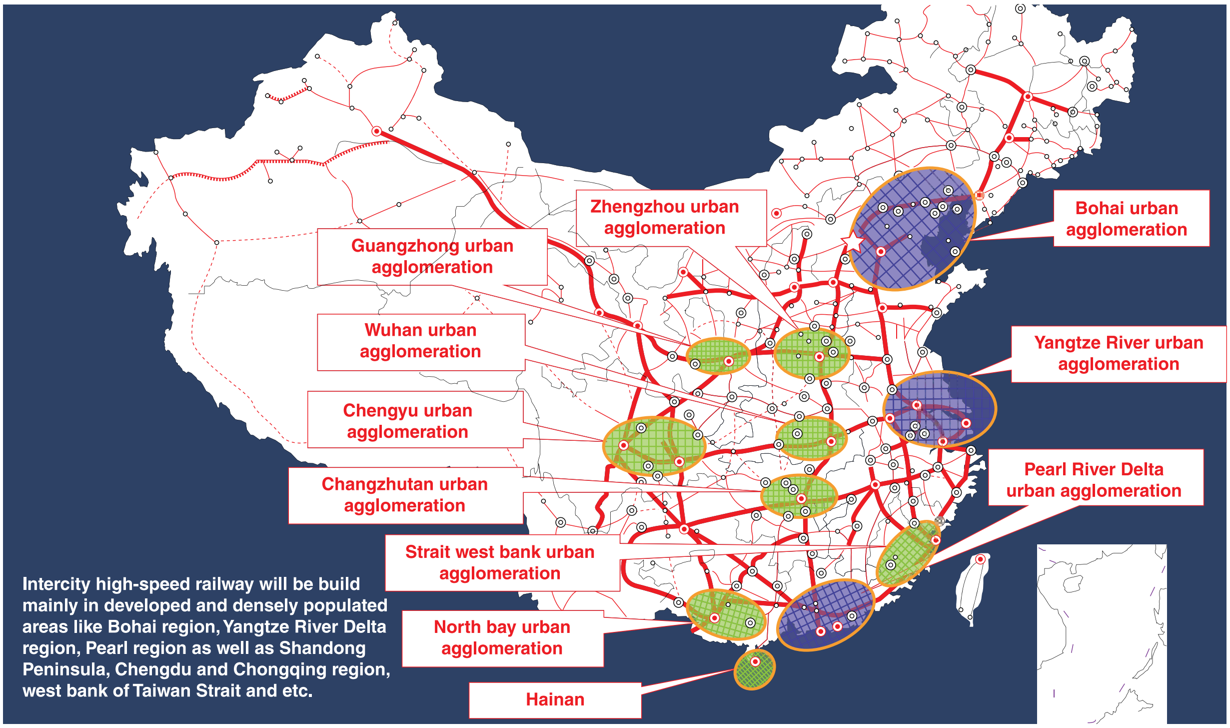


Figure 4.22 Intercity HSR in China

Source: Jian 2014

v. Development of HSR Technologies

National policies in China are to produce their own products. For the construction of HSR, they first set out to construct their own high-speed lines. They studied HSR technologies from around the world and manufactured two patented designs for 300km/h operation (a locomotive hauled train and a distributed-traction type electric train) and built a 50km, high speed passenger only test track from Qinhuangdao to Shenyang. Japan's slab track technology was presented by using published technical data without assistance from Japan. China understood that their own products could not meet speed goals. Therefore, intra-governmental revisions were made in 2002 and took vital technologies from leading overseas nations. The HSR around the world are into the two camps: the German and French locomotive (concentrated traction) system, and the Japanese shinkansen (distributed traction) system. **Figure 4.22** shows the intercity high speed railway that will be built in densely populated areas in China.

China has chosen the distributed-traction system. The major technical imports from abroad are carriages, signalling/transport management and ballast-less tracks etc. For the carriage technology, China used models based on the Swedish high-speed commuter train, Regina (built by Bombardier of Canada), the JR East Hayate E2-1000 (built by Kawasaki Heavy Industries) as well as the German ICE3 (built by Siemens). China modified the designs according to Chinese needs (e.g. body width, interior fittings). Ultimately, all the models presented, about 20% of the parts are made in the original countries and rest 80% are made in China under license. These trains are in service on high-speed (350km/h).

A locally revised new train has capability of 380km/h which has been launched on the Shanghai–Hangzhou line on 26 October 2010. Similarly, about 380km/h high speed train is scheduled for the line between Beijing and Shanghai in 2011. China is conducting R&D for train where the train speed will be 400km/h or more in the near future. **Figure 4.23** shows technology innovation achievements of Chinese high speed railways.

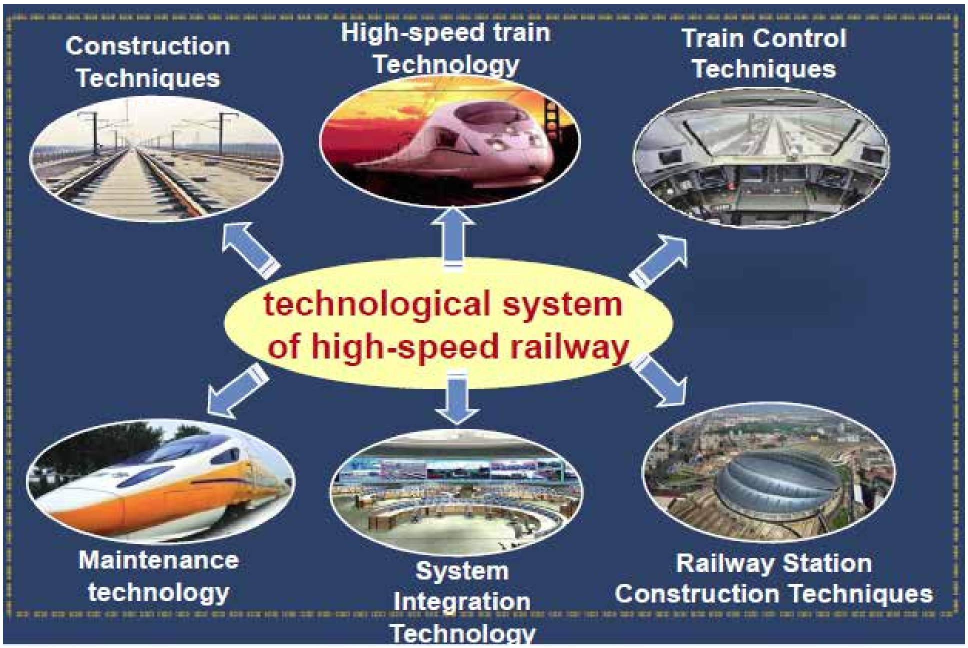


Figure 4.23 Technology Innovation Achievements of Chinese High Speed Railway

Source: Jian 2014

4.2.3 UNSATISFACTORY SERVICE LEVEL

a. Current Status

Feeder system is an important supporting system for the rail transport. The feeders, usually in the form of buses or trucks, are necessary to provide coverage to the first and last miles of the passengers or freights movement. Currently, the feeder system supporting the rail transport in Malaysia is inefficient and reliable.

Customer satisfaction is always an issue for public transport, including the rail transport in Malaysia. In Osman *et al.* (2012), the authors has highlighted the common problems faced by the passengers for KTM Komuter, e.g. relatively long waiting time, lack of punctuality, lack of integrated and efficient ticketing system, persistent delays and low service frequency.

Another problem commonly felt by the passengers is the problem with congested coaches during peak hour. However, during the workshop, rail industry stakeholder has reflected the other side of the problem. One of the limitations faced is the inherent train and station design, which limits the size and number of allowable train coaches, and cannot be alter without significantly upgrading the facilities. For instance, the Kelana Jaya line operated by RapidKL is currently operating with its maximum allowable train size of four coaches. It was also pointed out that there is low ridership during off peak hours. This is limits the utilisation level of the trains, as such as hinders the train companies from increasing the train capacity due to revenue concern. All these issues have become constraining factors that hinder further improvement of the customers' satisfaction.

Challenges

The fact that the feeders share the same road resources with other land transport is the main challenge to improving the efficiency of theet feeder system. As a result, the performance of the feeder bus or truck will be subjected to the road condition, such as being trapped in traffic jam.

As mentioned earlier, the inherent train and station design can limit the size and type of train being used. As a result, attempt to improve customer satisfaction via upgrading of the train cannot be done easily. Also, the lack of competition contributes to the lack of motivation train operators to improve their services.

b. Future R&D Needs

It was pointed out during the workshop that improvement of the feeder service via R&D is necessary. New transport technology, such as designated bus land for feeder buses, may be needed to upgrade the current feeder service. For cities beyond Klang Valley, proper planning of feeder services is needed to ensure seamless support to the rail transport in the future.

The use of ICT is expected to improve customer satisfaction on this matter. By providing accurate and timely information on the train service, the customer can be better informed and make suitable arrangement to their travel plan, reducing dissatisfaction due to problems such as train delays and infrequent train services. The development of railway technology, especially in terms of cultivating local experts, is necessary to reduce the reliance on foreign companies/ OEM on the MRO operation or even facilities upgrades. Having local railway talent will also reduce the down time of the trains and allow flexible management of the train services. Since there is lack of competition in the train services, the government should closely monitor the service level provided by the train operators, and spur them to improve the service level from time to time.

c. Benchmarking

According to the survey by the European Commission (26,000 passengers, 26 EU countries), Britain has the best rail network in Europe with the satisfaction score of 78% (74% France and Belgium, 51% Germany). As seen in **Figure 4.24**, the UK scored highest among countries with major networks on three categories relating to travel on trains including punctuality and reliability with 73% positive feedback, information during journeys (70%) and accessibility for passengers with limited mobility (65%). In the case of train station quality, Britain's scored is the highest (73%) according the cleanliness, buying ticket, making complaint as well as timetables information (Collins 2013).

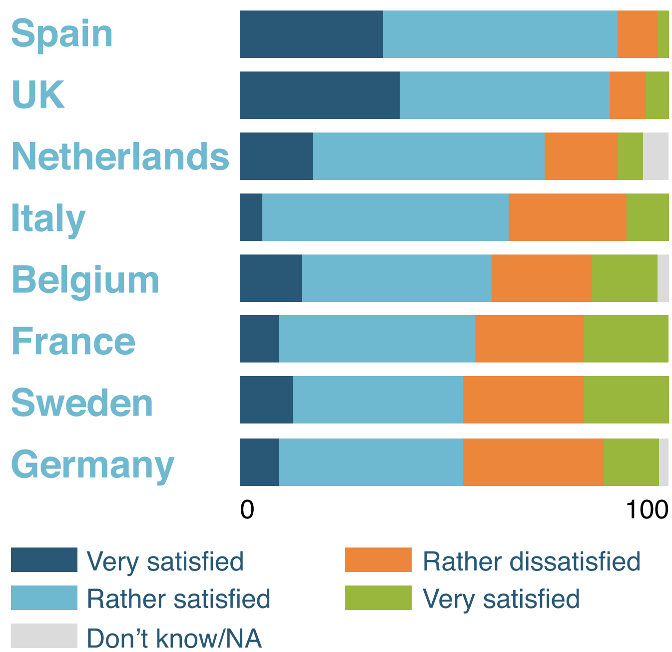


Figure 4.24 Satisfaction with punctuality and reliability

Source: Higgins 2013

4.2.4 OPPORTUNITIES OF OTHER VRAIL-BASED TRANSPORT NOT FULLY EXPLORED

a. Current Status

Currently Malaysia has several different modes of rail-based transport, such as commuter rail (KTM Komuter), light rail (RapidKL), monorail (RapidKL), airport rail-link (KLIA express) as well as the upcoming Mass Rapid Transit (MRT) system. During the workshop, it is felt that the potential for using some other types of rail-based transport, particularly tram, has not been fully explored.

b. Future R&D Needs

It is suggested that the possibility of using other rail-based transport should be explored. Research institute dedicated to railway technology should continuously monitor the trend and development of rail transport locally and globally, to identify and explore the potential of their application in Malaysia.

c. Benchmarking

Nottingham Express Transit (NET) as shown in **Figure 4.25** is latest light rail system (trams) since 2004, carried about 8.4 million passengers in the first year operation. Trams running are a mixture system: on-street and reserved track. Trams under line 1 covers from Station Street to Hucknall, and a short spur to Phoenix Park. Extensions of this line are planned. Namely, line 2 will cover Wilford and Clifton, whereas line 3 covers QMC, Beeston and Toton Lane Park & Ride.

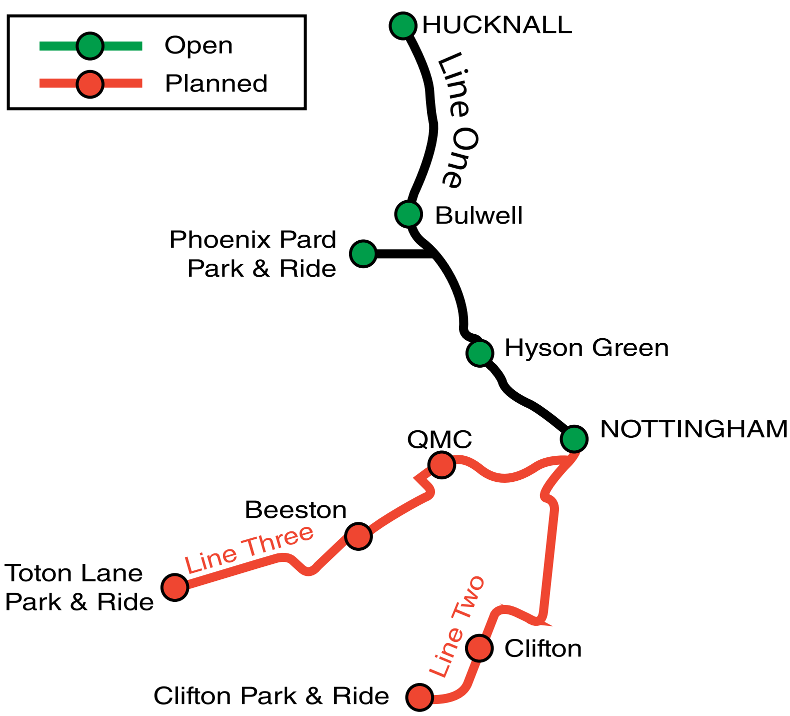


Figure 4.25 Nottingham Express TransitRoutes

Source: thetrams.co.uk

15 *Bombardier Incentro* trams (62 seating and 129 standing capacity) which are powered from a 750Vdc overhead power supply, running every 6 minutes Monday to Saturday with 23 tram stops (NET 2014).

Vauban is a neighborhood located about 4km south of Freiburg city centre, with a population of 5000 people. The neighborhood is designed and built to be car-free, based on a master plan created under the joint collaboration between City Council of Freiburg with Forum Vauban. Apart from making personal vehicle an inconvenient option, the city has incorporated a frequent rail-based transit system supported with excellent non-motorised transport facilities. The Tram is used for travel to and from the Freiburg city centre, with all houses within close proximity to tram stations (RTBP 2014).

Tram is used in China since old days in main cities (e.g. Hong Kong, Changchun, Anshan, and Dalian). The Japanese colonists built the tram lines in the early 1900s (TCG 2014). Tramway has been launched in Shenyang city in August 2013 of 70km-long line, 65 stations with the expectation of daily 150,000 passengers that serves about 7.2 million population of the city (ST 2014). China plans to construct 2,000km of latest tram way by 2020 where the estimation of 200 billion yuan (2013).

4.2.5 UNDERDEVELOPED RAIL FREIGHT

a. Current Status

As pointed out in the National Land Transport Master Plan by SPAD, railway provides a more reliable, safer and more efficient mode of freight movement, when compared to land freight. Nevertheless, the modal split for rail freight in Malaysia is considered relatively low, where (Ong *et al.* 2012) has reported that only 1.2% of the freight movement is done via rail, compared to 96% for road freight. One of the main reasons for the low modal split is the limited of connectivity to railway network. During the workshop, the importance of the development of rail freight in highlighted. Using the Trans-Asia railway, cargo can be easily transported to the inland of China or even to the Central Asia using train, instead of having to transport the product across oceans and then through land transport.

b. Challenges

The low connectivity of the current rail network can be seen as the main challenge to the development of rail freight in Malaysia.

c. Future R&D Needs

It is necessary for the authority to understand the potential and need for rail freight and devotes effort to develop the related facilities. A research institute designated for railway development will be useful for providing technical advice and support, as well as conduct feasibility studies and planning for the development of rail freight in Malaysia.

d. Benchmarking

Rail has a significant contribution in the Britain's economic. Rail freight supply and delivery about 43.5 million tons of goods to and from the ports in UK. About 65% of intercontinental trade to the north of England which is transported by rail from the southern gateway ports in UK. Daily about 1,000 containers handle by freight rail in the Port of Southampton. The Daily 22 freight rail carried in the Felixstowe port. The rail is usually strong to transport heavy and bulk commodities for import or export containers. As for example, coal transported by rail that produces about 25% electricity in UK. About 80% of stone for construction in London, more than 30% of metal products in the UK are supplied by rail. However, rail is still represented only about 12% of the UK surface transport market. Therefore, rail has a great potentiality that will reduce congestion and environmental pollution.

The rail network in Britain is railways where both passenger and freight train are used the same lines. About 1,000 freight trains and 19,000 passenger trains are operated daily. A complicated factor is timetable for the freight trains response with the short notice changes in demand from customers. The Government has stated its policies and regulations that to adapt and minimise adversely affect passenger or freight growth. The retail sectors are looking to the rail to offer for the environmental friendly sound logistics solutions as the part of the supply chain package. Rail sector emit less than 1% where road sector emit about 21% of total UK CO_2 emissions. A typical freight train can carried equivalent to 50 lorries in Britain. The rail freight saved 2 million tons of pollutants in the last 6 years. Freight trains emit 80% of less carbon dioxide compared to road transport for each ton of goods in Britain. According to statistics, ASDA Wal-Mart estimated 4 million road vehicle miles per annum saves by using a rail freight service. Marks and Spencer claim 40% of goods carried by rail at national distribution centre(FTA, 2014).

(Case Study) London's Rail Freight

The rail freight industries in UK are competitive and dynamic, but there are still vast challenges ahead (**Figure 4.26**). Rail Freight Strategy has been set out to develop rail freight in London over the next 10 years. Transport for London (TfL) realised that rail freight is important to flourish together with a developing passenger railway in London. Rail freight also makes significant contribution to the economy and quality of life in London as well as in UK. By implementation the Strategy will remove about 110- 176 million lorries miles, produce benefits in terms of environment, congestion relief and road safety worth of £80- 126 million annually. The background of the strategy is to carry the nation's freight and reducing the number of lorries on the roads(TLRFS 2007).

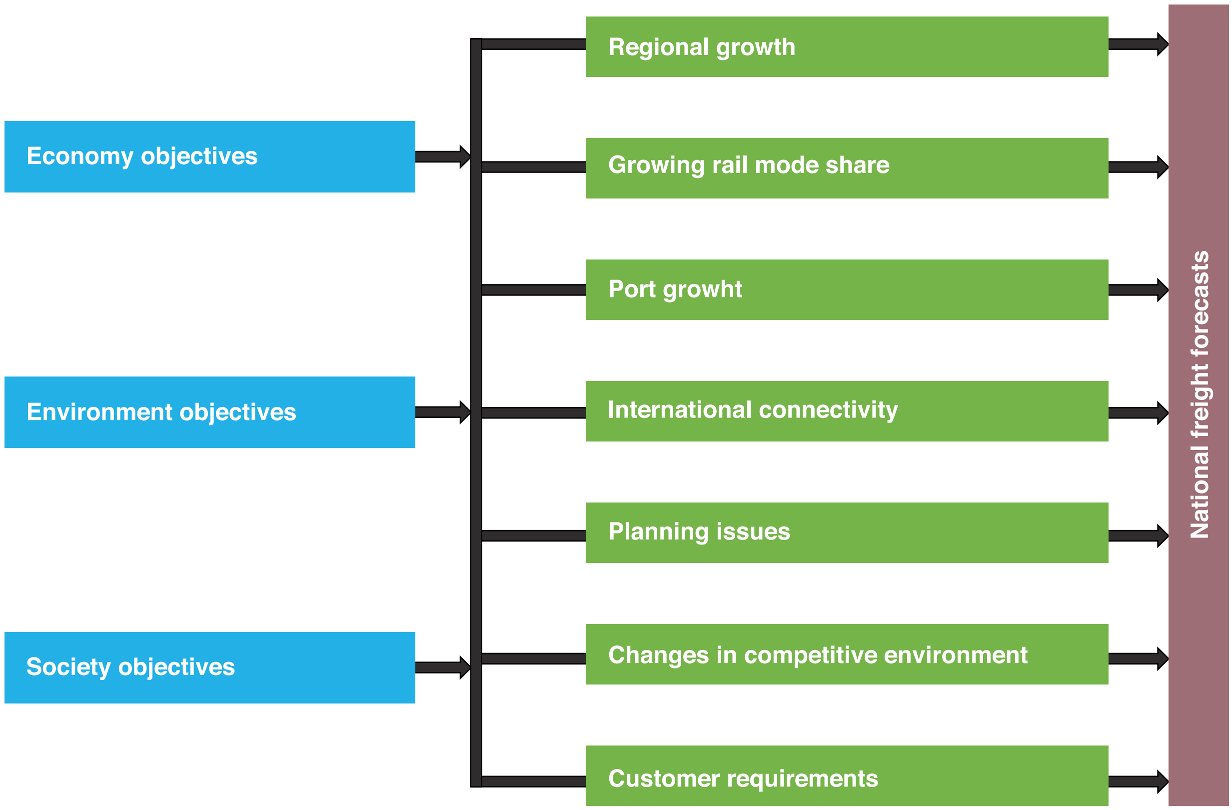


Figure 4.26 London's Rail Freight

Source: TLRFS 2007

The strategy is sits within an existing national and regional policy framework. The strategy also includes the 2007 Railways White Paper, Delivering a Sustainable Railway, Sustainable Distribution Strategy, the Network Rail Eastern and Southern, Cross London and Freight Route Utilisation. It is rooted in the existing London Plan, published in February 2004, and the Mayor's Transport Strategy. It is also consistent with T2025, TfL's 20 year Transport Vision for London. The Strategy (like the London Plan) envisions 10 years ahead and covers up to 2016 (TLRFS 2007).

(Case Study) Rail Freight Traffic in China

Rail freight traffic increased 8% in 2011 where the healthy growth is also expected in future.As shown in **Table 5.1**, Northern China was in the first rank (base on volume) of freight supply by railway in 2011. Among the China, rail freight of northern China is the fastest growth and the growth was 14.1% in 2011. Taiyuan-Datong and Baotou-Lanzhou lines carried the most freight in 2010 in China. Whereas, Beijing-Baotou has the highest growth of 38.7% top five busiest railway lines for freight in China (LFRC 2012) as in **Table 4.4**.

Table 4.4 Railway Freight Traffic by Region, 2010-2011 (Million Tonnes)

Regions in China	**2010**	**2011**	**Growth (%)**
Northern (Beijing, Tianjin, Hebei, Shanxi, Inner Mongolia)	1,429	1,630	14
Eastern (Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong)	549	589	7
Northeastern (Liaoning, Jilin, Heilongjiang)	513	471	-8
Northwestern (Shangxi, Gansu, Qinghai, Ningxia, Xinjiang)	501	550	10
Central & Southern (Henan, Hubei, Hunan, Guangxi, Hainan)	453	436	- 4
Southwestern (Chongging, Sichuan, Guizhou, Yunnan, Tibet)	239	242	1

Source: LFRC, 2012

Table 4.5 Busiest Railway Lines for Freight Traffic in China, 2009-2010 (Million Tonnes)

RAILWAY LINES	2009	2010	GROWTH (%)
TAIYUAN-DATONG	124	145	17
BAOTOU-LANZHOU	83	107	29
SHANGHAI-KUNMING	88	88	-
LIANYUANGANG-LANZHOU	84	87	5
BEIJING-BAOTOU	60	83	39

Source: LFRC, 2012

4.2.6 SAFETY

In the future, rail transport will be important mode of transport since there is an increasing concern on global trends such as climate change, population growth and urbanisation, congestion and hike of energy price. With the number of ridership is expected to increase, rail safety and security is becoming very important aspect to be taken care of as to ensure reliable and smooth rail operation.

In Malaysia, there are policies and regulatory bodies or associations involved in rail transportation. Under the Act 463 Railway Act 1991 (Amendment 2010), SPAD is responsible for a safe, reliable and efficient land public transport including the rail via the implementation of the Land Public Transport Act 2010. Besides SPAD, there is also Department of Rail and Railway Assets Corporation, a Federal Statutory Body under Ministry of Transport Malaysia where each has their own functions and responsibilities.

Rail transportation can be considered as a safe mode of transport as the number of accidents is relatively lower compared to that of land transportation. Nevertheless, there are several safety and security issues associated to rail transportation system such as collisions, derailments, level-crossing accidents, electrocution as well as staff and passengers' safety.

a) Passengers' Safety

The passengers' safety can be divided into two categories: passengers at station and passengers on trains. Passenger behaviour at stations, particularly apart from the management of stations, may contribute to accidents at the train platform due to slips, trips and falls. The risk profile can be minor injuries and fatal accidents.

Some measures that can improve passengers' safety at station include the improvement of passenger information in terms of signage, use of anti-slip materials for floors and stairs as well as improving station management and housekeeping. Besides that, passengers on trains are exposed to the risk of falling against fixed objects onboard and being struck while leaning out of trains or falling from a train in motion. This is mainly caused by passengers losing their balance or tripping while moving about within trains, contributed by poor track condition, train braking and suspension.

In order to reduce the risk to passengers on train, rough ride sites need to be identified and the corresponding action plan need to be developed. In terms of interior train design, the number of fixed objects that can act as an obstacle should be reduced. The reduction of crowding through the increase of the number of rolling stocks, may also reduce the risk to passengers. **Figure 4.27** shows passengers waiting for a train at an LRT station.

Figure 4.27 Passengers at an LRT station

b) Employees' Safety

The risk from train driver error can be in the form of signal passed at danger where train passes a stop signal without authority. The risk to employees also includes train dispatch and train crew personal accidents. In the event of signal passed at danger, the consequences may be catastrophic while train dispatch may result in minor injuries to passengers and train crew. Personal accidents to station staff also associated to slips, trips and falls where the risk varies from minor injuries to fatalities.

The sharing of best practices among train operating companies is some of the measures that can improve the safety of train crew, while lessening the risk of train crew errors. The measures also include improving safety critical communication protocols and audit. Furthermore, driver competency levels can be improved through regular training and assessment programmes. Use of train driving simulators can further enhance the driver skills.

c) Infrastructure and Engineering

Infrastructure and engineering present the risk which includes track, signaling and telecommunication as well as structure assets. The main potential of the risk is from train accidents, particularly derailment as in **Figure 4.28** that can cause disastrous consequences apart from the control system failures.

As such, poor track condition and train design can also cause an inconvenience in the train ride which may cause passengers and the staff to have minor injuries while riding on trains due to falls against fixed or hard object, spilt beverages and many more objects. Hence, implementing a regular system maintenance and inspection is a very detrimental measure to ensure that the whole railway system functions without any interruptions and contains less of risks. This includes rail tracks, signaling and telecommunication, and structure assets. Apart from that, the system upgrade employed in terms of equipment or software must be ensured of its compatibility with the existing system. Thus, in improving the processes for the supply of safety critical components and services, it reduces the risk posed.

Figure 4.28 Train derailment

d) Public Behaviour

The issues arise from public behaviour are acts of vandalism, trespass and assaults on passengers and staff. The acts of vandalism include objects thrown at trains and objects placed on the line.

In dealing with public behaviour related to crime, some actions that can be taken are increasing the use of surveillance camera or CCTV at station and train, increasing deployment of enforcement officers, and using court procedure to those offenders. Conflict avoidance training can be provided to all customer-facing staff and also developing safe zone concept at station and train.

Apart from that, trespass or misuse by pedestrians through traversing the crossing when it is not safe to do so contributes to the highest risk that may result in serious injuries and fatalities, due to being struck by a train or electrocution. Level crossings by road vehicle drivers also lead to road vehicle collisions with trains which create higher potential for catastrophic risk as it can cause the train to derail. To reduce the risk of level crossings as in **Figure 4.29**, public awareness campaign on rail safety should be conducted regularly and also encouraging the prosecution of road users who deliberately misuse level crossings. New technology that can reduce the risk such as a system that warns road vehicle drivers when approaching level crossings can be implemented as well.

Figure 4.29 Level crossing

2) Benchmarking

In this section, the international safety practices on railway in two countries, Australia and United Kingdom are reviewed. This includes key safety priority areas such as compliance with infrastructure standards and level crossing safety management.

A) Compliance with Infrastructure Standards

a. Australia

In Australia, infrastructure standards have been developed since its railway operations started and maintained by the infrastructure managers. The infrastructure standards cover the design, maintenance and inspection aspects. These standards evolve from local practices and they are influenced by earlier UK and USA standards. The infrastructure technical standards are fairly static and revised when necessary. When incidents occur, improvements are made to the standards where the change is made by issuing a notice. Depending on how significant it is, the notice can be mandatory instructions and this interim measure will remain until the standard is revised. User requirements can be incorporated into the standards through configuration management board that include all stakeholders of railway operation.

System engineering approach such as European Standard EN50126 (Railway applications – The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) are introduced into particular organisations which involve in new rolling stock acquisitions. However, they are neither applied to the existing infrastructures nor the new infrastructures.

b. United Kingdom

The standards that currently govern the railway in United Kingdom are Technical Specifications for Interoperability (TSI), Notified National Technical Rules, Railway Group Standards and standard by Network Rail (authority responsible for UK's railway network). TSI received a mandate from the European Commission to prepare the standards. The Notified National Technical Rules is a standard which fills up the gaps in TSI, whereas

Railway Group Standards covers the subsystems which are not upgraded to TSI standards. The standard by Network Rail is developed based on and in parallel with the Railway Group Standards.

Their Standard Committees comprise of representatives which come from the rail industry including the Infrastructure Manager, Network Rail. The standards developed take into account the findings from latest knowledge, best industry practices, and derogations of the existing standards as well as through formal inquiries.

The RAMS engineering process in compliance with EN50126 is being used for the new system such as new signaling systems, trains and etc. The focus on RAMS is on the reliability of equipment so that it would not cause problems to the networks and delays services. Besides, it also focuses on the equipment maintainability of ongoing maintenance particularly at the costs and safety.

B) Level Crossing Safety Management

a. Australia

In Australia, Australian Level Crossing Assessment Model (ALCAM) is used as a safety assessment tool in order to prioritise the railway level crossings based on their comparative safety risk. The model assists the decision making process for road and pedestrian level crossings as well as a method to determine the optimum safety improvements for individual sites.

Among the technology being used as safety provisions are:

- Retro-reflective boom gates with high intensity (LED) lights
- Active red-man warning lights at pedestrian crossings
- Predictor (constant warning time) device for active crossings
- Active pedestrian swing gates, including emergency exits with magnetic latches
- Rumble strips and signage for advance warning of crossings on highways

There are also procedural controls aimed at public awareness such as community awareness campaign form motorist and community awareness programme for pedestrians. For motorists, the advertising campaigns are conducted using press, radio and outdoor media. Whereas for pedestrians information on level crossing safety is distributed at railway stations, schools, community groups, television and radio.

b. United Kingdom

All Level Crossings Risk Model (ALCRM) is used throughout the nation rail network. The risk assessment methodologies used is based on weighted factors in order to estimate the risks arise from several parameters like level crossing protection, user information and traffic moment. The approach to level crossing risk modelling can be considered quite sophisticated as compared to other countries. The review of the risk assessments at its level crossings is done by Network Rail annually.

Studies on UK's rail industry's safety improvement are done by research organisation at Rail Safety and Standards Board (RSSB):

- ○ The use of median strips at level crossings with automatic half-barriers to avoid road user from attempting to move around while a train is approaching. The road user behaviour is monitored using CCTV.
- ○ The use of Obstacle Detection technique to detect any obstruction that may cause significant damage to a train and to assist the signaller to confirm that the crossing is clear through CCTV. Inductive loops, microwave radar and infrared detection are the techniques being used. In terms of public awareness, there are numbers of research project conducted by RSSB to understand public behaviour and motivation at level crossing. Moreover, safety campaign is also conducted through TV and radio advertisement as well as print media articles.

4.3 CURRENT ISSUES & BENCHMARKING: AEROSPACE

4.3.1 CONGESTION AND SUSTAINABILITY

4.3.1.1 MALAYSIAN AIRPORTS

Majority of the airports in Malaysia are managed by Malaysia Airports Holding Berhad (MAHB). There are three types of airports in the country, namely International Airports, Domestic Airports, and Airstrips. There are eight international airports as shown in **Table 4.6**.

Table 4.6 Malaysia International Airports

Airport	State
Kuala Lumpur International Airport, KLIA	Kuala Lumpur
Penang International Airport	Penang
Langkawi International Airport	Kedah
Malacca International Airport	Malacca
Senai International Airport	Johor
Kota Kinabalu International Airport	Sabah
Kuching International Airport	Sarawak
Miri International Airport	Sarawak

Source: Malaysia Airports Annual Report 2012

Meanwhile, there are 18 domestic airports and airstrip in Malaysia. Details is shown in **Table 4.7**.

Table 4.7 Malaysia Domestic Airports and Airstrips

Airports	**State**
Sultan Ismail Petra Airport	Kelantan
Sultan Abdul Halim Airport	Kedah
Sultan Azlan Shah Airport	Perak
Sultan Mahmud Airport	Terengganu
Sultan Abdul Aziz Shah Airport	Selangor
Sultan Haji Ahmad Shah Airport	Pahang
Tioman Airport	Tioman Island, Pahang
Pangkor Airport	Pangkor Island, Perak
Labuan Airport	Labuan Federal Territory
Lahad Datu Airport	Sabah
Sandakan Airport	Sabah
Tawau Airport	Sabah
Bintulu Airport	Sarawak
Sibu Airport	Sarawak
Mulu Airport	Sarawak
Limbang Airport	Sarawak
STOL Sabah	Sabah
STOL Sarawak	Sarawak

Source: Malaysia Airports Annual Report, 2012

The ability of these airports to handle passenger and aircraft movements will have important implications on the airport management system, baggage handling system, security systems and air traffic control system. The existing technology may not be able to accommodate the number of passengers and aircraft movements in 2050. **Table 4.8** shows the current capabilities of Malaysia's airports.

Table 4.8 Malaysia Airports Current Capabilities

State	Airports	Capacity/ Year	NO. OF AIRCRAFT STANDS	NO. OF RUN-WAYS	RUNWAY LENGTH(M)	LANDING AIDS	AIR-SPACE CLASS	CARGO CAPACITY (METRIC TONS)
JOHOR	Senai International Airport	5.4 million	8	1	3,800	ILS/LOC DVOR/DME GP/DME NDB	C	500,000
KEDAH	Sultan Abdul Halim Airport	800,000	3	1	1,372	NDB DVOR/DME ILS/LOC GP/DME	C	100,000
	Langkawi International Airport	2.5 million	2	1	3,810	DVOR/DME ILS/LOC GP/DME	C	300,000
KELANTAN	Sultan Ismail Petra Airport	1.4 million	3	1	2,400	NDB DVOR/DME ILS/LOC GP/DME	C	80,000
MELAKA	Malacca International Airport	1.5 million	3	1	1,372	NDB DVOR/DME ILS/LOC GP/DME	C	100,000
PAHANG	Sultan Haji Ahmad Shah Airport	1 million	3	1	2,804	L DVOR/ TACAN ILS/LOC GP/DME	C	10,000
PERAK	Sultan Azlan Shah Airport	320,000	3	1	1,798	L DVOR/DME ILS/LOC GP/DME VOR	C	1,000
PENANG	Sultan Haji Ahmad Shah Airport	1 million	3	1	2,804	L DVOR/TACAN ILS/LOC GP/DME	C	10,000

SABAH	Kota Kinabalu International Airport	12 million	12	1	3,780	L DVOR/DME ILS/LOC GP/DME	C	800,000
	LahadDatu Airport	100,000	3 small Aircraft	1	1,371	L	C	20,000
	Sandakan Airport	1.5 million	4	1	2,133	NDB DVOR/DME ILS/LOC GP/DME	C	50,000
	Tawau Airport	1.4 million	6	1	2,685	NDB DVOR/DME ILS/LOC GP/DME	C	60,000
SARAWAK	Kuching International Airport	10 million	9	1	3,780	NDB DVOR/DME ILS/LOC GP/DME	C	600,000
	Bintulu Airport	1 million	5	1	2,745	NDB DVOR/DME ILS/LOC GP/DME	C	60,000
	Miri International Airport	2 million	8	1	2,745	NDB DVOR/DME ILS/LOC GP/DME	C	300,000
	Sibu Airport	1.5 million	4	1	2,745	NDB DVOR/DME ILS/LOC GP/DME	C	20,000
	Mulu Airport	200,000	2 small Aircraft	1	1,195	DVOR/DME	C	20,000
	Limbang Airport	250,000	3 Small Aircraft	1	1,500	L NDB DVOR/DME ILS/LOC GP/DME	C	10,000
SELANGOR	Sultan Abdul Aziz Shah Airport	5 million	5	1	3,780	L DVOR/DME ILS/LOC GP/DME	C	800,000

TERENGGANU	Sultan Mahmud Airport	1.1 million	4	1	3,480	DVOR DME ILS CAT 1	C	20,000
WP KUALA LUMPUR	KLIA	100 million	80	2	4,019 & 4,000	L DVOR/DME ILS/LOC GP/DME	C	1.2 million
WP LABUAN	Labuan Airport	3 million	6	1	2,745	L DVOR/DME ILS/LOC GP/DME	C	300,000

Source: MAHB

Legend:

Abbreviation	**Full Name**
NDB	Non directional beacon
L	Low altitude VOR
DVOR/DME Equipment	Doppler VHF Omnidirectional Range/ Distance Measuring
DVOR/TACAN	Doppler VHF Omnidirectional Range/ Tactical Air Navigation System
ILS/LOC	Instrument Landing System / Localizer (Measuring error from runway centreline)
GP/DME	Instrument Landing System Glidepath / Distance measuring Equipment (Measuring error from pre determine glide path)
ILS CAT 1	Instrument Landing System Category 1. (Runway Visual Range <550m)
ILS CAT 11	Instrument Landing System Category 11. (Runway Visual Range <300m)
ILS CAT 111a	Instrument Landing System Category 111a. (Runway Visual Range <200m)
ILS CAT 111b	Instrument Landing System Category 111b. (Runway Visual Range <75m)

Note: Runway Visual Range is the distance over which a pilot of an aircraft on the centreline of the runway can see the runway surface markings delineating the runway or identifying its centre line. Airspace class C: Class C: Operations may be conducted under IFR, SVFR, or VFR. All aircraft are subject to ATC clearance (country specific variations notwithstanding). Aircraft operating under IFR and SVFR are separated from each other and from flights operating under VFR, but VFR flights are not separated from each other. Flights operating under VFR are given traffic information in respect of other VFR flights.

4.3.1.2 PASSENGER MOVEMENTS

Figure 4.30 and **4.31** indicate the passenger movements in the various airports from 2002 to 2012, including the predicted movements in 2020, 2035 and 2050. The predicted passenger movements for 2050 reveal that most of the airports will not be able to sustain the number of passengers with the existing capacity. To illustrate, Penang airport will exceed its capacity by 600% with a predicted passenger movement of more than 18million compared to its existing capacity of 3 million. Whereas, all the airports in Sabah consisting of Kota Kinabalu, Lahad Datu, Sandakan and Tawau will also exceed their current capacities by between 25 to 150%. In Sarawak with the exception of Kuching, Mulu and Limbang airports, all the other airports namely Bintulu, Miri and Sibu will exceed their capacities by between 50 to 250%. Sultan Abdul Halim airport and Langkawi airport will also exceed their capacities by 100% and 25%, respectively.

While in the East Coast States, Sultan Ismail Petra airport in Kelantan will expect more than 4 million passengers in 2050 but will only be able to handle 1.4 million passengers whilst Sultan Mahmud airport in Terengganu will exceed its capacity then by 50%. Labuan airport is underutilized as it is built for a capacity of 3 million but only approximately 800 million passengers are expected in 2050. This underutilisation is also observed with Melaka, Sultan Haji Ahmad Shah in Pahang, Sultan Azlan Shah in Perak, Sultan Abdul Aziz in Selangor, Mulu and Limbang airports. KLIA is expected to receive more than 125 million passengers in 2050. Although it is designed to accommodate 100 million passengers annually the existing phase is only able to handle 35 million passengers and with the completion of KLIA2 this will add a further 45 million passengers to the annual capacity. Hence, even KLIA and KLIA2 will not be able to fulfil the demands expected in 2050.

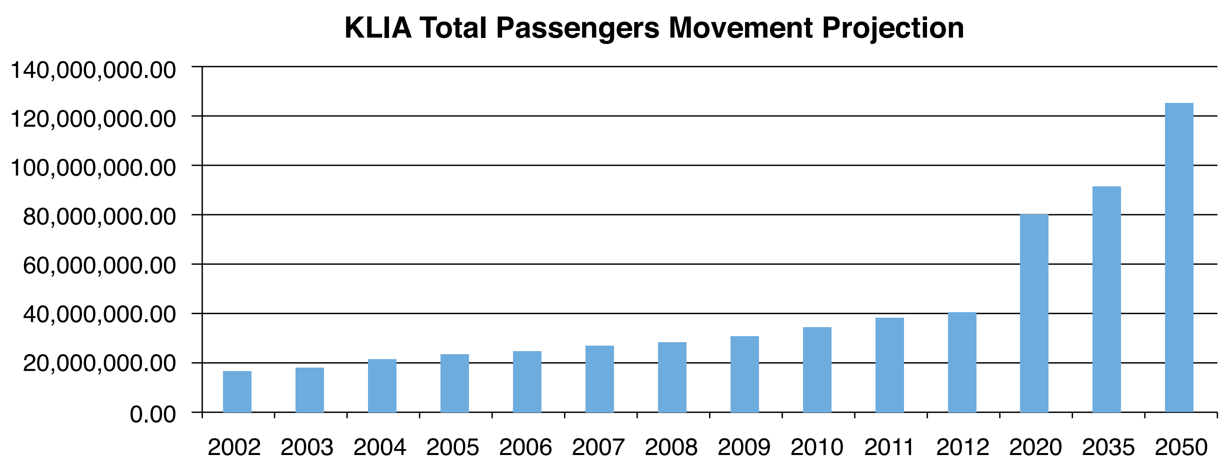


Figure 4.30 Kuala Lumpur International Airport passenger movement projection

Source: MAHB 2012

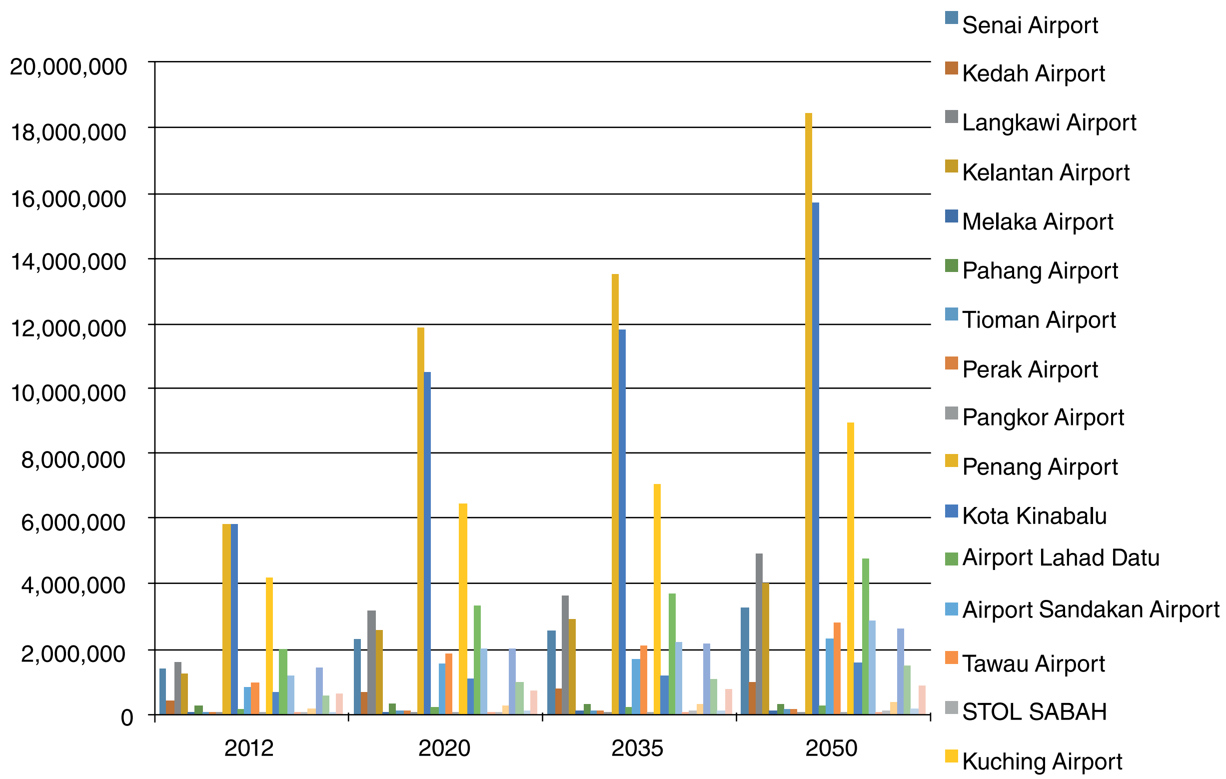


Figure 4.31 Malaysia's airport passenger movement projection

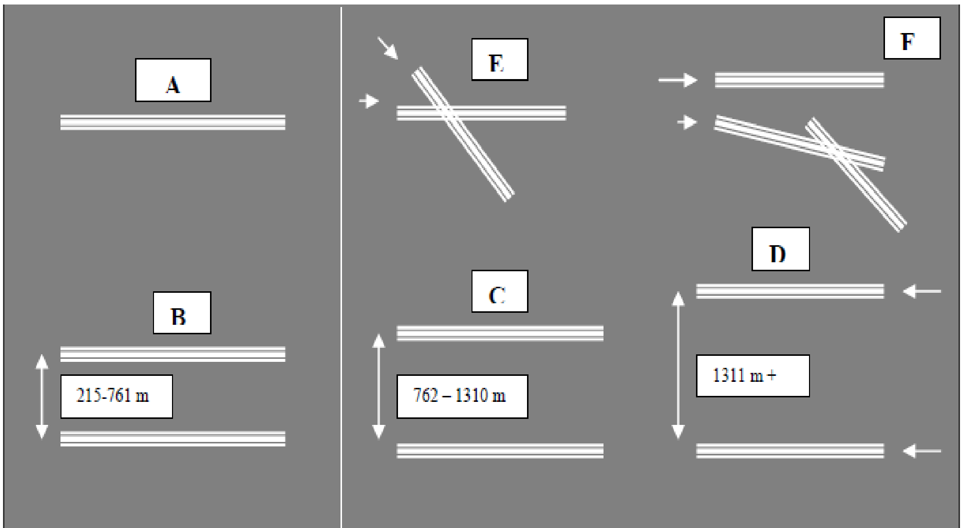
Source: MAHB 2012

4.3.1.3 COMMERCIAL AIRCRAFT MOVEMENTS

With the exception of KLIA airports, all the other airports have single runaways. Single runaways are classified as class A and have an operational capacity of between 195,000 to 240,000 aircraft movements annually as in **Table 4.9**. This means that all the airports with single runaways are able to handle the increase in aircraft movement projected in 2050 (including even Sultan Ismail Petra airport). Conversely, KLIA, which has 2 parallel runaways 2km apart from each other, is classified as a Class D and is currently handling only 68 movements per hour. Accordingly, it will not be able to handle the projected number of 900,000 annual aircraft movements in 2050 as the maximum operational capacity is only 370,000. Hence, KLIA2, with a dedicated runaway of a maximum capacity of 240,000, will help alleviate this problem, but perhaps not nearly enough.

In terms of aircraft stand, if the average turnaround time for each aircraft is 40 minutes, then each stand should be able to accommodate 1.5 aircrafts per hour. If the airport operates 18 hours a day then one stand can accommodate 9,855 aircrafts annually. Since aircraft take-off and landing is counted as 2 movements, therefore the number of aircrafts arriving at an airport is half the number of aircraft movements. Thus, theoretically only 3 airports will not be able to accommodate the projected number of aircrafts in 2050 with their existing number of stands namely Langkawi, Sultan Ismail Petra airport in Kelantan and Sultan Abdul Aziz airport in Selangor.

Table 4.9 Runway Configuration



Runway Classification	Hourly Capacity - (Ops/Per hour		Annual Volume Ops/Per hour
	VFR	IFR	
A	51-98	50-59	195000-240000
B	94-197	56-60	260000-355000
C	103-197	62-75	275000-365000
D	103-197	99-119	305000-370000
E	72-98	56-60	200000-265000
F	73-150	56-60	220000-270000

Source: ICAO Airport Planning Manual (1987)

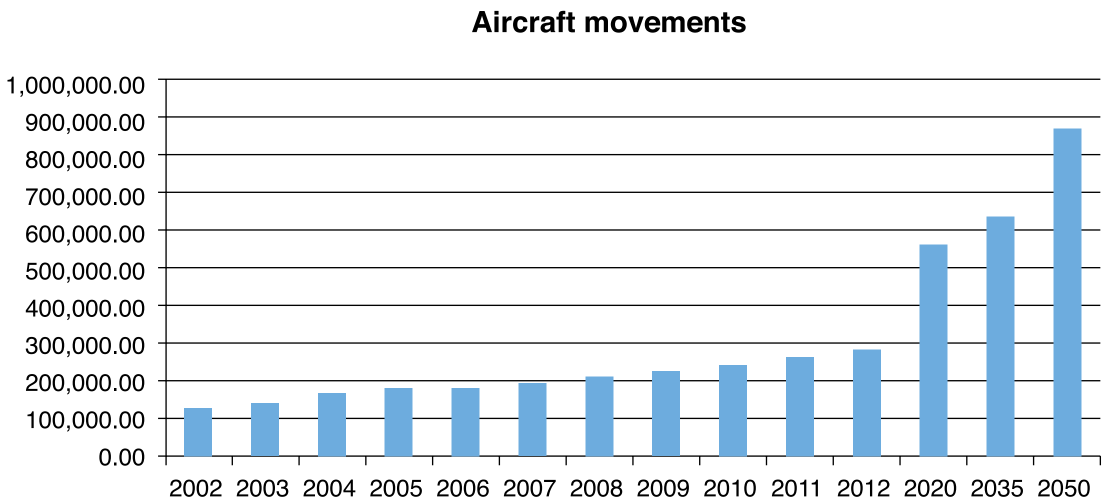


Figure 4.32 KLIA aircraft movement projection

Source: Malaysia Airports Annual Report 2012

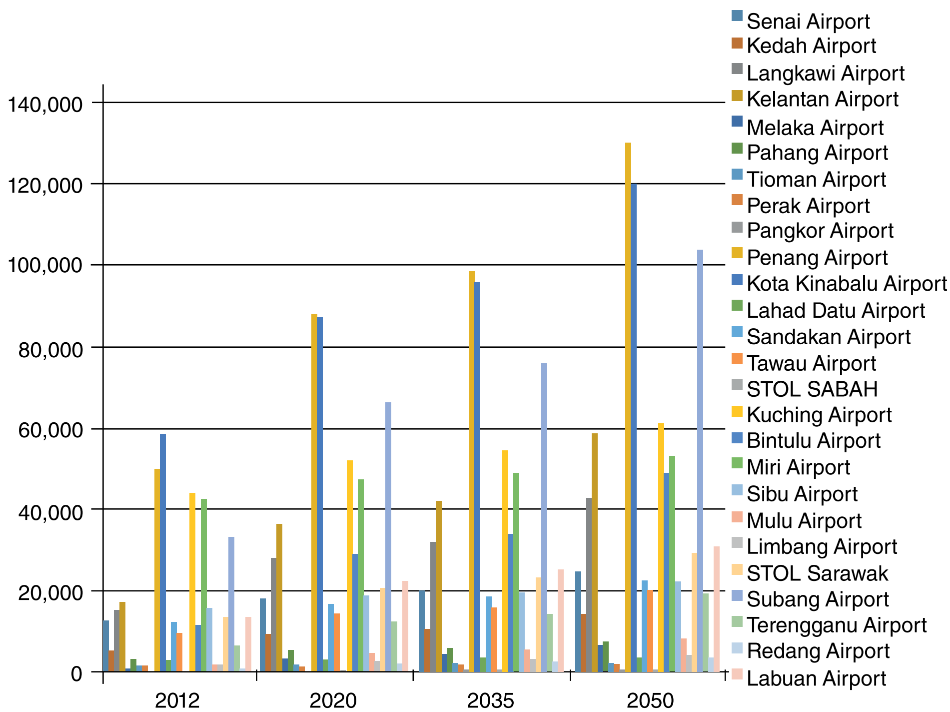


Figure 4.33 Malaysia's Airport Aircraft movement projection.

Source: Malaysia Airports Annual Report 2012

4.3.1.4 CARGO MOVEMENTS

In general, Malaysia will see a large increase in cargo movements as seen in **Figure 4.34**. However most of the cargo movements are concentrated in KLIA which will reach more than its capacity of 1.2million metric tonnes in 2050. Penang will also exceed its capacity in 2050 as seen in **Figure 4.35**. The general increase in cargo movements will have implications on logistics and cargo handling capabilities.

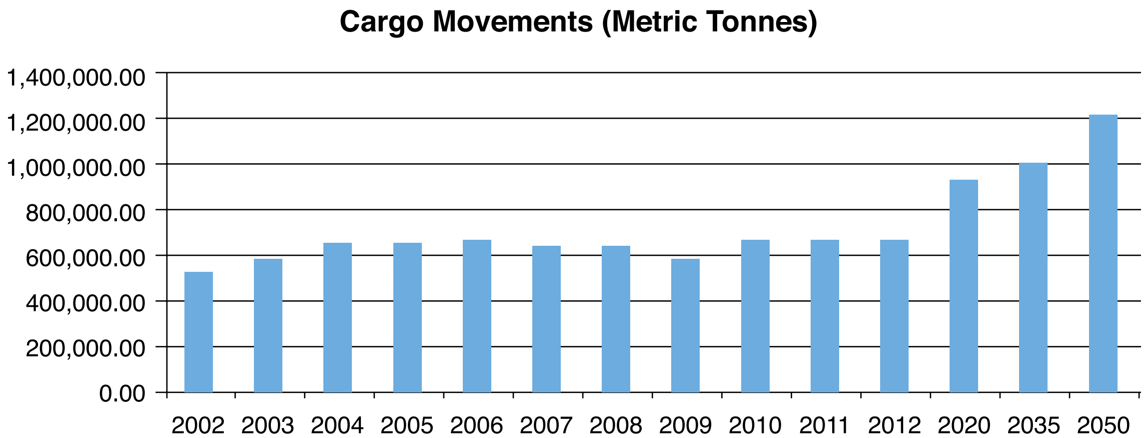


Figure 4.34 KLIA Cargo movement projection

Source: Malaysia Airports Annual Report 2012

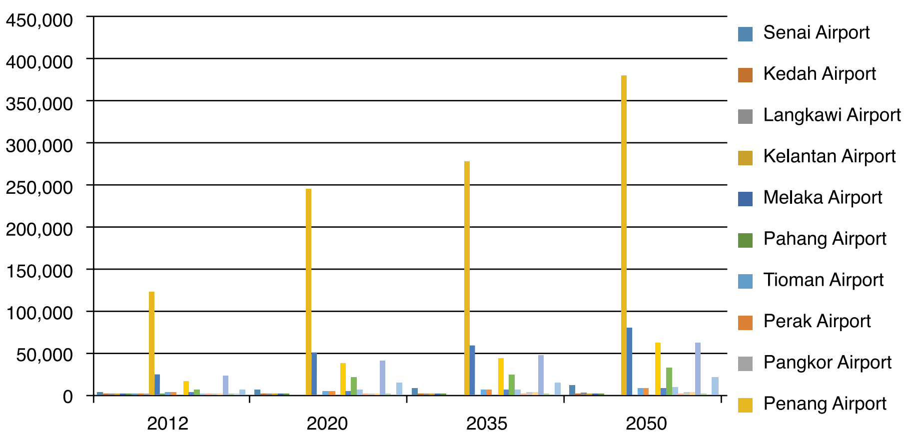


Figure 4.35 Malaysia's airport cargo movement projection

Source: Malaysia Airports Annual Report 2012

It can be concluded that in general Malaysia's airport will not be able to handle the predicted number of passengers' movement in 2050. However almost all the airports are well equipped to handle the predicted aircraft movements in 2050 in terms of operational capacity and aircraft stands. However the increasing number of aircraft movements will have critical implications on air traffic control. The increase in the number of passengers will affect the technology deployed for baggage handling, security screening and total airport management. Failure to mitigate this will cause delays. Delays have cause Europe 1.8billion euros in 2008. The following sections will discuss on the possible mitigations to alleviate congestions and ensure sustainability of the air transport industry.

4.3.1.5 BAGGAGE HANDLING SYSTEM

The increasing numbers of passengers will present airports and airlines with a tremendous challenge. This applies to baggage handling systems that will have to quickly and reliably sort and convey the entire luggage to the right place at the right time. At the front end, the baggage handling system needs to make intelligent decisions. This requires the front end system to collect bag data such as security status, departure gate and time and the destination airport. This is done in real time so that airport performance can be monitored in real time. Such a system called the Airport Operational Dashboard is already operating at Munich airport.

The baggage handling system also needs to be efficient. To this effect layout planning according to requirements such as the number of check-ins and capacity of early bag stores need to resolve in the design phase. This can be done using a layout planning tool to simulate material flow with real equipment. The system's ability to handle everyday demands can then be tested. Multiple redundancies can then be avoided thus reducing capital expenditures. Another consideration that ought to be deliberated is the usage of Radio Frequency Identification (RFID) baggage tags. These tags, unlike the conventional barcode tags which requires it to be in close proximity of the scanner, can be read from a distance and within a range of angles. RFID tags have a read-rate of 97% as compared to the conventional barcode tags that have a read rate of about only 80% on top of being more reliable and contain more data. Hong Kong International Airport was the pioneer and has successfully implemented this baggage tagging system in 2004, this was followed suit by Aalborg Airport, Libson Airport as well as Milan Malpensa Airport.

Serious thoughts should also be given to energy efficiency, use of materials and ease of maintenance when designing the baggage handling system. This will have a strong impact on the environment. A feature of the system could be to inform the destination airport of the quantity of baggage and its exact arrival time. The user friendliness of the baggage handling system could also be improved from an ergonomics point of view. A semi-automatic solution will help improve the loads that workers have to handle particularly at peak hours.

4.3.1.6 AIRPORT MANAGEMENT AND OPERATIONS

The increase in number of passengers will cause bottlenecks on the runaways, delayed departures, long lines at security and check in. However these can be alleviated by making the most of resources and avoid delays. A comprehensive airport management and operation system need to be developed that will allow smooth interaction between the different airport processes. The system should integrate airport management, airport performance management and flight information display systems.

The airport management system forms the backbone of airport planning and resource allocation. It seamlessly plans seasonal and operative flights and manage airport resources. The airport performance management system will be used for fine tuning airport processes for example when there are knock-on effects caused by delays at other airports, security incidents and urgent maintenance work. A time forecast of such incidents will allow the airport operator to take necessary actions and coordinates measures with all stakeholders. In short it supervises and manages operational processes including the detailed tunaround mamagement of the aircraft, human resources planning, baggage handling and passenger guidance.

The flight information display system guides the passengers from the moment they entered the airport to their check in counters right up to the departure feeding them with up to date flight information all the time along the way. Other uses of the display system includes information for ground handlers, other airport personnels and advertising. It also functions to help evacuate an airport quikly and efficiently in the event of emergency. For smaller airports, the display system can be used as an airport operational database with manual data entry. In order to mitigate the long standing Singapore-Malaysia airspace control, a study on the implication of flight diversion should be looked into. This could be done by benchmarking the management system employed by John F. Kennedy, LaGuardia & Newark Liberty Airports.

4.3.1.7 AIRPORT SECURITY SYSTEM

The increase in numbers of passengers will also increase the security risks at airport. Existing methods causes delays and inconvenience to the passengers. In particular body scanning using radiation technology can be dangerous to frequent travellers. Some of the technologies described below have been developed in Israel and can be developed indigineously. These include:

Chemicals that frees particles from fabric and luggage for speedy detection and analysis. The technology detects harmful susbstances that are used in explosives or biological agent. It can be integrated into scanners, magnometers and also a wand that can be passed over people and luggage. In Malaysia this can be applied to also detect drugs. The Suspect Detection System that interrogates and check the background of travellers and airport employees. It worls like a lie detector to monitor the pschological and physilogical fear of a terror suspect. A variation to this could be to identify drug mules. In this case it will search for cues that only drug smugglers are likely to radiate.

BriefCam that provides the user with a set of video review tools to locate events of interest quickly from surveillance footage. Therefore, individuals can be singled out or unusual occurences can be identified. In the event that the aforementioned systems are deemed too expensive or unfeasible to be employed in our airport security syetems, other R&D on low cost practical security system should be seriously looked into to reduce the impending bottleneck caused by the increasing influx of passanger by 2050.

4.3.1.8 MRO AND TRAINING

An increase in aircraft movements will require more and a wider range of aircraft facilities for MRO at the various airports. This is particularly so where the expected increase in aircraft movements is high. Currently most MRO activities are based near KLIA, Sultan Abdul Aziz Shah and Kota Kinabalu. There are oppurtunites for MRO activities to be more distributed throughout all the airports. In addition in most states there are already aircraft related training institutions that can support such activities. This includes aircraft maintenance and pilot training schools to fulfill the expected demand in commercial pilots. In view of the number of flight time of young pilots, a mentoring or buddy system should be introduced to increase the flight time hours accumulated by these young pilots. **Figure 4.10** shows the airport maintenance service provided by each airport in every State of Malaysia.

Table 4.10 Airport Maintenance Service

State	Airports	Maintenance Service	Training Institution(s)
Johor	Senai International Airport	No	1
Kedah	Sultan Abdul Halim Airport	No	3
	Langkawi International Airport	No	
Kelantan	Sultan Ismail Petra Airport	No	2
Melaka	Malacca International Airport	No	Nil
Pahang	Sultan Haji Ahmad Shah Airport	Yes	1
Perak	Sultan Azlan Shah Airport	No	1
Penang	Penang International Airport	No	Nil
Sabah	Kota Kinabalu International Airport	Yes (Mas Engineering)	1
	LahadDatu Airport	No	
	Sandakan Airport	No	
	Tawau Airport	No	
Sarawak	Kuching International Airport	No	1
	Bintulu Airport	No	
	Miri International Airport	No	
	Sibu Airport	No	
	Mulu Airport	No	
	Limbang Airport	No	
Selangor	Sultan Abdul Aziz Shah Airport	Yes (MAS Engineering)	2
Terengganu	Sultan Mahmud Airport	No	1
WP Kuala Lumpur	KLIA	Yes (MAS Engineering)	2
WP Labuan	Labuan Airport	No	1

Source: MAHB 2012

4.3.2 SAFETY

The existing system for monitoring flight utilises ground radar technology. This means that air traffic controllers are monitoring the aircrafts that come in and out of the air space within their regions. The air traffic controller receives a signal that an aircraft has entered his airspace and calls to that aircraft using the radar technology. The signal takes 12 seconds to travel from the ground to the plane. By 2020, all US airlines are required to implement Auto Dependent Surveillance Broadcast (ADS-B). The technology is a satellite based system that will sent signals to all planes and the air traffic controllers within two seconds. This also means that every cockpit will able to see other planes in their vicinity thus improving visibility and safety. This system would also enhance the existing scheduling system.

Nevertheless, there are some concerns about this technology particularly the non secure nature of its transmissions. The messages can be used to know the location of an aircraft. ADS-B messages can also be produced with simple low cost equipment, and as a result, opening the possibility of disrupting safe air travel. There are also concerns about the bandwidth and the dependence on satellite navigation systems.

Hence, R&D on ADS-B in Malaysian aircrafts and airports should be initiated in preparation of its implementation. Apart from that, there is also the need to form a special unit involving local expertise as well as abroad to investigate air related accident and incidents as it is a standard practice among other airports in the world.

4.3.3 URBAN AIR QUALITY AND ENVIRONMENT

A total of 70% of aircraft emissions are made of CO_2, whilst the rest consist of 30% H_2O, and less than 1% each of NOx, CO, SOx, VOC, particulates, and other trace components including harzadous air poullutants. During airport ground level operations and during landing and takeoff, about 10% of aircraft emissions of all types, except hydrocarbons and CO, are produced. At ground level 30percent hydrocarbons and CO, are produced. Vehicles include traffic to and from the airport, ground equipment that services aircraft, shuttle buses and vans serving passengers, auxiliary power units providing electricity and air conditioning to aircraft parked at airport terminal gates, stationary airport power sources, and construction equipment operating on the airport also adds to the emissions at airports.

The aviation emissions reflect the level of overall aviation activities. According to the U.S. Bureau of Transportation Statistics, there is as a 21.5% increase in population, 32% increase in the labor force, and 90% increase in GDP between 1980 and 2000 have driven the demand for air travel in the United States. This phenomena is expected to be the same anywhere else in the world.

Table 4.11 shows the estimated default fuel use and emission factors for some aircraft types for LTO cycle.

Table 4.11 Default fuel use and emission factors for some aircraft types for the LTO cycle. (KG/LTO)

Aircraft type	CO_2	CH_4 [b)]	N_2O [c)]	NO_x	CO	NMVOCs	SO_2 [d)]	Fuel
A300	5470	1.0	0.2	27.21	34.4	9.3	1.7	1730
A310	4900	0.4	0.2	22.7	19.6	3.4	1.5	1550
A320	2560	0.04	0.1	11.0	5.3	0.4	0.8	810
BAC1-11	2150	6.8	0.1	4.9	67.7	61.6	0.7	680
BAe 146	1800	0.16	0.1	4.2	11.2	1.2	0.6	570
B707*	5880	9.8	0.2	10.8	92.4	87.8	1.9	1860
B727	4455	0.3	0.1	12.6	9.1	3.0	1.4	1410
B727*	3980	0.7	0.1	9.2	24.5	6.3	1.3	1260
B737-300	2905	0.2	0.1	8.0	6.2	2.0	0.9	920
B737*	2750	0.5	0.1	6.7	16.0	4.0	0.9	870
B737-400	2625	0.08	0.1	8.2	12.2	0.6	0.8	830
B747-200	10680	3.6	0.3	53.2	91.0	32.0	3.4	3380
B747*	10145	4.8	0.3	49.2	115	43.6	3.2	3210
B747-400	10710	1.2	0.3	56.5	45.0	10.8	3.4	3390
B757	4110	0.1	0.1	21.6	10.6	0.8	1.3	1300
B767	5405	0.4	0.2	26.7	20.3	3.2	1.7	1710
Caravelle*	2655	0.5	0.1	3.2	16.3	4.1	0.8	840
DC8	5890	5.8	0.2	14.8	65.2	52.2	1.9	1860
DC9	2780	0.8	0.1	7.2	7.3	7.4	0.9	880
DC10	7460	2.1	0.2	41.0	59.3	19.2	2.4	2360
F28	2115	5.5	0.1	5.3	54.8	49.3	0.7	670
F100	2340	0.2	0.1	5.7	13.0	1.2	0.7	740
L1011*	8025	7.3	0.3	29.7	112	65.4	2.5	2540
SAAB 340	945	1.4 (E)	0.03 (E)	0.3 (E)	22.1 (E)	12.7 (E)	0.3 (E)	300 (E)
Tupolev 154	6920	8.3	0.2	14.0	116.81	75.9	2.2	2190
Concorde	20290	10.7	0.6	35.2	385	96	6.4	6420
GAjet	2150	0.1	0.1	5.6	8.5	12	0.7	680

Source: IPCC Guidelines on National Greenhouse Gases Inventories, p. 196

There are several ways to alleviate emissions at the airport.

- First is to reduce emissions from ground support equipment and other vehicles with alternative fuel. California and Texas have agreements with major airlines to convert gasoline and diesel equipment to electricity and alternative fuel. In Malaysia,Compressed Natural Gas (CNG) could be the alternative fuel for ground support equipment and vehicles, buses, trucks, taxis and other on-road vehicles operating in and around the airport. R&D in CNG driven vehicles and equipment is therefore crucial.

- Secondly the airport should be designed in such a way that there are high speed and free flowing limited access roads and readily available parking facilities. These will minimise motor vehicle emissions.

- Thirdly, the use of best practices for reducing emissions. For example NO_x emissions are higher during high power operations like take off. During taxing which is a low power operation, HC and CO emissions are higher. As a result, reducing engine power during takeoff or climb out will reduce the rate of NO_x emissions,increases HC and CO but have no effect on CO_2 emissions.

- Fourthly, the use of new technologies to improve air traffic management can help to reduce emissions in and around the airport. The technologies in communication, navigation, surveillance/air traffic management or CNS/ATM will ensure accurate approach routes, increase efficiency and capability of runaways, reduce arrival spacing and make ground operations more efficient thus reducing congestion and consequently reducing aircraft fuel use.

4.3.4 OTHER CONSIDERATIONS

A study should be conducted on the land utilisation within the surrounding vicinity of our main international airports namely KLIA and KLIA2. Hence, the utilisation should be driven to spur the air transport economic model as it is logistically accessible. An intermodal intermodal passenger transport or mixed-mode commuting should be availabe to reduce the dependence on private automobiles as a major mode of ground trasportation. This is effort is non trivial especially in controlling the amount of emmission or air quality within the airport environs. Besides that, regional airports especially underutilised airports should deliberate on opening its accessibility for personal/private use. It would bring in considerable revenue to the airports apart from giving the aiports a sense of purpose rather than being mere white elephants.

4.4 MARITIME AND INLAND WATER TRANSPORTATION

4.4.1 CONGESTION AND SUSTAINABILITY IN MALAYSIA PORTS

4.4.1.1 MALAYSIAN PORTS

Ports in Malaysia can be classified as Federal and State ports. There are at present seven major federal ports e.g. Port Klang, Penang Port, Bintulu Port, Johor Port, PasirGudang Port, PelabuhanTanjungPelepas, Kuantan Port and Kemaman Port. All of the ports are regulated by port authorities. The ports in Sabah and Sarawak are also administered by port authorities,though report directly to the respective State Ministry. These ports include Kuching, Miri, Rajang and Sabah. The current capabilities of most of these ports are shown in **Table 4.12**.

Table 4.12 Malaysia Ports Current Capabilities

PORT	CARGO CAPACITY (TEUS / YEAR)	NO OF BERTH	LENGTH OF BERTH (M)	MAX VESSEL CALLS	NO OF CRANES	SUSTAINABLE CRANE CAPACITY	PRIME MOVERS	AREA CONTROL CENTRE'S ACC @ RADAR COVERAGE (NAUTICAL MILES)	RADAR LIMIT
KELANG	20 million	53	6,079, 1,486, 1,561, 2,086, 30, 196	14560	74	10,182,400	424	26	Automatic Identification System, AIS: The signal takes 2 to 10 seconds depending on vessel's speed while underway, and every three minutes while vessel is at anchor.
PENANG	2 million	16	1,500	4160	34	4,678,400	60	10	
BINTULU	600,000	36	950, 514, 450, 270, 120, 65	9360	5	688,000	19	15	
KUCHING	158,000	5	635, 613, 125, 48	1300	3	412,800	3	10	
MIRI	48,000	6	390		5	688,000	12	15	
RAJANG	141,800	7	295	1820	3	412,800	9	15	
SABAH	200,000	12	350	3120	4	550,400	10	15	
JOHOR	1 million	24	253	6240	7	936,200	46	20	
KUANTAN	150,000	9	525	2340	4	550,400	4	15	
TANJUNG PELEPAS	8 million	12	2,160	3120	44	6.054,400	361	20	

Source: MOT

Port capacity is a function of draft, berth length, container acreage, container yard density, and operating hours. There are several assumptions and rules of thumb when calculating capacity, namely:

- Maximum annual TEU slot turnover = 70 turns (5 day dwell, 350 days/year)
- Crane available 16 hours/day (two shifts), 250 days/year
- Modern crane maximum = 35 moves/hour
- Vessel spacing at berth = vessel beam
- Maximum of 260 annual calls per berth (5 per week)
- Working draft = channel/berth draft – 3 feet
- Maximum vessel sailing draft = 92% of design draft
- **Sustainable capacity = 80% of maximum capacity**

The sustainable crane capacity can be calculated with the following examples:

- **74 cranes** @ max of 4,000 hours/year = 296,000 crane hours
- 80% = 236,800 sustainable crane hours
- Maximum crane productivity of 35 containers per hour
- 80% = 28 container/hour x 1.54 TEU/container = 43 TEU/hour
- Sustainable crane capacity = 43x236,800 = **10,182,400 TEU/year**

Thus, in the case of Port Kelang, although the cargo capacity is 20 million TEU per year, the sustainable crane capacity is only 10 million per year. In general, the current sustainable crane capacity of most ports exceeds the CY capacity except for Port Kelang, Johor and Tanjung Pelepas.

4.4.1.2 MALAYSIA CONTAINER PORT TRAFFIC

The global container forecast is shown in **Figure 4.36**. It can be observed that the total number of full containers shipped internationally is expected to grow from 113.6 million TEU in 2005 to 235.7 million TEU in 2015. This represents a growth rate of 7.6%.

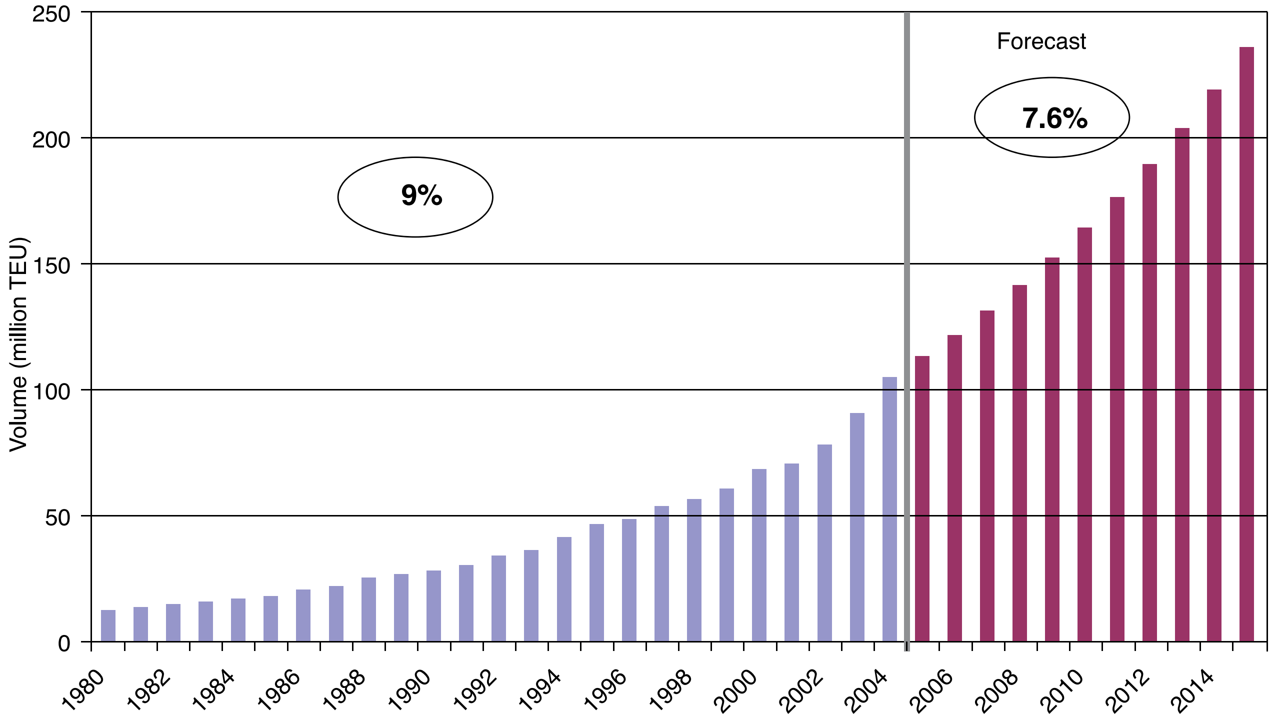


Figure 4.36 Global container forecast

Source: UNESCAP website

The growth rate of two major ports in Malaysia namely Port Klang and Tanjung Pelepas is set to reach more than 25 million TEU in 2050 (**Figures 4.37** and **4.38**). Based on **Table 4.37**, Port Klang will exceed its capacity by 34% with predicted container traffic of more than 30 million compared to its existing capacity of 20 million. The same is also observed of the second busiest port in Malaysia, Tanjung Pelepas port. Tanjung Pelepas port is designed to support 8 million TEUs of container throughput per year. Nonetheless, based on prediction in 2050, it will exceed by 70% its current capacity by the year 2050 when it is projected to receive 27 million containers.

Figure 4.39 shows the container traffic in the various ports from 2002 to 2012 and the predicted movements in 2020, 2035 and 2050. In general most of the ports will not be able to sustain the number of containers with the existing capacity in 2050.In terms of crane capacity, both Port Kelang and Tanjung Pelepas will not be able to handle the projected container traffic in 2050. However, most of the other ports have sufficient cranes to handle the projected container traffic in 2050.

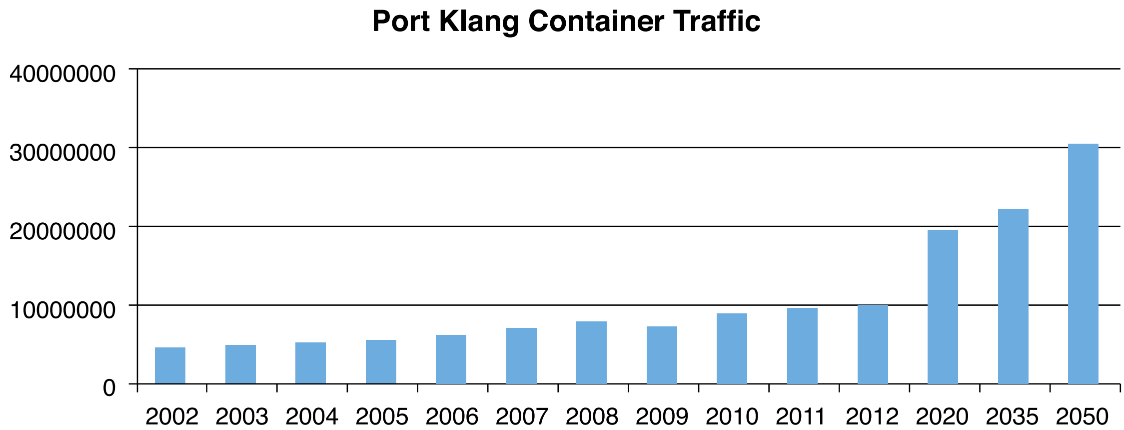


Figure 4.37 Port Klang container traffic projection

Source: MOT

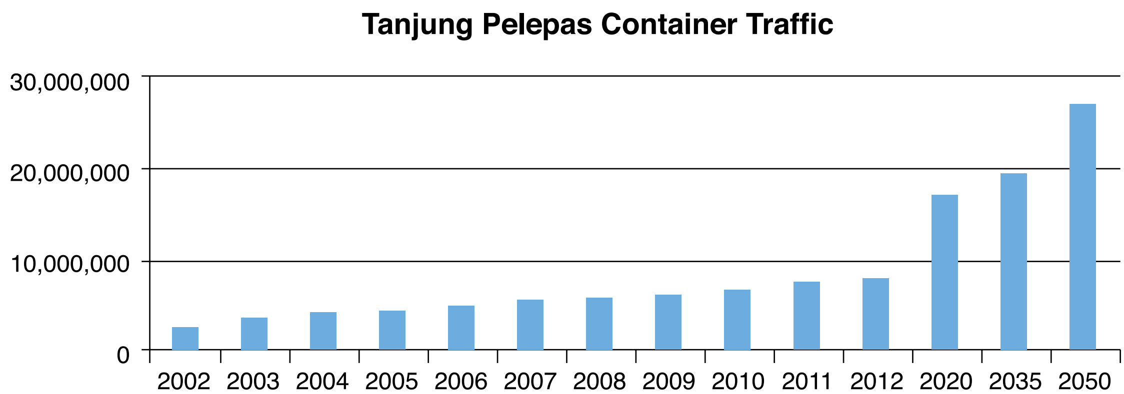


Figure 4.38 Tanjung Pelepas port container traffic projection

Source: MOT

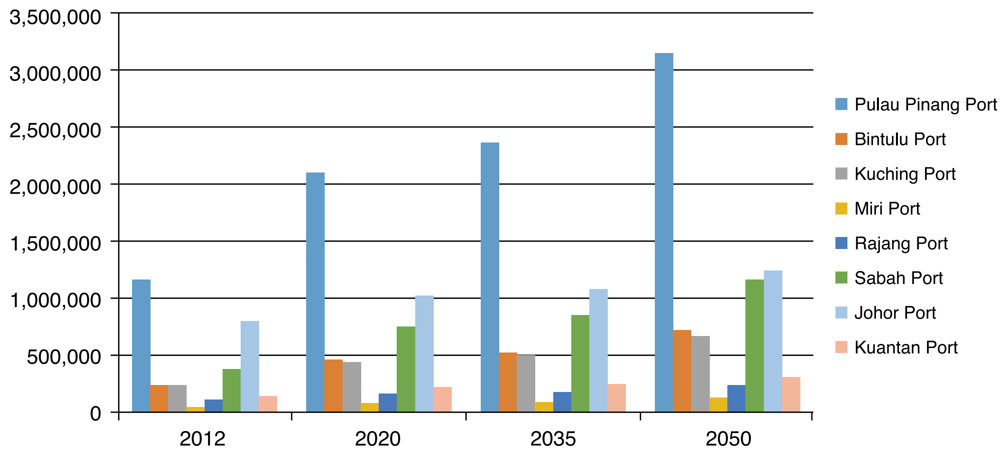


Figure 4.39 Total Container Throughput projection by Ports, Malaysia

Source: MOT

4.4.1.3 THE REPOSITIONING OF EMPTY CONTAINERS

It is reported that about 2.5 million TEU of empty containers are being stored. This accounts nearly 10% of existing container assets as well as 20.5% of global port handling. The major cause of this problem includes trade imbalances, repositioning costs, revenue generation, manufacturing and leasing costs, usage preferences as well as slow steaming.

Trade imbalance is a result of a region that imports more that it exports, hence contributes towards the accumulation of empty containers globally. If this scenario prevails, higher transportation cost as well as the tying up of existing distribution capacities will transpire. Repositioning cost is essentially the combination of inland and international transportation costs. The increase in this form of cost would introduce shortages of containers on the export market which is deemed unfavourable. Ship-owners maximises their revenue by allocating their containers without considering the economic prospect of their customers. For instance, ship-owners would rather choose to reposition their containers to available export markets than dally for the accessibility of an export load, which eventually leads to a more profitable revenue.

The lower cost in the manufacturing of new containers and leasing existing ones would somewhat increase the accumulation of empty containers. On the contrary, if the manufacturing and leasing costs increase, repositioning would be a viable option, however such instances are often temporary as imbalances and leasing costs are correlated. In terms of usage preferences, shipping lines and leasing companies have the tendency in not sharing market information on container quantities as well as positions owing to the competitive nature of their business, hence making it difficult to establish container pools. Slow steaming is the practice of reducing operational speed due to rising bunker fuel prices and excess capacity. This practice results in a longer transoceanic journeys which reduces the available containers inland, encourage transloading within the vicinity of port terminals and tie more container inventory in transit.

A solution to this problem is virtual container yard where information about container availability is displayed without the container being stored in a physical storage depot. The system would display the availability of a container for a new load, both geographically and temporarily. There are four key objectives of this virtual container yard namely, to display status information about containers, to improve information exchange between the parties involved in supply chain management, to transfer the container lease and the relevant documentation without having the container to be physically brought back to the depot or the terminal and also to facilitate the relevant parties involved in the supply chain management in their decision making process about the usage of container assets.

4.4.1.4 TOTAL SHIP CALLS

Based on a maximum of 260 annual calls per berth, Port Klang and Tanjung Pelepas will exceed their capacity by more than 100% and 400%, respectively (**Figures 4.40** and **4.41**). In general, the projected number of vessel calls exceeds the maximum capacity of all the ports (**Figure 4.42**).

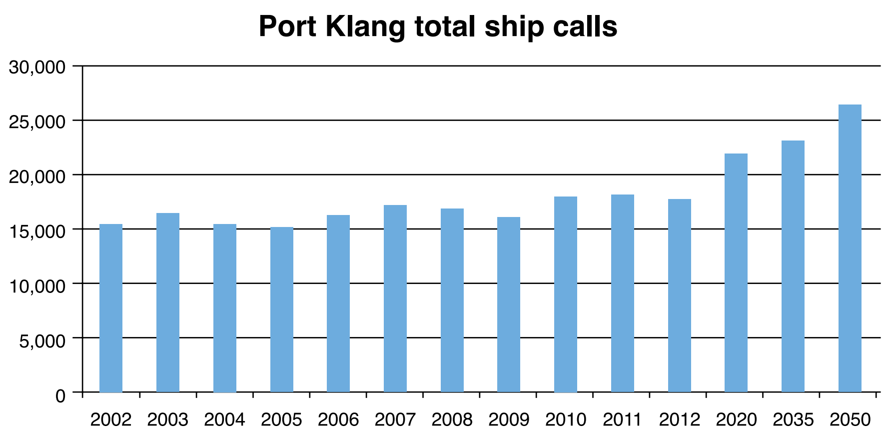


Figure 4.40 Port Klang total ship calls projection

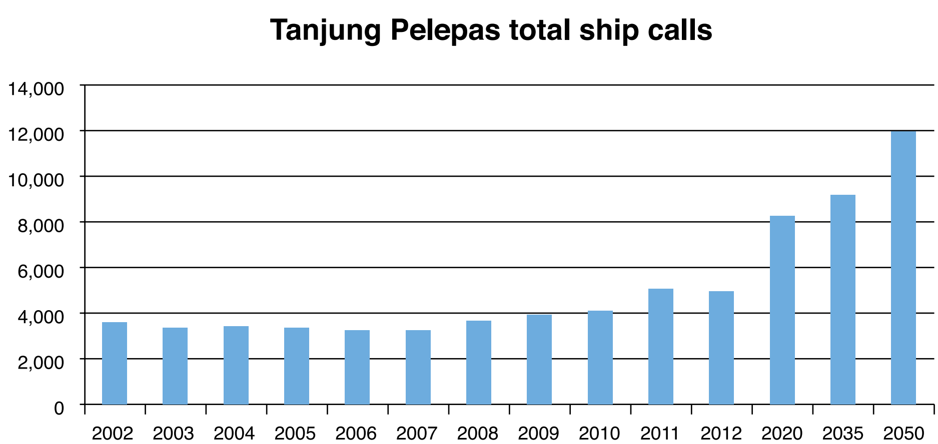


Figure 4.41 Tanjung Pelepas total ship calls projection

Source: MOT

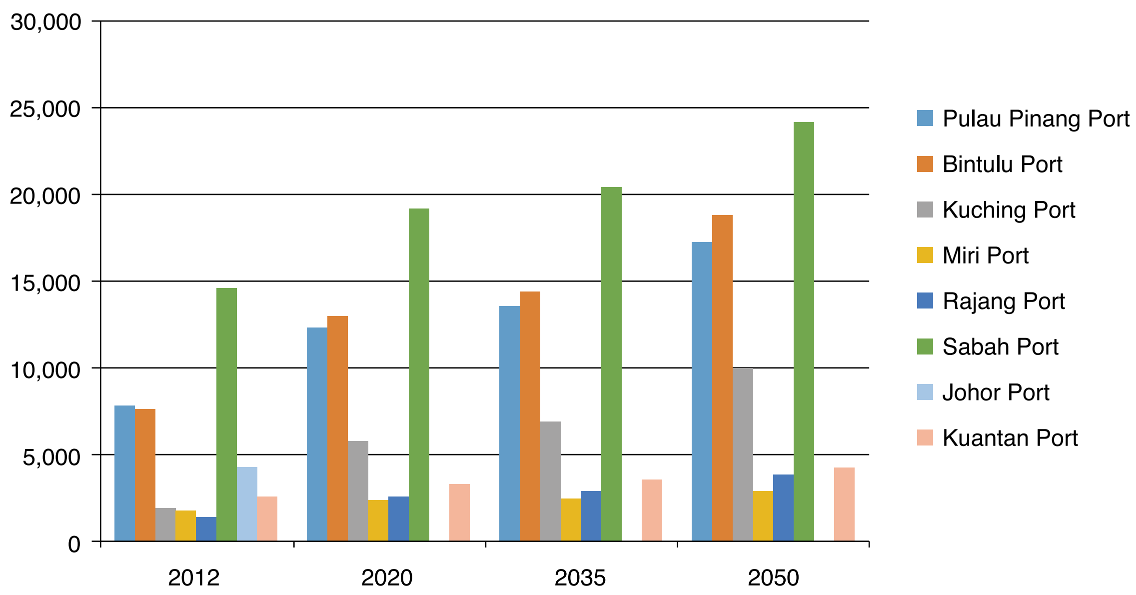
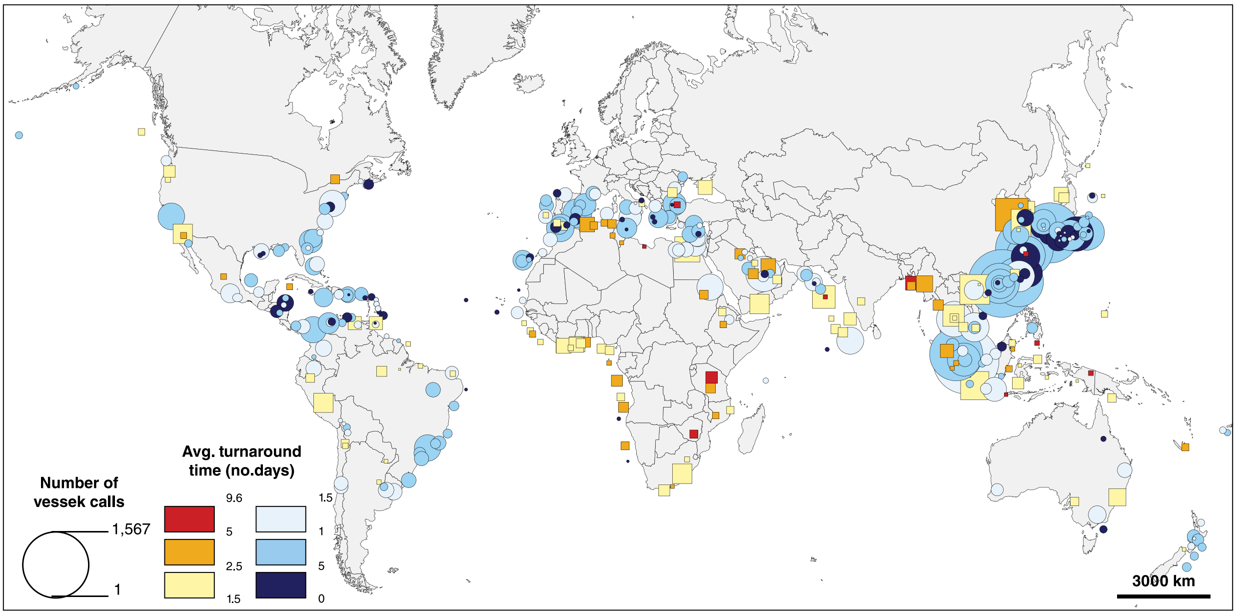


Figure 4.42 Total Ship calls projection by Ports, Malaysia

Source: MOT

4.4.1.5 TURNAROUND TIMES

It can be concluded that in general Malaysia's port will not be able to handle the predicted number of container traffic in 2050. This will have implications on turnaround times. The Average Turnaround Time (ATT) corresponds to the average difference between date of departure and date of arrival among all container vessels calling at a port (or country) within one month of navigation. The unit is the number of days per call and it matches the practical reality of port operations. Figure 4.43 show the average turnaround time in days of ports in the world. It can be seen that the turnaround time in Malaysia is between 1.5 to 2.5 days. Singapore port which handles a much larger number of vessel calls has a turnaround time of between 0.5 and 1 day. Thus, Malaysian ports need to improve on the turnaround time to cope with increasing vessel calls.



Source: Ducruet and Mer (2013)

Figure 4.43 Average turnaround time (in days) of ports in the world, May 2011

Source: Ducruet and Merk 2013

The average turnaround time can be reduced in several ways. One way is to improve ship-to-shore operation by having a vessel queuing system, modernising equipment so that operations will be quicker with double cycling, tandem and multiple lift cranes and personnel that can achieve high crane productivity rates. In addition terminal operations should be improved by resolving bottlenecks such as lack of yard equipment, unfavourable terminal surface, lack of storage capacity and inadequate terminal planning. Conditions of the port area may also affect turnaround time. Thus good intermodal connections with the hinterland within an integrated transport system will greatly improve port efficiency.

4.4.2 SHIP MAINTAINANCE, REPAIR AND TRAINING

An important consideration for sustainability is the capability of each port to support ship maintenance and repair, and the personnel capable of providing quality workmanship. In most of the major ports there are facilities for ship maintenance and repair for sizes up to 100 ton as shown in **Table 4.13**. Except for Kuantan and Penang port there are training institutions providing skilled workers for ship maintenance and repair in term of ship engine overhoul, fabrication to general services. However, in the advent of increasing vessel calls, there will be vessels of larger sizes and sophisticated technology. Thus, there is a need for upgrading the capability of the ship maintenance and repair facilities as well as training for maintenance and repair of more advanced technology vessels. There should be an initiative to collaborate with other world advance ports such as Busan port in Korea or Rotterdam port in Netherlands in terms of MRO training.

Table 4.13 Ship Maintenance Facility and Training

STATE	PORTS	MAINTENANCE SERVICE	TRAINING INSTITUTION
JOHOR	TanjungPelepas Port	Yes	1
	Johor Port		
PAHANG	Kuantan Port	Yes	Nil
PENANG	Penang Port	Yes	Nil
SABAH	Sabah Port	Yes	1
SARAWAK	Bintulu Port	Yes	1
	Kuching Port	Yes	
	Rajang Port	Yes	
SELANGOR	Port Klang	Yes	1

Source: MOT

4.4.3 SAFETY

Similar to air traffic control systems in airports, port authorities employ Vessel Traffic Services (VTS) for monitoring marine traffic. Typical VTS systems use radar, Closed-circuit Television (CCTV),VHF radiotelephony and Automatic Identification System (AIS) to keep track of vessel movements and provide navigational safety in a limited geographical area. The VTS coverage in the Straits of Malacca is shown in **Figure 4.44**.

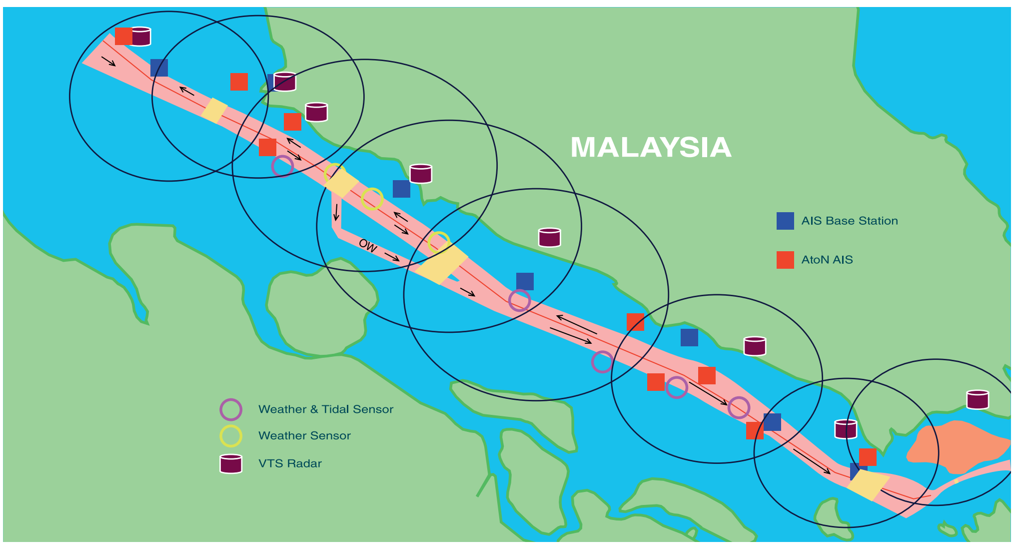


Figure 4.44 Malaysian VTS radar coverage

Source: Marine Department Malaysia

The Straits of Malacca is one of the busiest strait in the world. The Straits stretches from Pulau Sembilan to Tanjung Piai, for a distance of approximately 241 nautical miles. The narrowest waterway is in between Port Dickson (Malaysia) and Tanjung Medang (Indonesia) that is 22 nautical miles. Statistics shows that 62,334 ships of various types were reported by the Klang VTS in 2003. This number is set to increase by 2050 which will mean more risk especially at the “choke points”.

The International Maritime Organisation’s International Convention for the Safety of Life at Sea requires AIS to be fitted aboard international voyaging ships with Gross Tonnage (GT) of 300 or more, and all passenger ships regardless of size.Thus, every vessel can be individually identified along with its specific position and movements, enabling a virtual picture to be created in real time. However, AIS is not used by all vessels. To avoid collision with other ships and dangers (shoal or rocks), visual observation (e.g. unaided, binoculars, and night vision), audio exchanges (e.g. whistle, horns, and VHF radio), and radar or Automatic Radar Plotting Aid are historically used for this purpose. These preventative mechanisms, however, sometimes fail due to time delays, radar limitations, miscalculations, and display malfunctions and can result in a collision.

Since 2005, there have been some developments on AIS transmissions using satellite-based receivers. Several companies and governments have deployed AIS receivers on satellites (S-AIS). However the fundamental challenge is the ability to receive very large numbers of AIS messages simultaneously from a satellite’s large reception footprint. The Time Division Multiple Access (TDMA) radio access scheme defined in the AIS standard creates 4,500 available time-slots in each minute. This can be easily overwhelmed by the large satellite reception footprints and the increasing numbers of AIS transceivers, resulting in message collisions, which the satellite receiver cannot process.

There are opportunities to develop new technologies for terrestrial and satellite-based transceivers which will assist the reliable detection of Class B messages from space without affecting the performance of terrestrial AIS. The satellite-based TDMA limitations will never match the reception performance of the terrestrial-based network, thus it will augment rather than replace the terrestrial system. This combination has opened up a new technology called global AIS. The capability is wide reaching and comprehensive including:

- Environmental protection applications such as vessel carbon footprint calculations
- Arctic vessel monitoring applications
- Vessel Traffic monitoring applications particularly as a monitoring and analysis tools for coastal states
- ATON monitoring applications – monitoring Aid to Navigations or Navaid such as lighthouses, buoys, fog signals and day beacons.
- Search and rescue applications – rapid targeted response to distress notification.
- Anti-Piracy applications particularly convoy management, traffic analysis to identify high risk targets and wide area vessel traffic monitoring.

In **Table 4.14**, it indicates the number of accident cases reported to the Marine Department, Malaysia. By applying the AIS transmissions using satellite-based receivers as mentionedbefore, where every vessel can be individually identified along with its specific position and movements, it may help reduce the number of accidents or collisions.

Table 4.14 Number of Accident Cases Reported to Marine Department Malaysia

Year	2008	2009	2010	2011
Number of accident cases reported to Marine Department of Malaysia	81	113	102	85

Source: Malaysia Marine Department

4.4.3.1 MARINE DEPARTMENT MALAYSIA

The Marine Department of Malaysia is a government department under the Ministry of Transport. Its core functions are to ensure safe navigation of merchant vessels, to provide services to merchant vessels such as ship inspection, certification, registration and licensing, to provide services to ships navigating in Malaysian waters and ports, and to supervise examinations of seafarers. Yet, the enforcement of safety and security falls under the jurisdiction of the Malaysian Maritime Enforcement Agency.

IMO Convention adopted by Malaysia (Marine Department Malaysia 2013) for all ships registered under State flag:

- International Convention for the Safety of Life at Sea (SOLAS) 1974 or as amended
- International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78, annex I, II and V
- International Convention on Tonnage Measurement of Ships, 1969
- International Regulations for Preventing Collision at Sea (COLREGS), 1972
- International Convention on Load Lines, 1966 or as amended
- International Convention on Civil Liability for Oil Pollution Damage (CLC) 1969, Protocol of 1992

4.4.3.2 INLAND WATERWAY TRANSPORTATION SYSTEMS (IWTS)

The Inland Waterway Transportation Systems (IWTS) comprises of certain facilities such as locks, inland port, weir, dock, navigation aids and bridges to facilitate navigation of the vessels. In many parts of Malaysia, especially in the rural area of Sarawak, Sabah and Pahang, IWTS is still significantly used as a transport system. In Sarawak, where the inland IWTS is mostly thrived in Malaysia, the riverine transport system has a great significance to a large section of the population living in the interior and along the coast.

The IWTS is managed by Sarawak Rivers Board (SRB), which was established in 1993, with the corresponding policy The Sarawak Rivers Ordinance, 1993. One of the management aspects of SRB is managing safety aspect of IWTS, e.g. safety of waterways user and freight should be achieved before considering the cost or economic factors. Maintaining a safe inland waterway system should start from design, planning, development, operation and maintenance of waterway track etc.

a. Safety Management System

The performance of maritime and riverine safety management system is determined by data collection. A full risk analysis of all recorded fatalities, casualties, and incidents relating to water transport over the last decade has yet to be implemented for river transport. The analysis will be placed into a database for tracking future trends. For maritime sector, an inconsistent implementation of International Standards has been discovered from the analysis. Adoption of international best practices and standards for navigation, wharf, and terminal safety and security adapted to river and maritime systems will ensure consistency of implementation. This measure can be done by developing capacity building and a culture of marine safety through a training programme for river/sea rescue, navigation, Cardiopulmonary Resuscitation (CPR) and first aid, and promoting safety awareness campaign. The enforcement of safety procedures has to be effective so that prevention of problems prevails such as carrying out investigations of serious incidents and casualties in order to learn lessons for improving safety.

The Search and Rescue (SAR) operation is considered a part of safety management systems. The Global Maritime Distress and Safety System (GMDSS) is employed for ships and boats with these features:

- to coordinate through communications and signals all rescues agencies (land/sea) and able to notify any vessels that are located closed to the SAR scene for assistance without delays;
- Under GMDSS, 300 gross ton and above cargo ships and ferries are equipped with communication systems that meet the international standards;
- False Alarm - IMO had issued a specific design for the activation of GMDSS system to avoid false alarm through accidently activated system by inexperience crews onboard of vessels; and
- Notification and Cancellation of False Alarm – The vessels could use any means to notify the enforcement agencies of the false alarms.

b. River Vessels and Boats

Vessels and equipment vary greatly in age, design, condition, life-saving gear, and capacity. However, improper usage of river vessels and boats can increase the risk from overloading with minimal security measures. Technical innovation is highly sought to improve design of transmission systems, especially for very low-water conditions. Another pertaining issue is that there boatmen who are inexperienced, untrained, unfamiliar with regulations, and at the same time,disregard safety measures, and unaware of local procedures and customs. Identifying priority-training needs for the improvement of job competencies can help improve the safety of river vessels by conducting workshops, training sessions and seminars to enhance understanding and explore best practice in management and operation of an inland waterway system.

c. River Systems

The rivers can be dangerous with hazardous stretches. especially in the upper reaches, and sometimes sandbars and shallows occur in the river estuaries. Many stretches of river lack navigational aids and signage causing tricky and hazardous navigation due to routes, rapids, rocks, and changing currents. In addition, express boats, speedboats, logs and tugs with log-barges also occupy the river traffic. Hence, the risk of accidents such as collisions can occur, and fast large boats can create a wake that can overturn light boats. Education and awareness programme should be implemented to enhance the safety of river users.

Besides, some rivers were found to contain unmarked wrecks and other submerged objects that could be dangerous. Moreover, the inclement weather could also change boating conditions very rapidly. As a result, a flood warning system has been set up. Currently,the telemetry system at the barrage was upgraded from six stations to additional 18 telemetry stations. Each station was fixed with a Remote Radio Communication System (RRCS) that came complete with Flood Warning System features.

Any construction part of the river system has to comply with Marine and Risk Traffic Analysis (MRTA) requirement for infrastructure construction within rivers. This will ensure international performance standards in the development of efficient inland waterway transport are applied. Consultation with local communities before starting a construction project will be able to provide alternative by-pass channels that may be feasible in some instances, and navigation routes can be established and marked.

d. Terminals and Jetties

Currently, safe terminals and jetties are rare or non-existent. Most of the structures are poorly designed, which lead to the movement of passengers and cargo between land and boat is often precarious. Most of the operational procedures of terminals and jetties take little account of safety. There is also the existence of illegal jetties that do not comply with regulations and may be difficult and risky to use.

At the moment, the design of adjustable pontoons with landing steps, safety equipment, lighting, and signage has been developed to enhance safety of passengers and cargo movement. Standard designs for construction and operation to suit varying conditions, with safety equipment and awareness training for frequent users, and proper lighting needed to be considered.

e. Environmental Safety

The lack of facilities at terminals for boats to discharge bilge water, sewage and solid waste has an impact on the environment. Furthermore, other issues such as spillage of fuel and engine oil, abandonment of boat or other wreckage in the river and sea, and loss of cargo on the river/sea which in the case of contains hazardous materials, have to be addressed too. Specifically, within the IMO conventions there are regulations on transporting and handling hazardous goods on boats and ships.

f. Enforcement

The enforcement of safety of marine and riverine transport exists,however, it is problematic due to the lack of communication and cooperation among enforcement agencies. Only certain safety and security regulations based on IMO conventions are adopted. Currently, there is insufficient manpower due to lack of training among ship surveyors, inspectors and enforcement officers. Hence, there is a need to regularly review and update rules and regulations to ensure the safety and security are complied.

g. Robbery and Piracy

Shipping lines protect themselves against piracy in a number of ways: by paying for kidnap-and-ransom insurance, which pays for the costs of negotiating and the ransoms demanded by pirates if their ships are hijacked; by paying a surcharge for operating ships in war-risk zones and also for the measures they have to install on their vessels to ward off pirates, such as safe rooms, high-pressure hoses, loudspeakers and searchlights. They must also pay for the additional fuel it takes to steam through those waters at high speed, or diverting their ships around the most dangerous zones (Maritime Knowledge Centre 2012).

h. Trafficking of Migrant

The International Ship and Port Facility Security Code (ISPS Code) provides ships with procedures to prevent stowaways from boarding ships. Boat/ship inspections are done by maritime law enforcement agency.

i. Maritime Crew

Human error accounts for the majority of maritime casualties. To prevent additional casualties, naval simulation-based training has been used to reduce human errors factor.

j. Ship and Port Security

The operation of ship and port security must be in compliance with ISPS and ISM codes (IMO conventions). Current technologies developed to enhance security are the Coastal Surveillance System, and the HarbourDefence System.

k. Maritime Infrastructure and Operations

Any maritime infrastructure constructions are required to be evaluated by MRTA. The IALA Waterway safety assessment is performed for route analyses from international shipping lanes right to the port limit. Various methods have been developed for designing maritime infrastructure system such as 3D modelling and design testing, Navigation Simulation Studies, Vessel Traffic Management Systems (VTMS), and Ship & Cargo Simulation System.

l. Maritime Environment

Marine Impact Analysis is a mandatory requirement for maritime project developments, and the Environmental Impact Assessment (EIA) is required for environmental risk assessment.

m. Ships/Boats Design

In addition to a lack of regular maintenance of ships/boats, design flaws can also cause some boats/ships to sink. Hence, a mandatory audit can be proposed to ensure all vessels comply with international safety standards. The design of boats/ships is usually done by 3D modelling and design testing, and the environmental safety aspect, such as oil spill is done by using oil spill a modelling technique.

4.4.4 URBAN AIR QUALITY AND ENVIRONMENT

4.4.4.1 NEGATIVE PORT IMPACT

The main impacts on the environment related to port activity are within the field of air emissions, water quality, soil, waste, biodiversity, noise and health impacts.

a. Air emissions

Air emissions can be divided into two groups: Common Air Contaminants (CACs), which have a local or regional impact on air quality, and Greenhouse Gases (GHGs) that have a global impact on climate. Air emissions represent a major port-related negative environmental impact. An estimated 3.3% of global emissions in 2007 are shipping-related carbon dioxide emissions. NOx from shipping have been estimated to about 10% to 15% of the global NOx emissions from fossil fuels (OECD 2010). According to a study, the amount of pollution emitted by vessels during manoeuvring, loading, unloading, while hoteling phases are 4.5% of SO2 and 6.2% of NOx of the total pollution emitted by the ships (Gariazzo *et al.* 2007; in Sanabra 2013).These shipping-related emissions can be up to half of the emissions of the port-city, e.g. in the case for Hong Kong and LA/Long Beach with respect to SO2 emissions (**Table 4.15**)

Table 4.15 Shipping-Related Emissions as Share of Total City Emissions

Port	SO_2	NO_x	PM_{10}
Hong Kong	54%	33%	
Shanghai	7%	10%	
Los Angeles/Long Beach	45%	9%	
Rotterdam		13-25%	10-15%

Source: The Competitiveness of Global Port Cities: Synthesis Report

b. Water quality

A major source of water pollution in ports is oil spills. This comes from port run-off, unloading and loading of oil tankers, removal of bilge water, and leakages. Statistics have shown that 80% of oil spills occur in harbour waters (Miola *et al.* 2009). Bailey *et al.* reported that the other main source of water pollution is the transfer of harmful aquatic organisms (including dormant stages of microscopic toxic aquatic organisms such as dinoflagellates, pathogens such as the bacterium vibrio cholera), due to the discharge of ballast water, used to stabilise vessels (Miola *et al.* 2009).

According to the IMO, about 10 billion tonnes of ballast water is transferred each year, amongst which 3500 million tonnes is discharged (Endresen *et al.* 2004). Another source of water pollution are residual of chemical products contained in the tanks and of the product used in the washing operations, and antifouling paints which are used to coat the bottom of ships to prevent the development of sea life attaching itself to the hull and slowing down the ship and increasing fuel consumption (OECD 2011). Dredging, an essential port activity, also contaminate sediments and the surrounding water.

c. Soil

The main impact of ports on soil is erosion. It causes degradation of natural impact and harms the local biodiversity. It also displaces land that could be used for recreational or productive uses (Miola *et al.* 2009).

d. Waste

Waste in ports comes from oil terminals, fuel deposits and dry-docks operations, which produce oily and toxic sludges. Cruise ships are responsible for 25% of all waste, consisting of glass, tin, plastic, paper, cardboard, steel cans, kitchen grease, kitchen waste and food waste (Miola *et al.* 2009). Plastics released from vessels makes up almost 80% of all garbage found on shorelines and on the sea floor in the Mediterranean Sea (Abdulla & Linden 2008). Thus, there is a need for improving recycling of waste thus reducing landfills.

e. Biodiversity

One of the main sources of disruption of the balance of ecosystems is the introduction of non-indigenous marine species through the transfer of ballast water. These alien species can enter in competition with local species and cause heavy environmental impact. Sulphur and nitrogen compounds emitted from ship, oxidising in the atmosphere, can contribute to acidification, causing acid depositions that can be detrimental to the natural environment, such as lakes, rivers, soils, fauna and flora. NOx deposition is also a vector of eutrophication, which can alter ecosystems. Dredging has an impact on ecosystems because it can destroy the habitat of marine species.

f. Noise

A significant number of urban residents can be affected by port noise. The main damage caused by noise to the exposed population is annoyance and sleep disturbance, because they are more sensible to noise levels than other harmful effects. According to the WHO, sound pressure levels at the outside facades of living spaces should not exceed 45 dB at night, so that people can sleep with bedroom windows open (Berglund *et al.* 1999).

g. Health impacts of ports

Air pollution causes various respiratory and cardiovascular diseases while water pollution can result in skin and neurological health problems (Human Impact Partners 2010). SOx can affect the respiratory system and trigger bronchitis episodes and chest infections when its concentration exceeds 0.06mg/m3. A concentration of over 100mg/m3 of Nitrogen oxides can provoke serious damages to the breathing apparatus. They are lethal when the level exceeds 300-400 mg/m3 (Batistelli *et al.* 2011). Asthma attacks caused by Particulate matter (PM) has caused millions of work lost days (Miola *et al.* 2009).

Added to that, indirect health impacts include deprivation of parks, community centres, and clinics that can contribute to mentally and physically healthier populations (Department of Transportation 2011). To illustrate, nitrogen dioxide and organic carbon emitted from various port activities have also been linked to bronchitis symptoms (Peters 2004; in Sharma 2006). Another source of harmful air pollutants is trucks travelling in and out of the port producing harmful emissions that lessen air quality (UCBHIG 2010). Noise from port operations can cause high blood pressure, heart disease, and other stress-related symptoms. In Shanghai for example, the population is said to suffer more from noise pollution than air pollution caused by ports (Yang in Sharma 2006).

4.4.5 MITIGATING NEGATIVE PORT IMPACTS

Ports generate large local economic benefits. However they will not be sustainable if the negative impacts related to their development are not mitigated. These negative impacts can be considerable.

a. Air emissions

I. Monitoring emissions

Maritime shipping is most carbon-efficient form of transport in terms of grams of carbon dioxide per cargo ton, as compared to other modes such as rail, road or air transport (WSC 2013). However the sheer scale of maritime transport activities generates massive quantities of emissions.

Various ports have introduced systems for monitoring compliance with clean air regulations. To illustrate, the port of Tallinn, in Estonia, has installed two automatic stations for measuring concentrations of controlled compounds in the air. If at any point levels exceed predefined limits, operators, inspectors, the harbour master and port authority are automatically warned so that measures can be taken in order to reduce emissions.

II. Incentive schemes

Voluntary incentive schemes can help stimulate reductions in emissions from shipping, via slow steaming, fuel shifts, cleaner ships, truck retirement and modal shifts. The Vessel Speed Reduction Programme (VSR) at the Port of Long Beach rewards ships that voluntarily lower their speeds within the harbour, through reduced docking fees for vessels that remain within a 12-knot speed limit. It aims to reduce NOx emissions from ocean-going vessel by slowing their speeds as they approach or depart the port.

Environmentally differentiated port dues that are based on the Environmental Ship Index (ESI) provides a rebate to environmentally-friendly vessels. The ESI is an instrument to determine the environmental performance of ships with respect to air pollutants and CO2. It measures a ship's emissions based on the amount of nitrogen oxide (NOx), sulphur oxide (SOx), Particulate Matter (PM) and greenhouse gas released. To illustrate, the port of Amsterdam, gives a rebate on the port due, ranging from EUR 200 to EUR 1400 in 2012, depending on the size of the vessel.

Truck retirement programmes can help mitigate air pollution by replacing old trucks operating in ports. Emission inventories conducted in US ports have consistently identified drayage trucks as significant contributors to port-related pollution, accounting for 25-43% of NOx emissions (Norsworthy & Craft 2013).

b. Investment in Clean Technology

Ports can offer green services by supplying low-sulphur fuel. The port of Falmouth managed to develop a strong market supplying fuel for Low Sulphur Oil bunkers. Several European ports have begun promoting the use of Liquefied Natural Gas (LNG) as a ship fuel.

Another approach to induce cleaner shipping practices is that of 'cold ironing', also known as Shore Connection, On Shore Power Supply, and Alternative Maritime Power Supply. There is increasing number of ports in Europe and North America that provide shore power to ships that come into their quays. Thus, instead of using their diesel-fuelled auxiliary engines, these ships use power generated by the local grid, which significantly diminishes diesel- and other fuel-derived emissions while in port.

Apart from that, ports should also invest in cleaner, low-emission technology to drive their own operations. The port of Houston, for example, implemented several energy efficiency measures, including improved lighting control systems and the installation of new window systems to reduce the dependence on artificial lighting.

Furthermore, ports should only use cargo-handling equipment with the lowest emissions engines on the market. To illustrate, the port of Busan, Korea, had switched from fuel-driven Rubber Tired Gantry Cranes (RTGCs) to electricity-driven RTGCs (e-RTGC) in its cargo-handling operations. It is estimated that even when taking into account emissions produced through electricity generation, emissions of CO2 reduced by 28,000 tonnes (OECD 2010). This kind of approach may be suitable for large ports. In contrast, for smaller ports improvement can be gained by fitting old equipment with emission control devices and innovating measures such as reducing idling procedures.

Another clean technology strategy is to use renewable energy. The port of Houston, for example, signed a deal with Direct Energy in 2006 that saw 5% of its electricity generated through wind power. Ports can also generate their own electricity to light on-port facilities. PSA Singapore Terminals, for instance, have been using Solatube lighting systems in their facilities since 2008.

c. Water Quality

There are two ways for limiting the impact of harmful discharge of vessels: by regulating where discharge may and may not take place, and by limiting how much may be discharged. At the international level, the International Convention on the Control of Harmful Anti-Fouling Systems on Ships – which was adopted in 2001 and entered into force in 2008 – prohibits the use of several harmful compounds used in anti-fouling systems, and created a mechanism for ensuring that future anti-fouling systems would not include harmful substances.

d. Waste Water Reception Facilities

In the European Union, a specific directive focusing on port waste reception facilities was adopted in 2000 (2000/59/EC). It requires the formulation and implementation of a waste reception and handling plan (in consultation with stakeholders), and mandatory waste delivery for any ship that does not have sufficient waste storage capacity for its voyage to the next port of call. Ship owners are also required to pay for waste disposal as part of the port dues, regardless of actual disposal. The development of adequate reception facilities can thus constitute a key component in increasing the attractiveness of a port to shippers and in improving the environmental conditions of the surrounding environment.

e. Sewage, Sludge and Oil Spills

Ports must also develop strategies to cope with a range of potential water quality impacts resulting from their own activities and physical layout. Bunkering often poses a range of pollutant risks, particularly oil spills. The port of Gothenburg introduced a stringent set of rules in 1999 that encompasses a wide range of activities, requiring the installation of electronic overflow alarms, the carriage of at least 50m of oil booms with absorptive material, and the vetting of all bunker barges by the Port Authority.

The stormwater run-off can carry many pollutants, including petroleum products from vehicles, litter, construction materials, sand and other sediments, heavy metals, livestock effluent, fertilisers and pesticides, as well as various other aspects of the urban system. Hence, the port must formulate measures for effectively dealing with stormwater run-offs. The port of San Diego's SUSMP, for example, integrates several design concepts into any new commercial and industrial development projects larger than one acre in dock and maintenance areas of the port. The requirements under the SUSMP comprise the use of pervious surfaces (permeable pavements and surface structures), as well as the planning of land slopes and gradients to ensure drainage or retention into designated zones. For instance, in the port of Nantes-Saint-Nazaire, an extensive water treatment plant has been built to deal with run-off from the dry bulk docks. The water is first sieved before being treated chemically, in a process that significantly reduces pollutants in the run-off water.

f. Biodiversity and Biosecurity

The main threat to biodiversity constitutes ballast water. This can be mitigated in three ways:

- Under Regulation D-1 of BWM 2004, vessels must perform ballast water 'exchange' which involves the replacement of water taken in at the ocean water which generally contain fewer organisms, but those that it does contain are less likely to survive in the coastal environment of the regulating State.
- Secondly, ballast water must be treated so as to remove or nullify invasive species. It can be a mix of three main kinds of treatment technology (IHS 2013): mechanical (including filtration and cyclonic separation); chemical treatment and biocides (chlorination, residual control, advanced oxidation, etc.); as well as physical disinfection (ultraviolet, heat, cavitation, electrolysis, ozonation, etc.).
- Thirdly, are the measures associated with the production of information on ballast water and planning of BWM. Canada, for example, published its non-binding "Canadian Ballast Water Management Guidelines", as early as 2000, and transformed them into binding regulations in 2004.

g. Solid Waste

Solid waste management in ports involves the collection, transport, processing or disposal, planning and monitoring of unneeded material bi-products generated through port activity. Solid waste can have many sources in a port, from on-port facilities to vessels and the treatment of cargo itself (e.g. oil refinery). Typically, the management of waste is carried out through three main strategies, applied to different phases of the life cycle.

- Firstly, there are upstream measures that try to cut down on the overall amount of waste generated in the first place.
- Secondly, there are downstream measures that seek to recycle and reuse waste that has been produced. And,
- thirdly, there are end-of-stream measures that seek to improve upon the final disposal and treatment of waste that can neither be recycled nor reused.

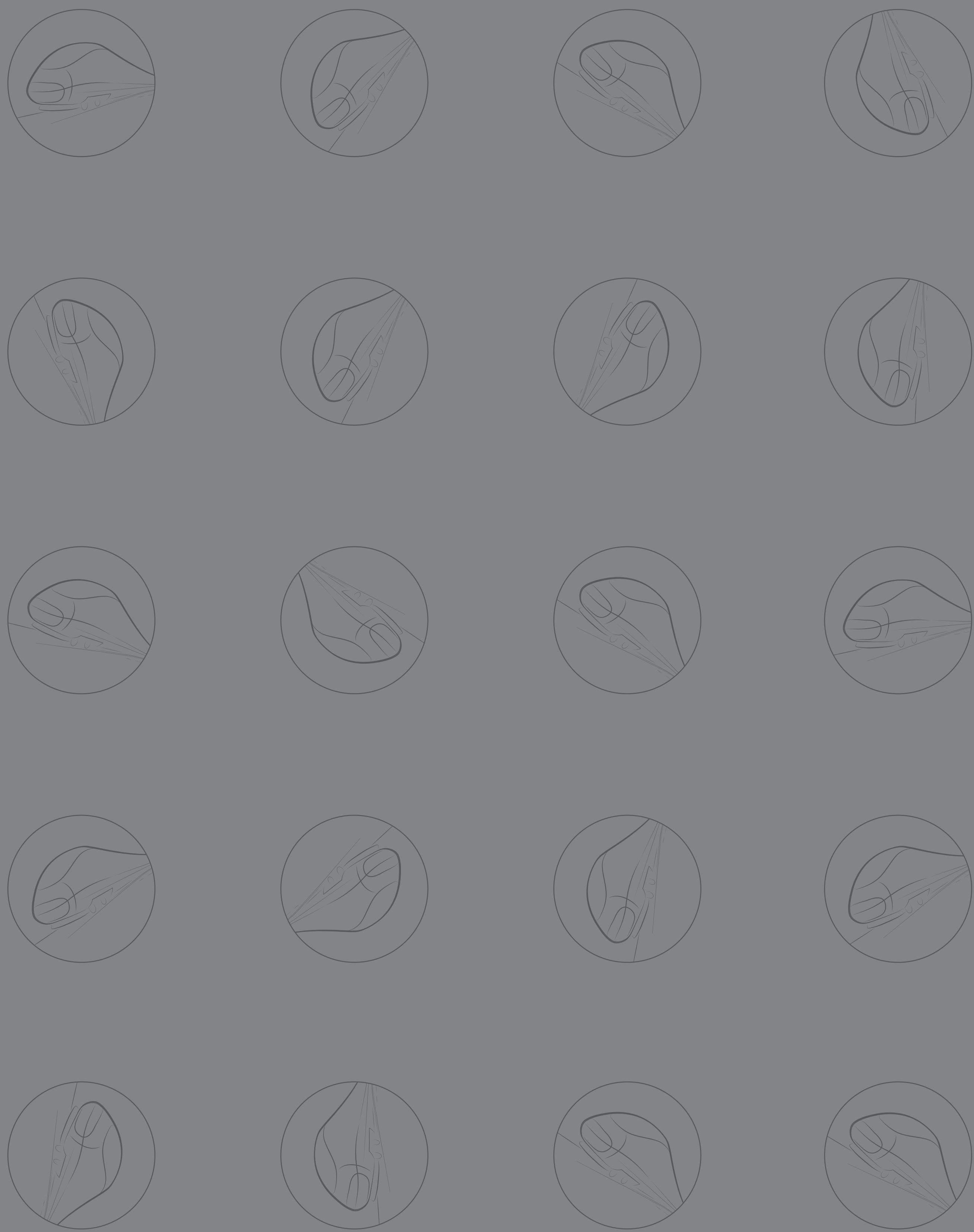
h. Port Noise Impacts

Ports in Malaysia should also invest in noise measurement. Namely, the Port of Valencia has three noise meters distributed around the port that can take measurements every second and 24 hours per day (Rizutto *et al.* 2010). These noise maps can determine priorities in terms of policy interventions. There are three ways to reduce noise impacts of ports: reducing at source, port design and barriers, and adaptations in residential areas.

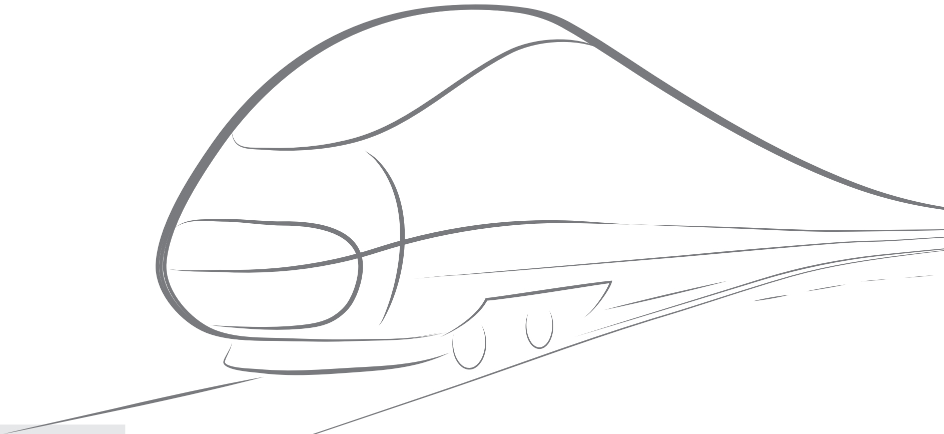
Added to that, noise from ships can be reduced by silencers on the diesel generator exhaust. Whereas, if there are space limitations in the casing, a solution would be to use the main engine exhaust silencer during port stay for the diesel generator exhaust by rerouting the exhaust. Noise from the ventilation systems can be reduced by adding mineral wool to fan rooms, or more expensive solutions such as cylindrical silences, baffle silencers and noise reducing louvers. Onshore power supply would eliminate the need for power generation on-board and thus eliminates the noise from the diesel generator and reduces the need for engine room ventilation.

Electrifying moving equipment in ports that are using diesel could reduce noise impacts and air emissions. Electrification of rubber-tired gantry cranes in Busan Port has reduced noise levels from 85 dB to 65 dB (OECD, 2011). In addition, the use of cooling water instead of air cooling could also reduce the noise impact of port equipment.

A well design port can reduce sound impacts to the urban area. This could include relocating the noisiest activities, such as entrance gates, and more drastically, berths or whole terminals. Port planning schedules could also take noise impacts into account. The noise impacts from ships is sometimes asymmetric, in which case it would make sense to berth the ship with the less noisy side facing the noise sensitive areas in the port. Acoustic barriers such as container racks, non-residential buildings or tress can be located near the source or the receiver.



CHAPTER 5
THE FUTURE AND MEGA TRENDS



5.1 MEGA TRENDS AND INNOVATIVENESS

5.1.1 FUTURE MEGA TRENDS

This chapter lists emerging mega trends currently surfacing in the global world in general, and in the Transportation sector in specific. These trends will be eminent in the near future, as this report is scheduled to cover from the year 2020 to 2050. Mega trends are transformative, global forces that define the future world with their far reaching impact on business, societies, economies, cultures and personal lives (Frost & Sullivan 2011).

Meanwhile, innovativeness are new and original ideas introduced to tackle existing or budding problems. Furthermore, as the world's population rapidly moves into urban areas, cities around the world will need to evolve in order to meet a new set of demands. Moreover, the current scenario revealed that most cities consume 75% of the world's energy and are responsible for 80% of the global GHG emissions. In the future, the cities will have to deal with resource constraints - from oil and water scarcity, to food insecurity – and population growth pressures. In order to address sustainability issues for over the next 20-30 years, global mega trends have to be identified. Global mega trends are provided in (European Environment Agency 2011; Kearney 2012; Frost & Sullivan 2011). From the examples presented, common mega trends that have been identified are is follows:

1. Governance: redefining and shifting of major global power

2. Rapid urbanisation leading to Mega Cities, Mega Regions, Mega Corridors, Mega Slums, and Smart Cities

3. Social: ageing population, personal robots, population trends, consumption patterns

4. Natural resources, e.g. scarcity of water, food, and energy.

5. Sustainable technology and innovation

6. Transportation corridors

7. Healthcare and new pandemics

8. Environment, climate change, and pollution

5.1.2 MEGA TRENDSIN THE TRANSPORTATION SECTOR

From the viewpoint of the Transportation sector, there are several specific Mega Trends that need to be focussed upon, which are as follows:

a. Internet of Things (IoT) / Internet of Vehicles (IoV)

Devices in a networked environment have enable connectivity between them. Real time information and services can be obtained in an instant. Such technology can be applied to connectivity of vehicle-to-vehicle, vehicle-to-infrastructure or vehicle-to-human. One example is autonomous vehicles. Self-driving cars will be one of the trends in the future. LiDAR (Light and Radar) technology is a safety feature for cars to reduce accident rates and collisions. In addition, LiDAR will also facilitate vehicle-to-vehicle communication for improved road safety. Current initiatives of self-driving car by BMW, Nissan and Mercedes only use traditional radar and video technology.

Google has also launched its autonomous car and since 2012, the cars has logged more than 700,000 miles in both highways and city streets. The software can detect hundreds of distinct objects simultaneously - pedestrians, buses, a stop sign held up by a crossing guard, or a cyclist making gestures that indicate a possible turn. Another example of autonomous vehicle aside from cars is UAV (Unmanned Aerial Vehicles).

b. Commercial Satellite Technology

According to Frost & Sullivan (Frost & Sullivan 2011), the space industry will be one of the trends of the future. Over 900 satellites will be launched by 2020. In the past, satellite communications are mostly dedicated to military applications. In the future, commercial satellite applications will dominate the market. Satellite-based technology will have an impact on transportation system such as ITS, GPS, automobile navigation, air-traffic control, automated aircraft-landing, etc. Hence, with an enhanced navigation system, accidents, fuel consumption and travel time can be reduced.

c. Intermodal Transportation System

All transportation modes – land, aerospace, and maritime – will offer seamless integration either at the national or international level. The integration, of all the modes will be facilitated by information technology. Online information and electronic booking and payment systems integrating all means of transport should be embedded in multimodal travel. In other words, integrated ticketing system requires only one ticket for all modes of transportation for traveling from one location to another. Therefore, pedestrians or goods can be move from one location to another at anytime and anywhere in an efficient and safe manner, e.g. door-to-door mobility. The intermodal transportation system is also part of the framework in Europe and US by 2050 (Federal Transportation Advisory Group 2001; European Union 2011).

d. Shift from Road to Rail and Water Freight

To reduce carbon emission by road, freight multimodality should be considered into the framework. In Europe, road freight will be shifted to other modes by 2030, and more than 50% by 2050 with the introduction of green freight corridors (European Union 2011). To meet this goal will also require appropriate infrastructure to be developed.

e. Efficient Additive Manufacturing

Additive manufacturing, which is the industrial version of 3D printing, can be used to mass produce jet engines. This technique is already in the planning by General Electric aviation division. The manufacturing industry will have the most significant commercial impact by 2050. This technology can also be applied not only for aerospace industry, but also to land and maritime industries.

f. Vehicle Design Technology

This technology will produce clean, safe and silent vehicles for all different modes of transport, from road vehicles to ships, barges, rolling stock in rail and aircraft (including new materials, new propulsion systems and the IT and management tools to manage and integrate complex transport systems). For instance, self-healing materials, in which the biomimicry of non-living structural materials will have the capacity to heal itself when torn, cracked, damaged or cut. Added to that, this invention can be applied to vehicle design as a safety measure, especially when involving accidents. The vehicle can also restructure itself to its original condition after being involved in accidents. Nanomaterials and nanotechnology will help contribute longer lifetime of vehicles and carbon emission (Federal Transportation Advisory Group 2001; European Union 2011).

g. Green Transportation

Carbon dioxide from vehicles are one of the major contributors of greenhouse gas emissions today. This condition worsens by time as the number of vehicles on the road keep increasing daily. To curb this, we need to opt for green transportation – by producing and using clean, highly efficient vehicles powered by sustainable low carbon fuels and electricity, and by better designing communities to include accessible and convenient alternatives to driving. Among the means of achieving this is through the use of EEV, as stated in Malaysia's National Automotive Policy (NAP), electric vehicle, and through hybrid vehicles.

As our nation is concerned, several important national trends which can affect the transportation sector can be identified as:

h. Increase Mobility due to Increase in GDP and Population

It is a common trend for a country to have its mobility grows with the increasing GDP and population. For Malaysia, the similar trend can be observed from historical data. In terms of Real Gross Domestic Product (GDP), an average annual growth of 6.3% is observed across the 40 years span from 1971 to 2010, where the per capital GDP increase from RM6,000 to RM30,000 (SPAD, 2010). According to the National Physical Plan 2, Malaysia's population has been experiencing an annual growth of 2.2% from 2000 to 2008, bring the population from 23.3 million to 27.7 million over the period. By 2020, the population in Peninsular Malaysia alone is projected to be approximately 28 million. Both the growth of GDP and population has contributed to the increase in vehicle travel demand. The vehicle travel demand in Malaysia was only 13 million trips per day in 1991. This figure has grown approximately 300% to 40million trips per day in 2010, and is forecasted to reach 133 million in 2030, if the same growth persists (SPAD 2010).

i. Urbanisation

As the country continues to develop, it is expected that there will be a net shift of population from rural areas to cities, where opportunities are abundant. According to the NPP2, urbanisation is forecasted to hit approximately 75% by 2020, with the central region of the Peninsular Malaysia, particularly the Klang Valley–being the most densely populated area in Malaysia.

j. Sustainable Living

Due to the hike in fossil fuel price as well as pollution problems, there is an increase in global awareness regarding the sustainability of our modern civilization. Countries all over the world are looking at sustainable development where growth can be achieved without severely impacting the environment. In terms of transportation, emphasis is given to the use of more efficient vehicles to cut down on carbon emission. As a matter of fact, the National Automotive Policy unveiled in 2014 has highlighted the nation's focus on energy efficient vehicle, in line with the idea of creating more sustainable transport system.

Based on these nation trends, it is expected that the transportation sector in Malaysia will develop in the following manner:

k. Increased Emphasis on Public Transport as the Means of Transportation

As the travel demand continues to grow with the increasing population, it is expected that the transportation system in Malaysia needs to shift from private-vehicle-based to more public-transport-oriented. This is especially so for urban areas, where about 75% of Malaysia population is expected to be by the year 2020. According to SPAD in the National Land Transport Master Plan, a target has been set to increase the modal share of land public transport to 40% in urban areas. For rural areas, the target is to enhance the accessibility and increase connectivity between geographies. All this will contribution to achieving the vision of having public transport as the choice of traveling method among Malaysia by 2030. The high population density also calls for more efficient public transport, with high passenger carrying capacity. As suggested in NPP-2 and Land Transport Master Plan, rail-based transport is expected to play the important role as the main mode of transportation in Malaysia.

l. Use of More Energy Efficient Transport

In line with the global will to reduce carbon emission and to promote more sustainable living pattern, there will be emphasis on the use of energy efficient transport. Rail-based has long been considered as a more efficient means of transportation, both for moving people or good, compared to road-based transport.

m. Increase in Traveling Quality Demand

As Malaysia strive to become a developed high-income nation with per-capital income of approximately RM50 000 ($15 000), it is expected that there will be a general increase in the demand of better traveling quality. The people will be more willing to pay for faster and more comfortable transportation. For public transportation, the demand for better service quality will increase. In turn, such a trend will provide suitable environment for the development of more advance transportation, namely through the high-speed rail. As as a consequence, public transport operators will also be driven to improve their service level and provide better travel experience.

In addition, in managing mobility, urbanisation, sustainable living, environmental effect, efficient transport as well as over population, many countries are planning and constructing rail-based transportation systems. The development of High Speed Railway (HSR) is growing very fast (e.g. United Kingdom, China) in many countries. To illustrate, UK has a plan to invest more than £16 billion for HSR out of £70 billion in transport sector by 2021. UK is moving towards integrated major cities by constructing HS2 where the construction going to start in 2017, completed by 2025, launched between London and Birmingham from 2026 (Qi 2011).

Currently, the China's HSR network is the world's best because of the technological development, station positioning as well as urban planning (Takagi 2011). Chinese's HSR network speed services up to 350km/h which are the world's fastest. The passengers flow in the urban public transportation system is increasing rapidly because of the rapid development of high speed rail between cities (Peng *et al.* 2012). The HSR around the world are into the two camps: the German and French locomotive (concentrated traction) system, and the Japanese *shinkansen* (distributed traction) system. China has chosen the distributed-traction system. China modified the designs according to Chinese needs (e.g. body width, interior fittings). Ultimately, all the models presented, are about 20% of the parts are made in the original countries and rest 80% are made in China under licence. These trains are in service on high-speed

(350km/h). A locally revised new train has capability of 380km/h which has been launched on the Shanghai–Hangzhou line on 26 October 2010. China is conducting R&D for train where the train speed will be 400km/h or more in the near future.

5.1.3 INNOVATIVENESS FOR MALAYSIA'S TRANSPORTATION SECTOR

After the research conducted, listed below are the innovativeness that can be employed by Malaysia to further develop the nation's Transportation sector:

a. Up to now, there is no centralised agency that is in charge of the Transportation and land use planning in Malaysia. Currently, there are several agencies responsible for this sector, including Suruhanjaya Pengangkutan Awam Darat (SPAD), Ministry of Transportation (MOT), and Road Transport Department (RTD), to name a few. Following other more developed nations' examples, countries such as South Korea, Germany, and Singapore have a centralised agency in control of their country's Transportation matter. Thus, Malaysia needs to streamline all these agencies to only a single agency in charge of the country's Transportation matter. There will also be no more clash of jurisdiction between different agencies if this step is to be implemented because there will be only one agency whose power is to plan and implement matters pertaining to Transportation.

b. We also need to have a single unifying National Master Plan for Sustainable Transport. This master Industrial Activities plan serves as a framework for the nation's current and future Transportation plans. By doing so, the Government and other relevant parties will be clear on the future path and direction of the nation's Transportation agenda.

c. Malaysia is well-known as a nation with excellent policies, but lacking in terms of implementation and execution of those policies. It is hoped that the single body that is in charge of the nation's Transportation sector will be able to be stricter in this matter and implement the policies pertaining Transportation in a better manner than currently done.

d. We also have several different levels of authority in terms of land use and transportation planning. The existing federal, State, and district levels made the planning and implementation of Transportation matters a nightmare. It also increases red tapes and prolong the implementation time of projects.

5.2 THE FUTURE AND MEGA TRENDS: LAND TRANSPORTATION

5.2.1 CHALLENGES TOWARDS ACHIEVING SUSTAINABLE TRANSPORT

There are several key challenges or barriers towards achieving sustainable green transport goals in Malaysia through policy measures highlighted under the "Improve, Shift and Avoid" strategy. The barriers are categorised into political, institutional, financial, societal, methodological and capacity as shown in **Figure 5.1**.

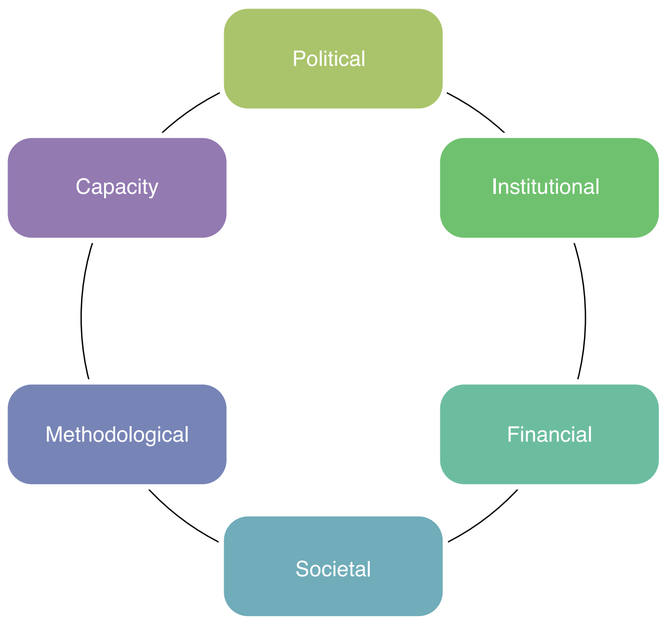


Figure 5.1 Barriers towards green transport in Malaysia

5.2.1.1 POLITICAL

Strong and consistent political will are a requisite foundation for a paradigm shift towards green transport. Governments play a critical role as policy makers to put forth the required building blocks to push cities and countries forward towards sustainable growth in the transportation sector. Political barriers includes low or wavering levels of Government commitment to measures to reduce growth of private vehicles and their use, to scaling up and replicating sustainable policies and projects. Policy measures that are seen as to increase monetary burden on the general population such as congestion charging, parking charging and removal of fuel subsidies will face stiff opposition. There can also be vested commercial and political interests in developing unsustainable transport solutions especially from vehicle manufacturers, providers of transport services and land developers.

There should be an overarching vision of sustainable transport and robust long-term political support for the realisation of this vision which can drive policy development, the creation or strengthening of institutional structures and appropriate financing structures. Strong leadership and political acceptance are critical at the national, local and municipal levels to ensure sustainability of these efforts. Cities which have seen a successful transition towards sustainable urban transport practices have in great part benefitted from strong leadership, for example (UNESCAP 2012):

(i) Urban development based around BRT system in Curitiba, Brazil enabled by the vision of its then Mayor Jamie Lerner.

(ii) The demolition of urban highways in Seoul, South Korea led by then Mayor Lee MyungBak who then became the country's President, in part because of his successful policies.

(iii) The implementation of the congestion charge in London, UK, enabled through the leadership of then Mayor Ken Livingstone.

Generally, the political challenges facing policy measures such as congestion charging, development of public transport and non-motorised transport infrastructure are common in other cities across the world. There is a need for countries and cities to share good practice and learn from each other as they implement these policy measures. Malaysia and its cities can benefit through organisations, alliances and forums as a platform at the highest level for information sharing, technology transfer and inter-city cooperation. Much can be taken from Indonesia's experience in phasing out fuel subsidies or Singapore's experience in forming a single transport agency to manage their land transport system.

There are also international awards such as the Sustainable Transport Award which recognises leadership and visionary achievements in sustainable transportation and urban liveability. This can be replicated at local and national level to award leadership at municipalities or states that have significant contribution towards green transport in Malaysia. This can also facilitate budgetary support to exemplary governance.

In addition, Universities can also mainstream the issues of sustainable transport and urban development within their curriculum to foster the next generation of leaders. This can be supported by organisations through scholarships to promote such courses.

5.2.1.2 INSTITUTIONAL

One of the main barriers towards proper and efficient implementation of policy measures is institutional barriers such as the mandates of and division of responsibilities between different agencies which can be subject to poor coordination, cooperation and integration. It can also encompass the lack of legal power and ability to influence the activities of the private sector such as developers, the informal sector, and inefficient or insufficient legal frameworks. This barrier is experienced not only within the transport sector itself, but also in its relationship with other public sectors such as land use, finance and environment sectors. Demand for transport is intrinsically linked with decisions made in other sectors especially land use and a lack of integrated and strategic planning and communication with these sectors can compromise the development of a comprehensive transport strategy.

This is especially true in Malaysia where the transport sector is governed and enforced by multiple agencies operating under several different ministries. Further complicating matters is the division of responsibilities between the federal Government and State governments and the associated division of work to the State departments. Most transport policies in Malaysia are developed in the top-down manner: the central agency formulates the policy, while the local levels are given the responsibility or directed to implement it. The rise in urban sprawl at the outskirts of cities demonstrates the lack of integration effort between land use and transport planning. There are also cases where there are conflicting measures undertaken by these various agencies.

A recent study has highlighted the institutional challenges of implementing urban transport policy in the Klang Valley (Ariffin 2012):

(i) **Multiplicity of agency** – Too many Government organisations involved in transportation planning and implementation creates a problem, whereby no authority has ultimate control, which ultimately causes delays and inefficient process. This is very likely caused by power struggles between the different levels of Government.

(ii) **The absence of a lead agency** – Although traffic flows in the Klang Valley cross several local governments jurisdictional boundaries, there is no proper Government institution that effectively coordinates the overall regional development of the Klang Valley. There should be one single authority on transport policy to plan and implement as well.

(iii) **Coordination and communication** – There is an absence of a cordial relationship between different levels of Government, particularly between the Federal and the State Government regarding boundary issues and many within transport policy communities viewed the commitment to coordinate and cooperate as getting into other organisation's territory.

(iv) **The need for a clear line of responsibility** – There is no clear line of responsibility and a lack of role clarity in urban transport policy implementations that affects effective communication and cooperation between agencies. This hampers decision-making and organizational relationships between agencies become considerably harder to develop.

(v) **Divorce of policy and implementation** – The multi-jurisdictional nature of urban transport system in the Klang Valley has caused the divorce of policy formulation from implementation. When policy formulation is divorced from its implementation, the objectives that have been set earlier will more often fail to be carried down to the implementing agencies.

(vi) **Lack of resources** – Centralisation of administrative and financial power has limited the autonomy of the local governments to effectively implement urban transport projects, which very much depends on financial capacity. Although the local authority is said to be an agent for implementation, the lack of financial and human resources made available to achieve this has hampered their vital participation in ensuring effective implementation.

(vii) **Awareness of sustainable transport** – The real meaning of sustainable transport is far from being understood by most people in the policy communities, such as officials from the federal level agencies as well as politicians. Academicians were not directly involved with either policy formulation or implementation, so were unable to make any real impact on the policy. The Government also focuses on commitments to economic growth and other priorities deemed to be more important.

Although SPAD is given the power to plan, regulate and enforce all matters relating to LPT, its effort is still confined to other related agencies' cooperation at the local and national level. Moreover, SPAD's jurisdiction spans over the whole of peninsular Malaysia, which limits its possibility to effectively formulate, implement and monitor LPT policy and programs at local level.

The effort towards a sustainable transport system will benefit greatly with the formation of an integrated transport agency with the mandate to formulate, implement and enforce the policy measures under the "Avoid, Shift and Improve" strategy at the local and national level. A local level urban transport agency at each major city should have the purview to manage local level policy measures such as parking management, congestion charging and integration of public transport services and non-motorised transport. This can ensure that unique features to certain cities will be taken into consideration during development of the integrated transportation system.

At the national level, apart from enhancing inter-ministerial cooperation, there should be serious consideration towards merging the various ministries that have intrinsically transport related portfolios into a singular integrated ministry. For instance, the Republic of South Korea formed the Ministry of Land, Infrastructure and Transport to better streamline the country's policy measures with the recognition that land, infrastructure and transport are an inseparable entity and efforts to achieve sustainable development should be looked at from these three aspects as a single subject. The ministry should be responsible on nationwide policy and fiscal measures such as fuel and vehicle taxes and the removal of subsidies promoting private vehicle use. The ministry will also be tasked to work with relevant industries and markets to set and improve emission, fuel efficiency, safety, fuel quality standards. Their leadership is also expected in facilitating knowledge and technological transfer through a "top-down" approach.

5.2.1.3 FINANCIAL

Financial constraints pose a huge barrier in implementing measures to develop and improve the public transport and NMT infrastructure and operation. Funds are often skewed towards financing unsustainable forms of transport projects and subsidies. This includes expansion and construction of urban highway in a bid to ease chronic traffic congestion together with transport and fuel subsidies.

There are two forms of financing requirements for sustainable transport (GEF-STAP 2010):

(i) **Capital investments** are funds invested in developing and constructing infrastructure provisions for railways, bus rapid transit, cycle paths, stations and roads. It also applies to investments in developing or transfer of new technologies such as energy efficient vehicles and ITS. Capital investments for infrastructure and technology need to be matched by large resources.

(ii) **Recurrent expenditures** requires continuous stream of financial resources to cover the operation of public transport, maintenance of vehicles and infrastructure, administrative costs for institutions, support for policy and programs such as air quality management programs, and traffic management which includes signalling and priority crossings. These expenditures should generally be met by users of the transport system via road tolls and public transport fares. Aspects that are involved in transport financing is portrayed in **Figure 5.2**.

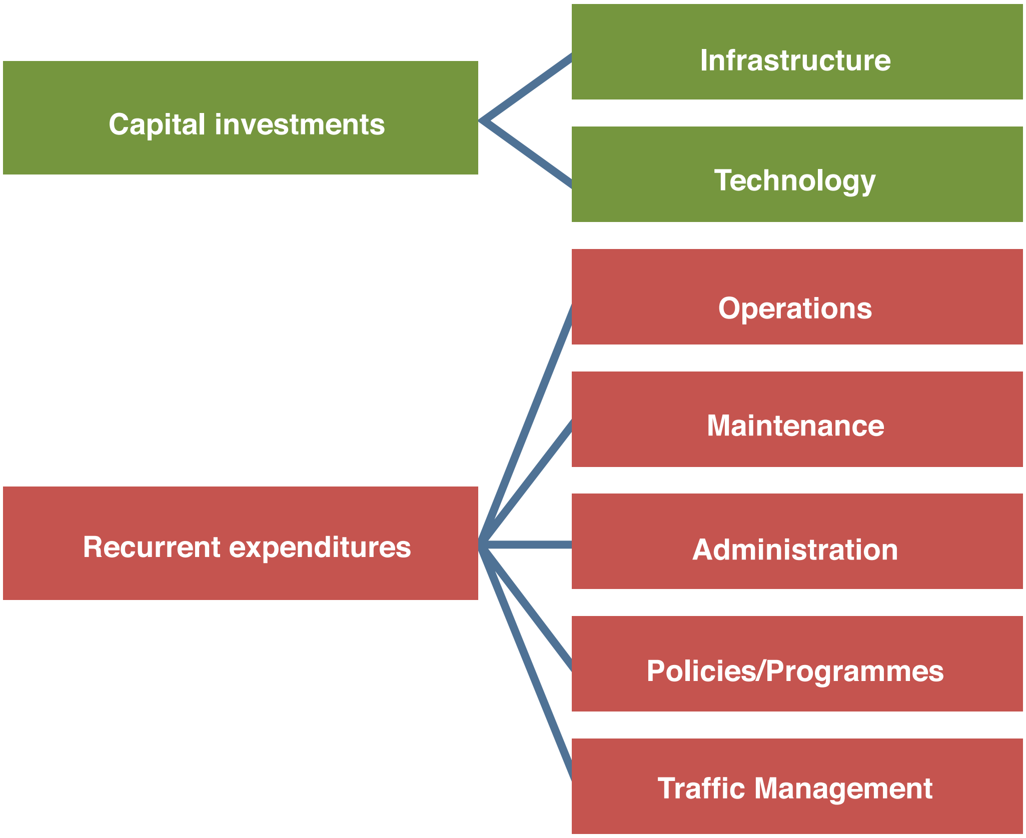


Figure 5.2 Aspects of transport financing

Source: UNESCAP 2012

Three forms of financial instruments are available at local, national and international level (UNESCAP 2012):

- **Local sources** includes revenues from parking charges, road pricing and congestion charges. Where demand is high, fare box revenue can be sufficient to cover operating costs of public transport. In addition, for transit line projects, funds can also be recouped from land development when the land value increases as a result of public transport investment along the corridor.

- **National sources** include revenues through taxes levied at national level such as fuel tax and vehicle tax. Removal of unsustainable subsidies forms another financial source as the financial burden of these subsidies can now be channelled to support sustainable transport infrastructure development.

- **International sources** from donors and climate related funds are also available to support sustainable development projects such as from the Asian Development bank (ADB), and mechanisms under the Global Environmental Facility (GEF) and Clean Development Mechanism (CDM). These bodies have already supported projects in many developing countries.

To manage these multiple financial sources appropriately and effectively, a transport fund should be considered, which would effectively collect the financial sources into a centralised budget and the resources can be redistributed to the local level, subject to certain criteria.

5.2.1.4 SOCIETAL

Poor public acceptance of an instrument can be a major barrier in efforts to improve the transport system, in particular policy measures that are seen as to increase monetary burden on the general population such as congestion charging, parking charging and removal of fuel subsidies. No measure can be successful without the full participation of the general public. This can be attributed to a lack of awareness of the need for change as a result of poor understanding of local and global costs of unsustainable transport, perceptions of public transport being for lower classes and of the private car as a status symbol. There can also be public backlash if strategies are implemented to push people away from private transport without having proper provisions in place for transport alternatives.

Any policy measures that are to be developed should include comprehensive stakeholder consultation. Public awareness and education campaigns have been proven to increase the effectiveness of transport policies implemented in developed countries. Stakeholder engagement should therefore be planned and conducted at the same time as the transport strategy and implementation plan are being developed to ensure widespread support, commitment and participation.

Another important aspect of public inclusion is the recognition of co-benefits. Transport strategies and policies can lead to the reduction of GHG emission but climate change mitigation is rarely the driver of the development of these schemes. Instead it is often the local social, economic or environmental impacts that can help to realise the vision of sustainable low-carbon transport and to secure the required political support. The society also tends to be more receptive towards local issues such as environmental and health cost, air and noise pollutions, congestion and delays, and road accidents rather than global warming. These costs are the ones that should be highlighted and be at the forefront during stakeholder discussions together with the potential benefits of sustainable, low carbon transport such as improved local air quality, less congestion, improved travel time and better quality of life.

5.2.1.5 METHODOLOGICAL

This barrier is characterised by the lack of clear targets, achievement indicators and quantifying tools to properly account the cost-benefit of a particular policy scheme on GHG emissions and other co-benefits. Although on the national front the Government have made an international commitment to reduce the nation's carbon intensity, there is yet a clear strategy and roadmap to enable the required measures to take place.

There needs to be a comprehensive and systematic assessment system in a top-down manner, from core ministries of local governments to follow suit. This requires the development of a measurement system to properly assess the impacts of interventions which requires proper data collection and monitoring of indicators. It should also be accompanied within the setting of objectives and quantifiable targets, as well as milestones for achieving the objectives and targets set. These should be linked directly to the transport sector but should be wide-ranging to reflect the numerous co-benefits that interventions in the transport sector can have, such as improvements to congestion, road safety, noise, air quality and health.

A few organisations have made efforts to develop the aforementioned assessment system. Most are tailored towards project based assessment of GHG reductions; taking advantage of climate financing. The LCCF system developed by KeTTHA is able to calculate citywide GHG emission from each sector of a city including from the transport sector but it has yet to be fully embraced as a national guideline.

5.2.1.6 CAPACITY

Inadequate human capital and technological capabilities forms the barrier in terms of capacity. This includes lack of skills to develop and implement appropriate technologies and methods in a wide variety of fields such as integrated transport planning; vehicle, fuel and infrastructure standards; assessment, evaluation and accounting of transport impacts.

Human capacity development should be the cornerstone to support Government initiatives towards sustainable transport in the long term. As mentioned previously, higher education institutions can offer courses and programs supporting the various fields under sustainable transport. Organisations and private sector can support these initiatives through scholarships and internships.

It is important that appropriate technologies are also made available through technology development and transfer which can be disseminated through both public and private channels. Although in the short term technology adoption is a more viable path towards technological advancement, proper mechanisms must be put in place to ensure adequate level of knowledge transfer is achieved. It is also important that there is an alignment between research institutions and private sector in the direction of research and development to be pursued in the national interest.

Another important aspect to look at is the current market's viability for low-carbon alternatives. If a low-carbon vehicle technology is to be imported, it has to be ensured that local industry is able to support its implementation and operation through maintenance and service.

5.2.2 SAFETY

Transportation-related crashes and incidents have a serious impact on our national economy. As transportation demand increases and the system becomes more integrated to meet the demand, security will become more difficult, unless new innovative technologies are developed to mitigate the vulnerabilities.

a. Due to the high rate of road fatalities, WHO target 50% reduction of projected fatality on road crashes by 2020. The Road Transport Department is currently taking the initiative to reduce the number of road fatalities by 10% each year.

b. Based on the revised NAP 2014, 40% reduction of carbon emission should be achieved by 2020. However, practical solutions for reducing greenhouse gas emissions within the transportation sector might be elusive in the short term. Switching to non-carbon-based fuels and very efficient vehicles would eliminate dependence on petrol while improving local air quality and reducing the emissions of greenhouse gases. Transportation-related energy consumption and environmental impact will require a transition to efficient zero-emission vehicle technologies and renewable fuels. New materials and new vehicle types (e.g. electric, energy efficient vehicles, fuel cells) will enable vehicles to operate efficiently with little noise, and possibly even below ambient noise conditions. Advanced battery and fuel cell technology, electric power trains, and advanced designs will eliminate noxious emissions from most surface vehicles.

c. At the moment, voluntary compliance to UN vehicle regulations is being practiced by vehicle manufacturers. Mandatory compliance to UN vehicle regulations should be proposed after the year 2020. Vehicle industry should look into research on nanotechnology, developing materials with a high strength-to-weight ratio, so that new vehicle designs can withstand crashes and protect the passengers against injury.

d. Based on the revised NAP 2014, current inspections of private vehicles are on voluntary basis. In an effort to reduce further road accidents, the inspections can be made mandatory after 2020.

e. ISO 39001 has recently been introduced by International Standards Organisation to help all organisations that wish to design safe traffic, or want to supply society with safe products and services. A mandatory practice to adopt ISO 39001 in Government agencies and ministries can be proposed as mid-term milestone.

f. Integration of intermodal transport: Human error and environment awareness are the leading contributors to all crashes and incidents in all modes of transportation, reducing overall system performance. The advancement of micro-sensors, processors, and expert systems in human-centered systems will help to adapt to and compensate for human error and facilitate task completion. Automated vehicle operations and distributed computing can perform vehicle-centric route optimisation, increasing system-level safety and efficiency. As a result high-confidence systems and high-bandwidth communication infrastructures are required to ensure connectivity among all system elements, regardless of the environment or security threats.

g. System optimisation and database integration between agencies in an information grid will facilitate and improve the service efficiency of the management and enforcement agencies.

In conclusion, these elements are essential to achieve a safe and secure transportation system:

- Social, economic, and institutional policy issues;
- High performance computing, IT systems;
- Human performance and behaviour;
- Advanced nanotechnologies;
- Energy, propulsion and environmental engineering;
- Sensing, advanced processors, and measurement technologies;
- Analysis, modelling, design and construction tools.

5.1.3 TARGET FRAMEWORK

Benchmark measures in Section 4.5 were deliberated on with relevant stakeholders on land transport. Measures that are considered relevant to Malaysia were discussed and analysed using the LFA. The LFA is presented in the Appendix section. The outcome from the stakeholder workshop was the following list of measures that are critical for the sustainability of the transportation system in Malaysia. The measures are as follow:

- Develop on Integrated Land Use – Transport Masterplan
- Implement ITS
- Improve public transport
- Parking management
- Congestion charging
- Improve vehicle technology and fuel standard
- Removing fuel subsidies

Though these measures may seem direct and straightforward, however, require a thorough study of their feasibility and impact; a structured and transparent plan of implementation; and a continuous programme to update and improve the plan where and when necessary.

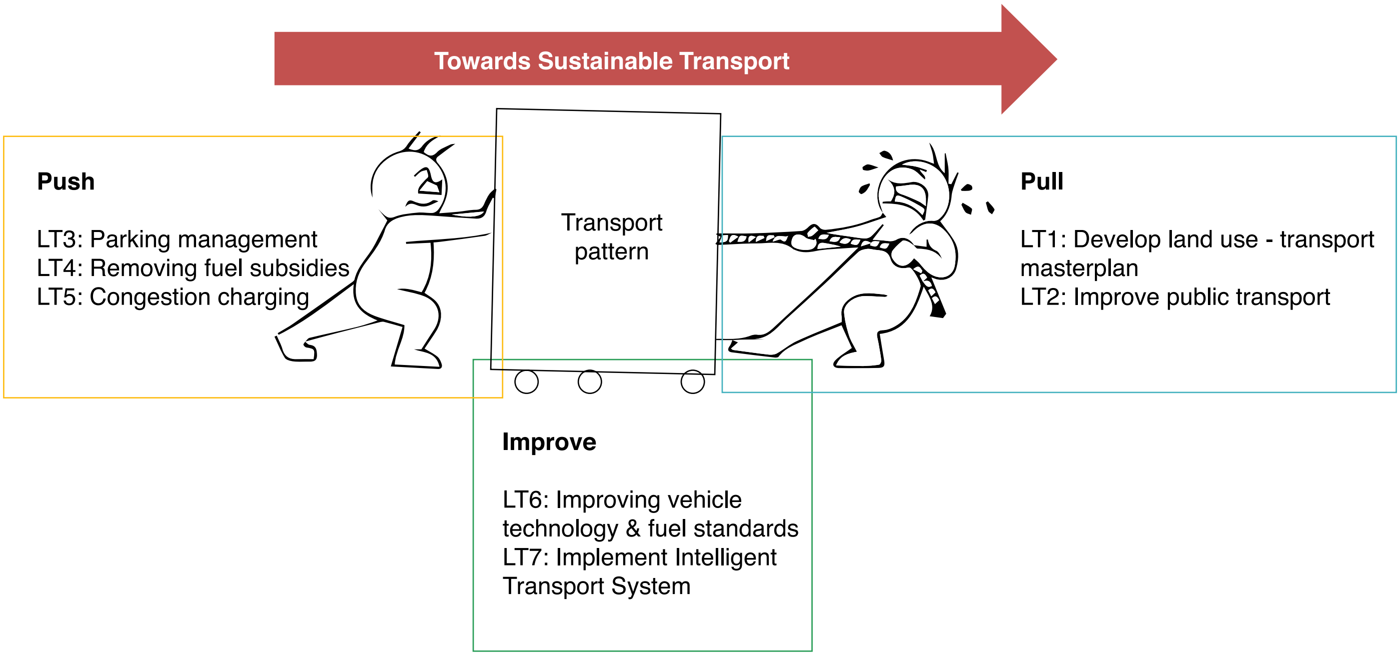


Figure 5.3 Measures towards sustainable transport

Short-Term Strategy (2020)

a. Develop Integrated Land Use – Transport Masterplan

As highlighted earlier, a land use pattern has a direct implication on the transport system of a certain area. Thus, it is imperative that a city is built to cater for the accessibility and mobility needs of the people rather than cars (UNESCAP 2012). It is of vital importance for cities to have an urban form that enables public transport to be the main mode of choice of the people.

To achieve this, cities must be built 'up' through compact, high-density and mixed use development around a public transport corridor TOD. In a compact city form, places of interest will be within walking distance of each other thus reducing the need for cars. Long distance travel can be achieved by utilising public transport. The strategy to "build up" is reflected in the spatial planning policy of the country. Policy NPP32 in NPP-2 highlights the TOD concept as the basis of urban land use planning in order to ensure viability of public transport. The foundations of TOD are shown as in **Figure 5.4**.

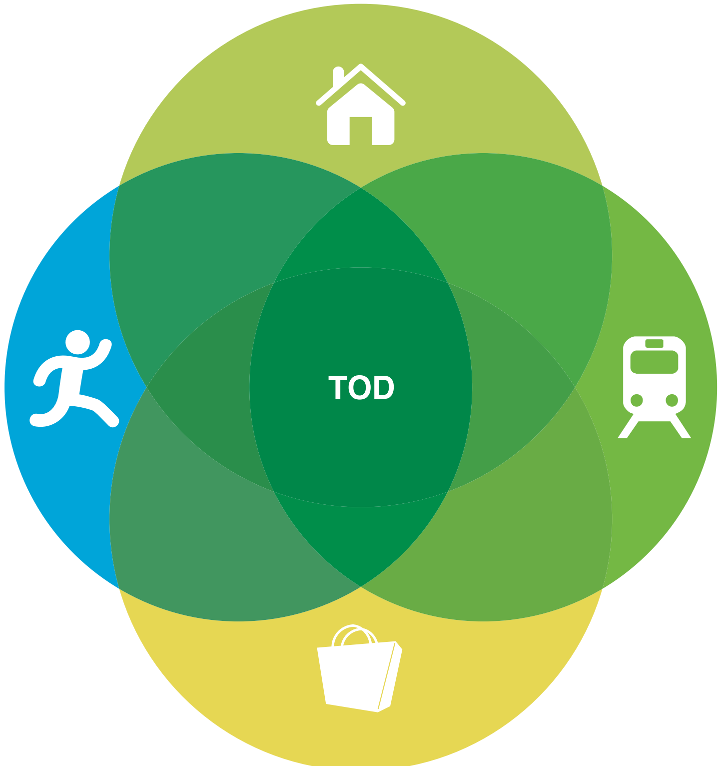


Figure 5.4 Foundations of TOD – home, work and shopping served by NMT and public transport

Source: Sustainable Transportation in the Netherlands

However, implementation of the NPP2 guideline has been shown to be ineffective at local level. Urban sprawl which encourages private vehicle use while limiting public transport reach is rampant around the city, especially in the GKV area. Cheap, low density housing at the outskirts of the city attracts more people to live outside the city, while at the same time increasing the commute distance to work. The urban form and transport pattern that we have today points out that currently transport planning is divorced from land use planning. Not enough weight is given to the impacts of land use decision on transport pattern. Transport planning is left as an afterthought to spatial planning.

An integrated transport land use plan is required to foster a balance of mixed land uses which recognise the importance of spatial proximity, layout and design of these uses and their impact on transport choices. The overall goal is to ensure that development of land is conducted with the consideration of its transport-generating impact. The development of integrated transport and land use master plans can be considered one of the single most important aspects of transport demand management (UNESCAP 2012).

"Improving Transport Choice", a guideline for planning and development document by the New South Wales Department of Urban Affairs and Planning is the perfect example of an integrated land use and transport plan. The front page of the document is shown in **Figure 5.5**.

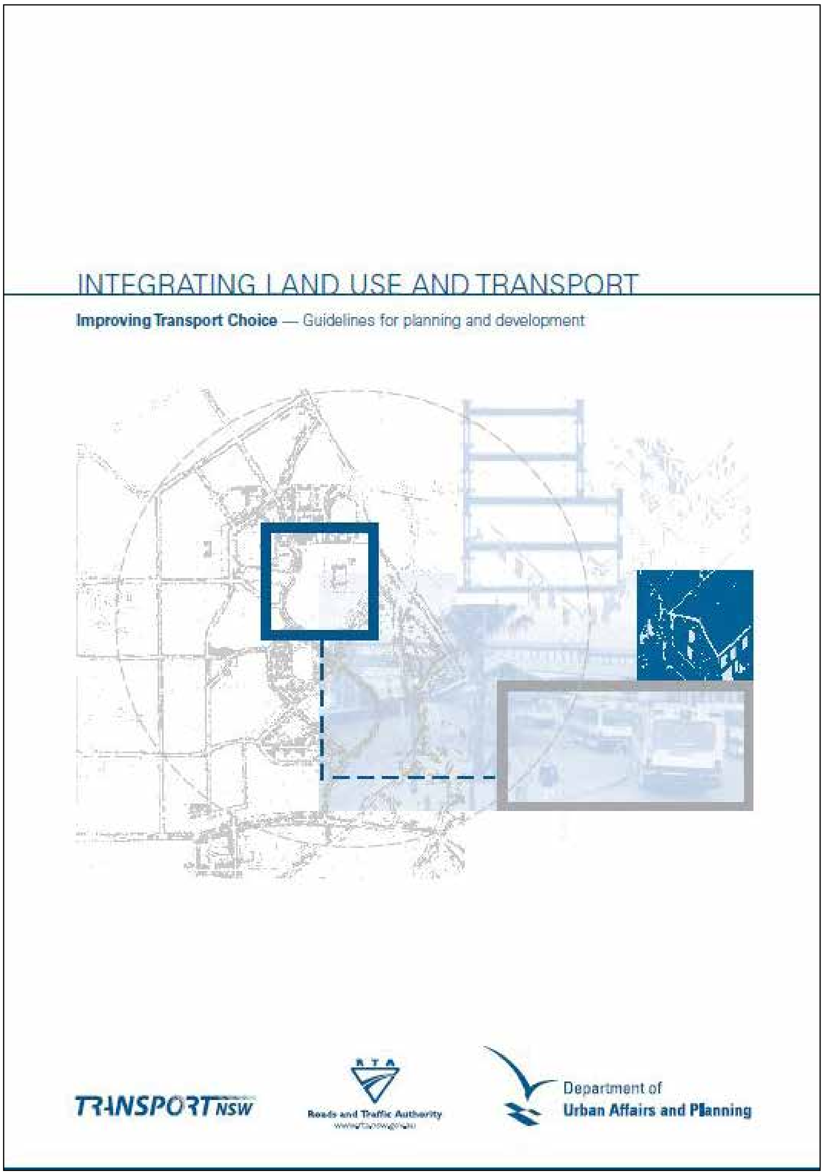


Figure 5.5 Improving Transport Choice

Source: Department of Urban Affairs and Planning 2001

The purpose of the document is to:

- better integrate land use and transport planning and development; and
- provide transport choice and manage travel demand to improve the environment, accessibility and liveability.
- The objective of the document is to:
- reduce growth in the number and length of private car journeys; and
- make walking, cycling and public transport use more attractive.

The document is drawn based on the following ten principles:

- Principle 1. Concentrate in centres
- Principle 2. Mix uses in centres
- Principle 3. Align centres within corridors
- Principle 4. Link public transport with land use strategies
- Principle 5. Connect streets
- Principle 6. Improve pedestrian access
- Principle 7. Improve cycle access
- Principle 8. Manage parking supply
- Principle 9. Improve road management
- Principle 10. Implement good urban design

The document highlights that land use planning is only one important component of measures required to achieve transport objectives. Improvements to public transport services, and travel demand policies such as parking supply, are equally important and are directly addressed. The principles in the document form the basis for decisions on land use plan and development projects across the State (Department of Urban Affairs and Planning 2001).

The recent effort to draft the National Transport Strategy by the Economic Planning Unit indicates that Malaysia is already in the right direction in addressing this issue. As such, there is a need to ensure effective channel between Federal-State-local planners in order to implement national vision more effectively to the ground level. Research is also required to tie transport issues to land use, human behaviour and other concepts of transport in Malaysia to identify the correct measures to be implemented here.

I. Technology Application

Software such as the Geographic Information System (GIS) and travel demand modelling system are powerful tools that offers the possibility to improve the capability of planners to ensure transport are given due consideration during spatial land use planning. GIS is a database that stores various information (land use, socio-economic, environmental, etc.) and links the information to a geographical location. GIS and GIS-based analytical tools are used by planners to visualise, analyse, interpret and understand land use and transportation connections and assist in spatial planning. The structure of GIS data sources and data layers are shown in Figure 5.6.

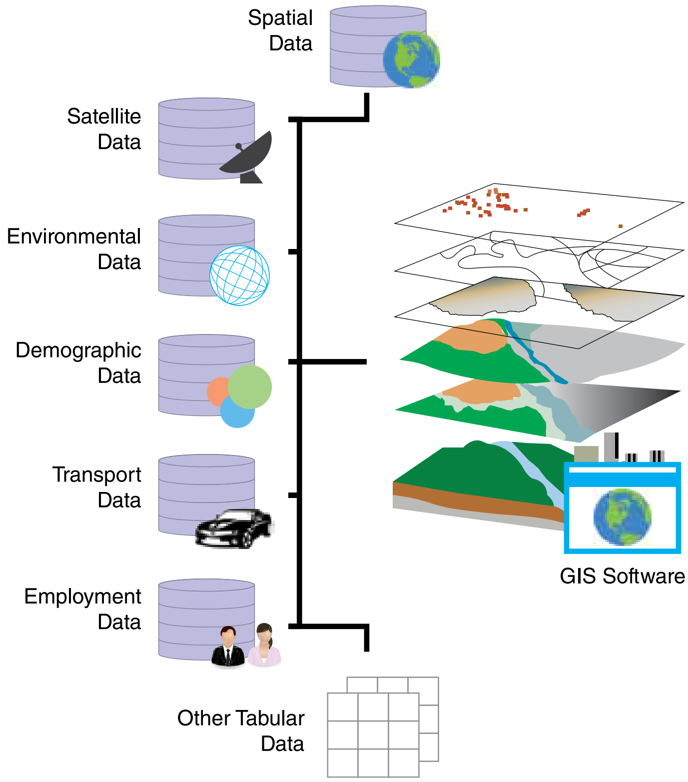


Figure 5.6 Structure of GIS data sources and data layers

Source: City of Malden

There are also examples of GIS based software for handheld devices used as community outreach and facilitation tool where the public can play a role in data collection and give feedback on certain plans.

i. Travel demand model is a computer model used to forecast travel behaviour and travel demand for a specific future time frame, based on a number of assumptions. Transportation models mathematically represent how choices are made when people travel. The model is applied in selected areas or regions, with inputs on land use data, demographic data, including a road and transit network as a planning and forecasting tool. The model assesses the cost-benefit and impact of major projects on the existing transport network. The example of microscopic traffic simulation is shown in **Figure 5.7**.

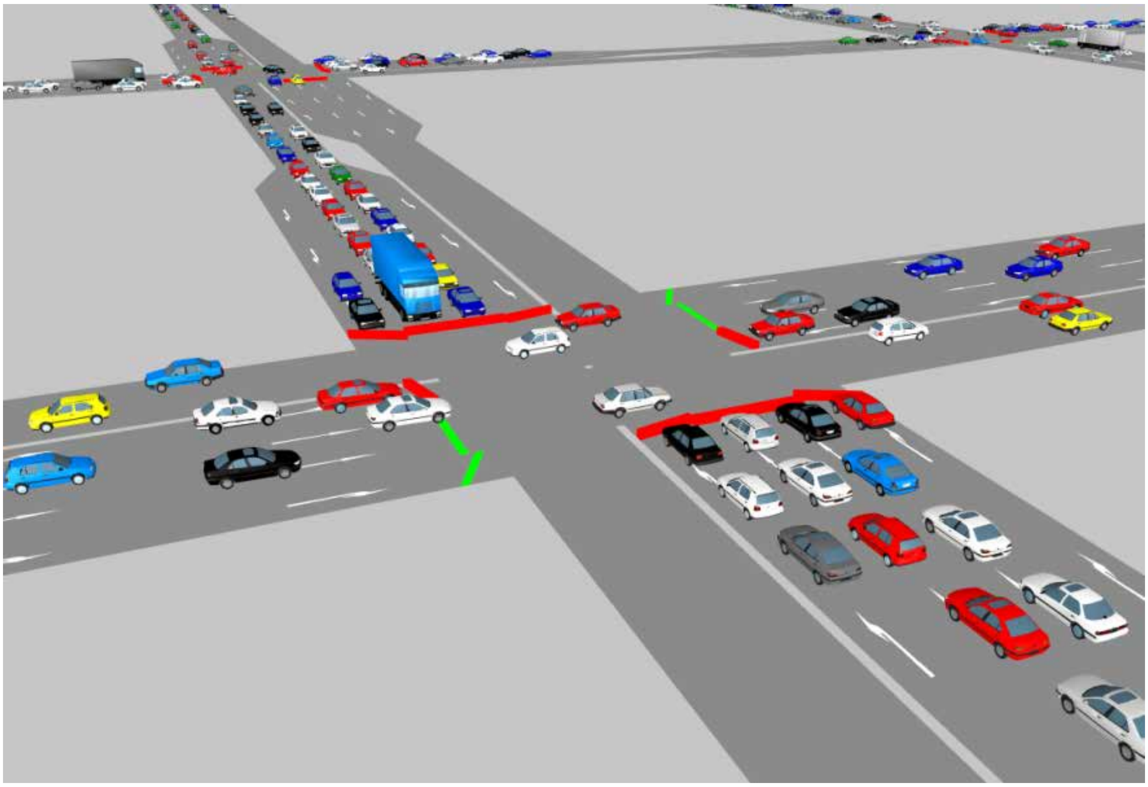


Figure 5.7 Example of microscopic traffic simulation

Source: Centre for Traffic Research Sweden

These systems provide scientifically sound methodology to forecast future scenarios. Through utilising these tools, planners and city officials can plan based on measures that will ensure a path towards best possible future transport scenario.

There is a need, however, for a policy that pushes widespread application of these software in town and city planning. The Government must also devise a programme for training of staffs from relevant departments that will build the required knowledgeable and skilled manpower. Utilisation of these software will also require an extensive data collection effort to build and maintain high quality databases of information that will be input to the models.

b. Implement Intelligent Transport System

The term Intelligent Transportation System (ITS) represents the application of Information and Communications Technology (ICT) in vehicles and transport networks that has had a huge impact in various aspects of transport and traffic planning, monitoring, management and control. As the demand on any transport system in a city continues to grow parallel with the growth in economy and population and coupled with limited options to expand infrastructure, innovations in ITS enable an entire transportation system to work as effectively and efficiently as possible to help make transport more sustainable.

The key function of ITS is delivering real time, accurate and comprehensive travel information to help travellers decide whether or not to make a trip, when to set off and the best mode of transport to take. In personal vehicles this translates to more efficient routes that ensure shorter travel distance and journey time with minimum on-road interference. For public transport users this means the complete capability to time their journey around a public transport service guaranteed to be punctual, comfortable and safe. In all ITS promote mobility and access to all, increase safety and security of the transport system and at the same time help directly reduce environmental impacts through efficiency gains.

Many countries around the world have made substantial investments in deploying ITS in their transportation systems, including Malaysia. However, the application of ITS in Malaysia can be described as minimal at best. There is also a significant difference in how implementation of ITS was approached as well as compared to other successful countries. A prime example of ITS in Malaysia is the Integrated Transport Information System (ITIS) which was launched by the Kuala Lumpur City Hall in 2005, which is an example of ITS for traffic monitoring, management and control. The system is aimed at providing brief traffic information to motorists of what to expect along the way such as road congestion for them to decide on the best travel route and time to get to their destination.

The nerve centre of ITIS is the Transport Management Centre (TMC) located in Technology Park Malaysia. Real time traffic information are collected through its Advanced Traffic Management System (ATMS) consisting of CCTV cameras, “machine vision”-based Automatic Incident Detection (AID) system and GPS-based Automatic Vehicle Location System (AVLS) fitted on public transport vehicles as moving probes. The processed information are then disseminated to the public via the Advanced Traveller Information System (ATIS) consisting of roadside Variable Message Signs (VMS), ITIS call centre, internet and radio. The ITIS information process is shown in **Figure 5.8**.

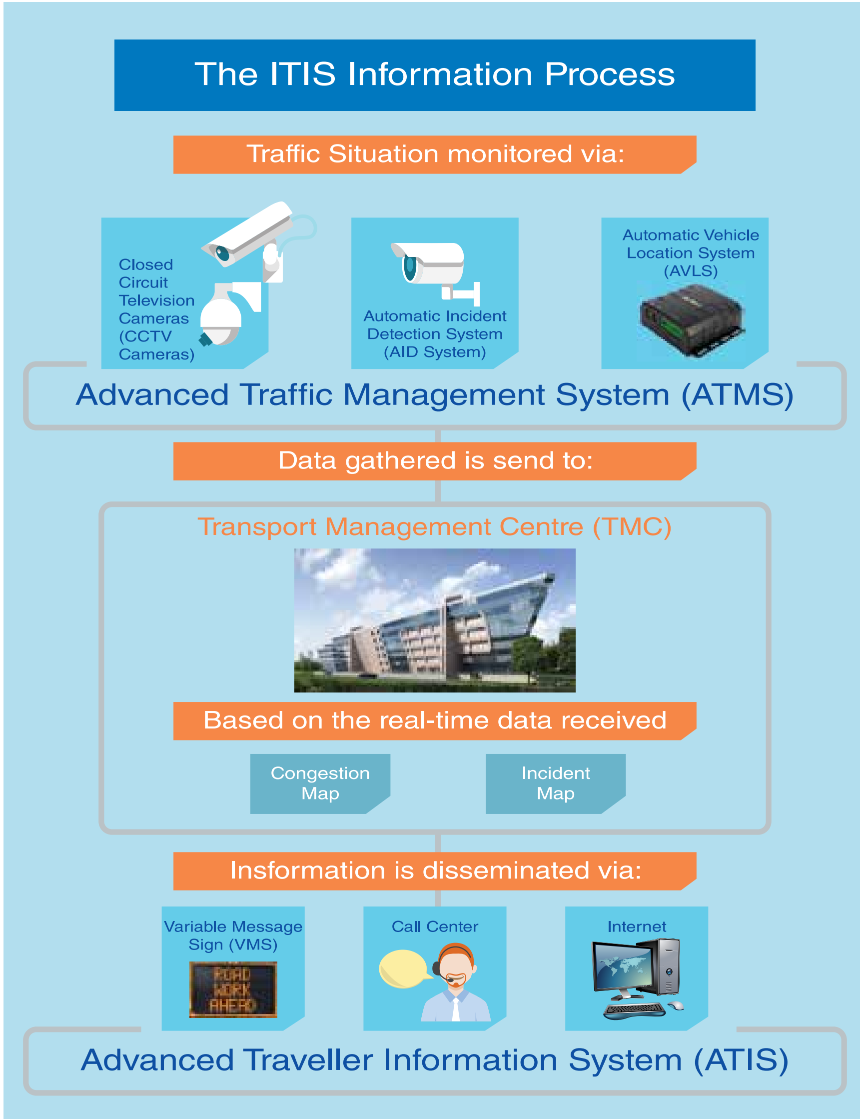


Figure 5.8 The ITIS information process

Source: http://www.itis.com.my/atis/about_fact_sheet.jsf

The launch of ITIS was billed as the system to help ease the traffic woes of road users in the Klang Valley. However, almost a decade later, the system has become obsolete, with various reports of the system components in a State of disrepair. There was also very little effort in promoting the services that the system offered, resulting in low awareness and use by the public. Consequently, the information provided is also not extensive enough to effect any changes in travel routes of road users and reducing traffic congestion in the city.

Figure 5.9 Dysfunctional ITIS Variable Message Sign Panel on Federal Highway in 2014

In a world where technological innovation is a constant, implementation of ITS infrastructure cannot be seen as a one-off solution, but rather a structured programme of implementation, upkeep, update and upgrade so the system remains relevant to meet the often increasing needs and demands of road users. This is the programme that countries at the forefront of ITS application such as Japan and Hong Kong are going for and what Malaysia has to strive to achieve.

In contrast, densely populated cities such as Tokyo and Hong Kong face enormous challenge in providing an efficient transport system. (Continuous economic growth; very limited supply of land to accommodate traffic increases through new transport infrastructure; and a demand for better, safer and environmental - friendly transportation system have called for innovative solutions to transport problems through application of ITS). The recurring theme of success stories of countries with successful ITS projects are two-pronged:

(i) Development of a structured ITS programme specific to their local needs;

a. Europe published the European Commission's White Paper on "European transport policy for 2010 – time to decide";

b. Australia formed its National Strategy for ITS in 1999;

c. Japan introduced its national "Strategic Plan for ITS in Japan" in 1996;

d. South Korea introduced its master plan "Intelligent Transportation Systems 21" in 2000;

e. Hong Kong published its policy paper "Intelligent Transport System in Hong Kong" in 2006; and

(ii) Promotion of ITS projects as a platform to facilitate the growth of local transport and electronics industries that fosters a strong ITS industry, directly contributing to national growth.

Among others, most technology applications highlighted earlier in this chapter such as the full range of technology that constitutes the Advanced Public Transport System; Parking Information and Guidance System; and the Multi-Lane Free Flow System falls under the ITS banner.

One important ITS case study that can be highlighted here is the Journey Time Indication System (JTIS) in Hong Kong (JTISHK) and Kowloon (JTISK). The JTIS functions to disseminate real time journey information to motorists via LED displays, interactive voice response system and internet speed map to enable them to choose alternative routes to cross the harbour from Kowloon Peninsula to Hong Kong Island and vice versa to avoid traffic congestion. The JTIS assists motorists to make an informed route choice to cross the harbour before arriving at critical diversion points.

Figure 5.10 The Journey Time Indicator System LED time indicator in Hong Kong

Note: The systems displays the average journey time, in minutes, to cross the harbour for each of the available routes. The digits are shown in three different colours for different traffic conditions: red represents congested traffic, amber represents slow traffic and green represents smooth traffic, updated at five-minute intervals

Source: Hong Kong Transport Department Official Website

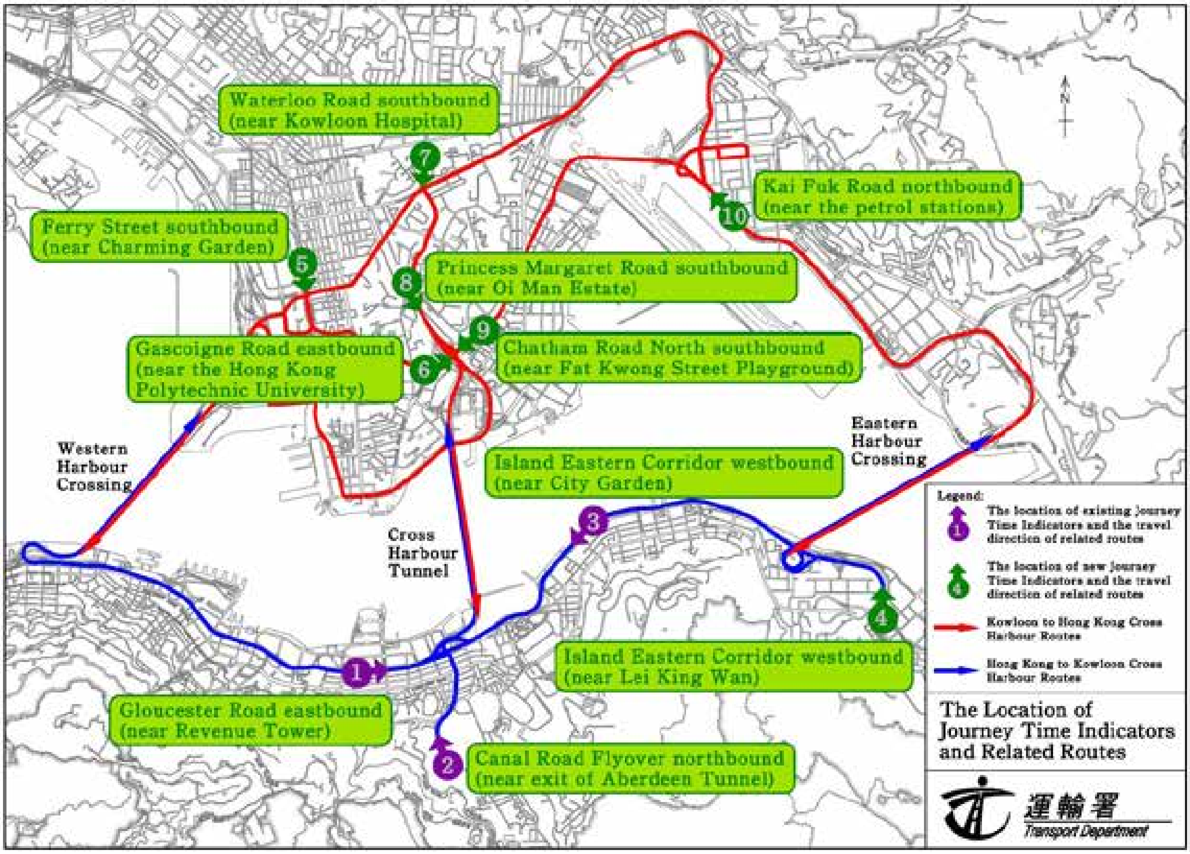


Figure 5.11 Locations of JTIS panels in Kowloon Peninsula and Hong Kong Island

Source: Hong Kong Transport Department Official Website

The JTISHK was the first to be commissioned in 2003 on Hong Kong Island. The effectiveness of the system had led to the extension and implementation of the JTISK in 2010 on Kowloon Peninsula, it was fully integrated with the original JTISHK. In 2013, the system was further expanded with the introduction of Speed Map Panels (SMPs) in the Hong Kong New Territories that provides a schematic of road traffic speed on major routes bound for Kowloon.

Figure 5.12 The Speed Map Panels in Hong Kong displays the schematic map of major routes ahead as well as the estimated journey time. The displays are colour-coded with green, amber and red to represent different traffic conditions: red represents congested traffic, amber represents slow traffic and green represents smooth traffic

Source: Hong Kong Transport Department Official Website, http://www.td.gov.hk/

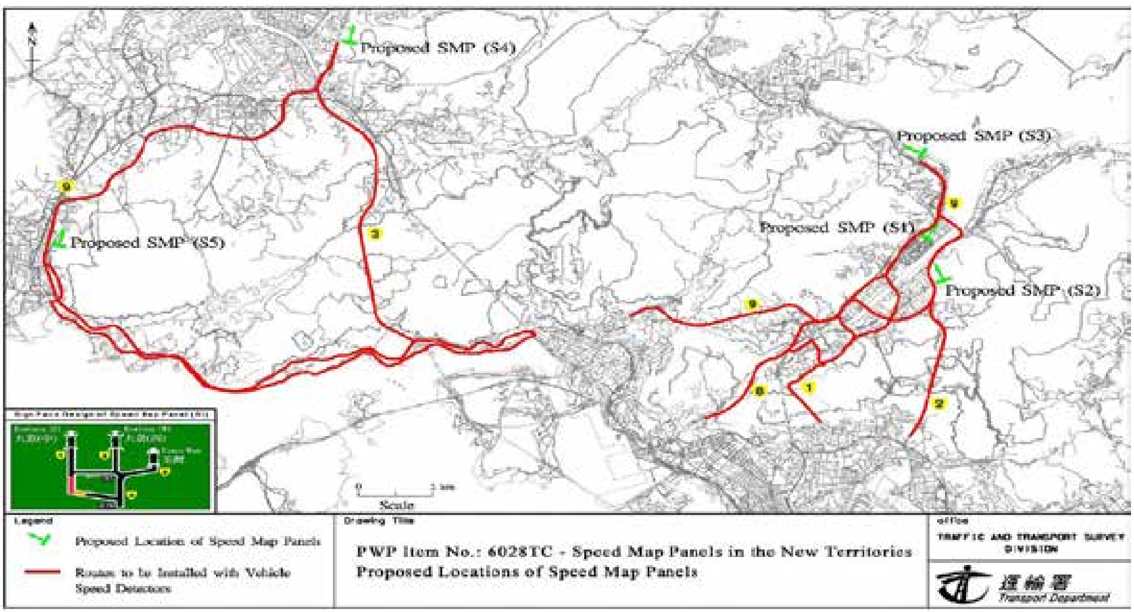


Figure 5.13 Locations of Speed Map Panels in Hong Kong New Territories

Source: Hong Kong Transport Department Official Website

While providing motorists with real time information, the system has been shown to successfully allow for a better distribution of traffic on roads, alleviate congestion and reduce the travel time of road users and was very well received by the public. In collecting the necessary data on road traffic speed and journey time, a hybrid detection methodology of Video Image Processing (VIP) through video detector and Automatic Vehicle Identification (AVI) tag reader by Radio Frequency Identification (RFID) was employed. The AVI tag reader captures the time stamps of vehicles passing a particular AVI tag reader together with their identification information. By matching the identification information of the vehicles the journey time of the vehicle passing through two consecutive tag readers are computed at two-minute intervals. The video detectors, on the other hand record the traffic counts and the spot speeds of vehicles travelling at a particular location.

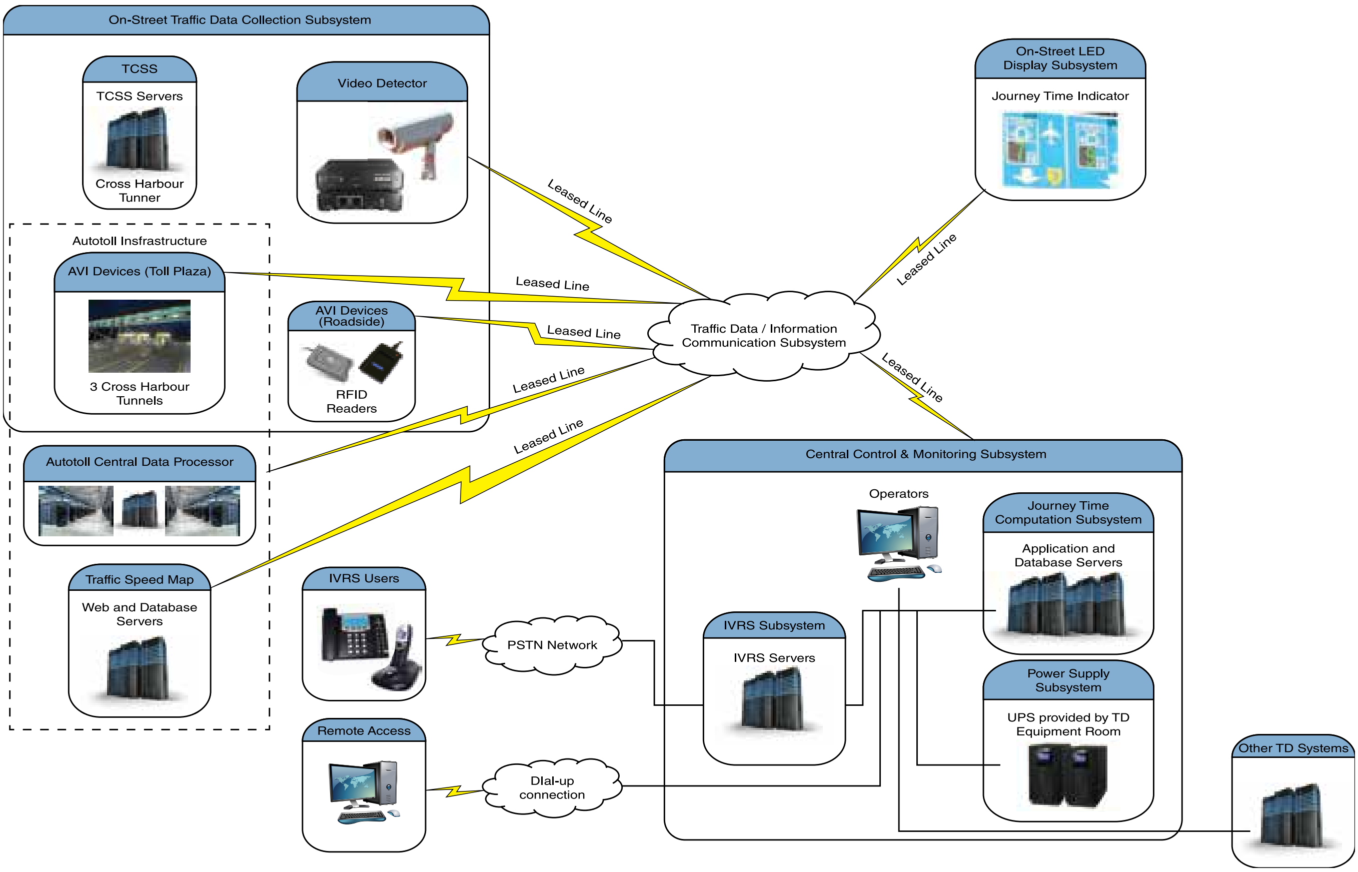


Figure 5.14 JTISK technology block diagram

Source: Autotoll 2011

The hybrid combination of the two technologies had been identified as the most cost effective methodology for the required data collection methodology. This is also due to the fact that the AVI technology was already in place for the Electronic Toll Collection since 1993. By 2012, more than 250,000 electronic toll tags were already issued by the service provider. With the required technological platform already in place, the service provided merely needed to extend the application of AVI from ETC to the new JTIS, reducing costs and without the hassle of applying new technologies.

As such as, there is a systematic flow of technological progression and expansion that builds upon similar technological architecture in creating ITS systems to solve local transportation issues. Furthermore, by relying on local expertise, the development team is well endowed in the workings of the previous systems.

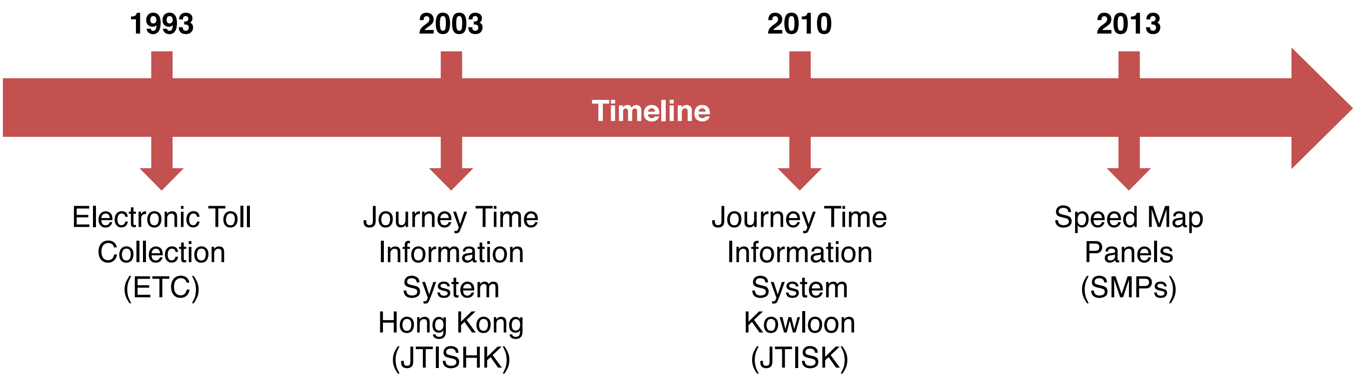


Figure 5.15 Timeline of ITS implementation in Hong Kong based on the same basic data collection architecture

The detection method employed is just one example of a myriad of ways traffic data is collected. The Tokyo Traffic Control Centre, for instance, compiles information from cameras, helicopters, police, citizen reports and over 17,000 vehicle detectors to monitor real time traffic condition throughout the city. The centre can directly manage more than 7,000 traffic signal controllers to ensure smooth traffic flow. Information on traffic conditions are then relayed to road users via variable message signs and live traffic report broadcast.

Figure 5.16 The Tokyo Traffic Control Centre ensures smooth traffic operations throughout Tokyo Metropolis around the clock. The centre also has the capability to handle unusual situations such as big events and disasters

Source: http://www.shifteast.com/inside-the-tokyo-traffic-control-centre

With their ultra-proactive approach driven by their own Government and relying on local R&D, Japan has created completely new industries and market out of ITS. Japan currently is the leader in many ITS areas, particularly for in-vehicle information system, computerised traffic control centres and Super Smart Vehicle System.

In recent years, Google and Waze Mobile tapped into the opportunity offered with the growing use of smartphone: the Floating Car Data (FCD). The Google Maps and Waze GPS application essentially transforms every vehicle with an active smartphone into sensors that continuously transmit their position data in order to generate crowd-sourced traffic information. This results in highly accurate real time display of traffic conditions and navigation guide directly to users; enabling them to make an informed choice on their routes on the go. Google and Waze will likely achieve a higher degree of accuracy with the ever growing smartphone market.

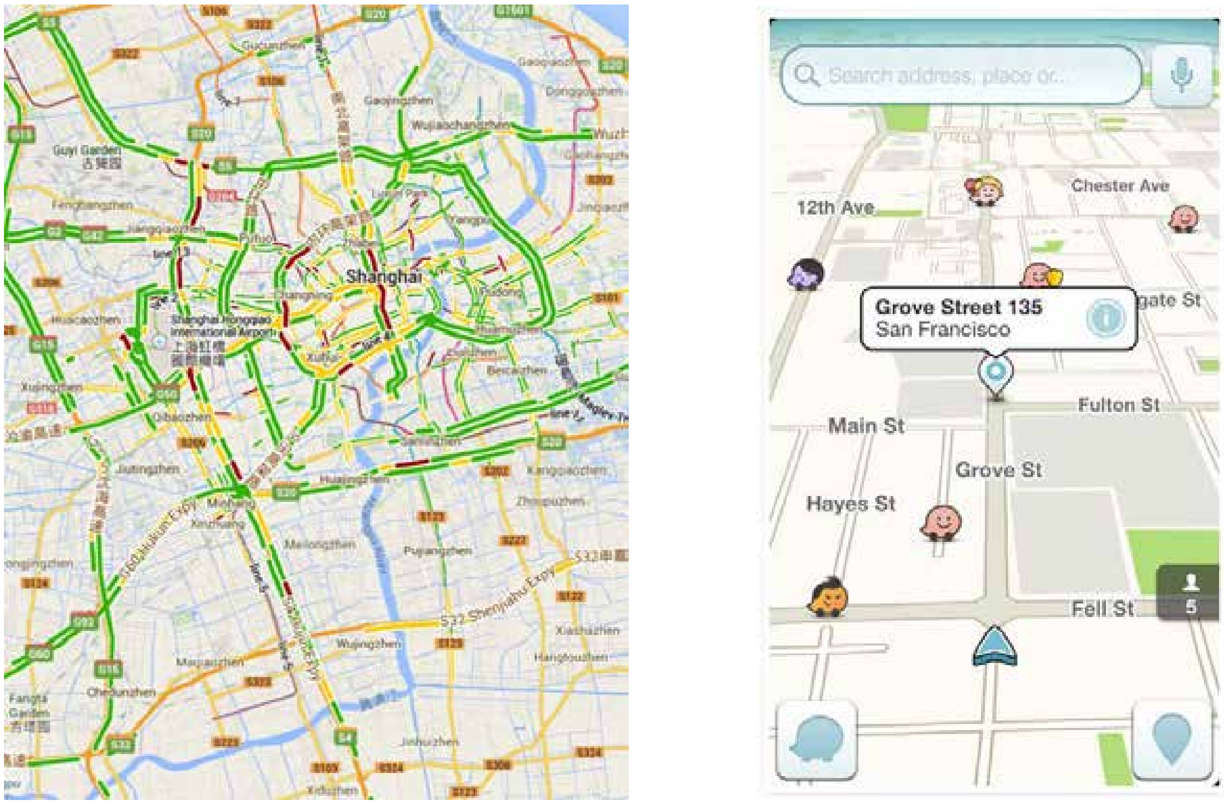


Figure 5.17 Smartphone applications such as Google Maps and Waze offers crowd-sourcing of Floating Car Data to provide real time traffic conditions to road users

Source: Google Maps and Waze Official Website

The concept of FCD is similar to the emerging concept of Internet-connected vehicles or IoV, with the addition of smart infrastructure that directly communicates with the vehicles. This opens up the possibility of autonomous private vehicles in the future to become a reality.

ITS also plays an essential role in improving the service quality of public transportation. Unlike private cars which offers the convenience of door-to-door travel, public transport users usually needs to go through several modes of transport between their origin and destination. Public transport users rely heavily on information on the public transport service such as routes, scheduling, stops, transfers, ticket fares and such to properly plan their journey. Having these information accurately creates a pull factor that attracts people to use public transport rather than their personal cars or motorcycles. Web and smartphone applications for travel directions such as Google Maps are great tools to get step-by-step instructions that guide users to their destinations. It also offers comparison of different travel options such as different routes, number of transfers, estimated journey time, travel by all available public transport modes or travel by bus only. Locally developed navigation applications such as gothere.sg in Singapore provides more detailed information, namely travel fares, time-sensitive directions for bus and train service, detailed bus info and arrival times.

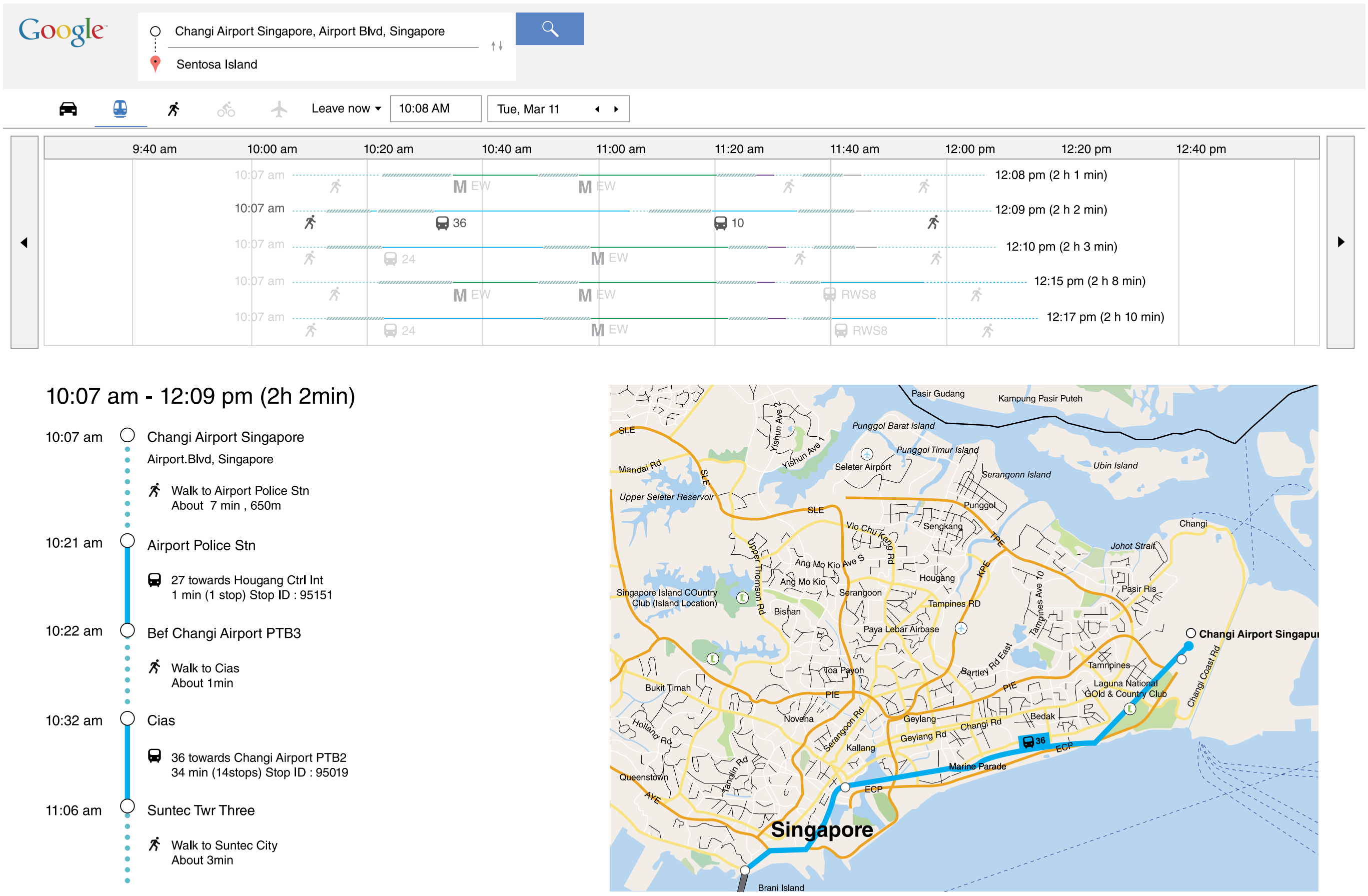


Figure 5.18 Google Maps' public transport navigation service provides step-by-step instructions that guide users to their destinations

Source: Google Maps Official Website

Figure 5.19 Locally developed gothere.sg web and smartphone application provides more detailed information on travel options in Singapore than Google Maps

Source: gothere.sg.

The cloud-based Taiwan Taxi service, an upgrade from their previous web-based system, is another example application of Information, Communication and Technology (ICT) to improve public transport. Before the introduction of the Taiwan Taxi smartphone application, users can call for a taxi by direct call to call centres or through the Taiwan Taxi webpage. The Taiwan Taxi smartphone application offers users a more simplified way of booking a taxi. The system can directly locate the user's location through GPS, hence the user simply needs to specify the pickup time and wait for the response. The application also provides an innovative solution to things that had seem difficult to achieve before: customer satisfaction survey is done through a simple rating system and an emergency call button is also included to ensure safety and security of passengers.

Figure 5.20 Taiwan Taxi smartphone application for taxi booking service

Source: Chang 2012

Web and smartphone applications are examples of a form of Travel Information Service (TIS) which disseminates public transport information to the public. However, these front-end services for the users are only made possible with the back-end system that tracks real time transit vehicle locations, estimate the on-time status and control the overall public transport operations during normal and also emergency conditions through the application of the full range of technologies that falls under the Advance Public Transport System (APTS).

There is ample opportunity to apply ICT in transport and implementation of ITS here in Malaysia. Malaysia has to emulate successful countries such as Hong Kong, Japan and Europe with a structured roadmap of ITS implementation and a focus to develop local industries. With continuous technological advancements and innovative solutions, ITS will continue to grow as a major industry to provide efficient and safe transportation system of the future.

c. Improve Public Transport

As indicated in Chapter 4, the overall aim of sustainable transport is to create an environment that enables public transport to be the transport mode of choice for the people, supported by non-motorised modes of transport serving shorter trips. The reasoning is simple: there are too many cars on the road which keeps increasing versus limited road capacity with land too valuable just to make room for cars. This is especially true in urban areas where demand for mobility is high while space is limited. This message is conveyed most effectively by the poster by the city of Muenster Planning Office shown in **Figure 5.21**.

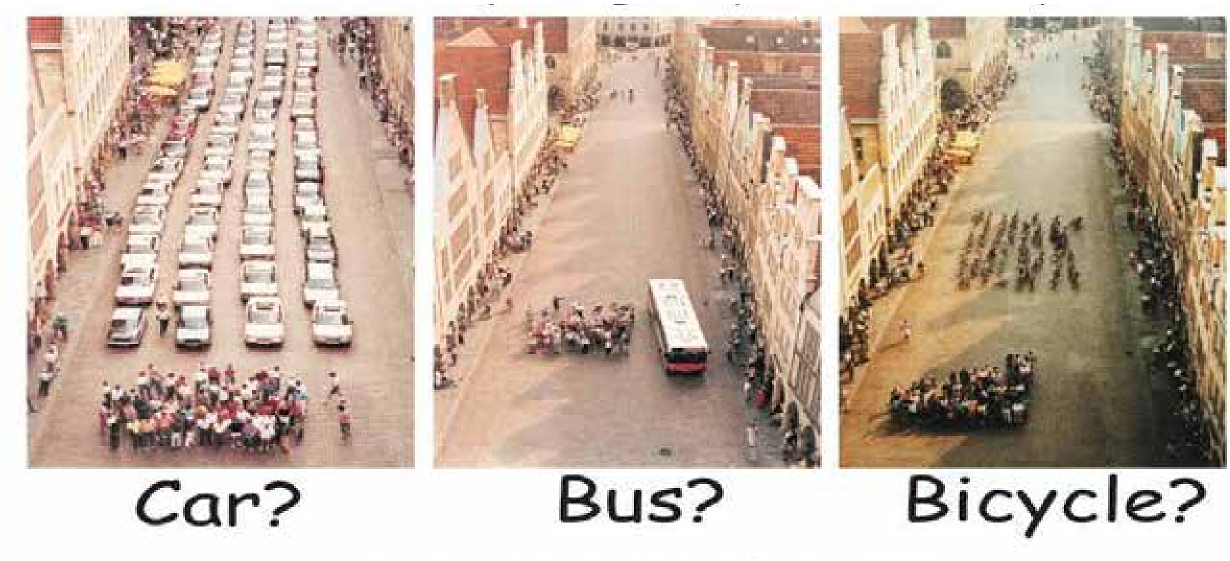


Figure 5.21 Comparison of space utilisation by car, bus and bicycle

Source: City of Muenster Planning Office 2001

The poster provides a graphic message of how space is utilised by three modes of transport: passenger car, bus and bicycle. The campaign compared the amount of space needed to transport 72 people with the following statistics (FHWA 1994):

(i) Car: Based on an average occupancy of 1.2 people per car, 60 cars are needed to transport 72 people, which take 1,000 square meters

(ii) Bicycle: 72 people are transported on 72 bikes, which require 90 square meters

(iii) Bus: 72 people can be transported on 1 bus, which only requires 30 square meters of space and no permanent parking space, since it can be parked elsewhere

The campaign provides a compelling case to the space-efficiency of public and non-motorised transport. A single bus manages to transport the same number of passenger as 60 cars utilising only 3% road space required by car. Bicycles utilises only 9% of the same road space. Public transport and NMT uses scarce road space more effectively. Taking into consideration the negative externalities of driving passenger cars such as congestion, parking requirements, GHG emission and air pollutant emissions, public transport is a much superior mode of transport. If a high percentage of travel demand can be met through public transport, the reduced number of cars on the road frees more road space and reduces congestion. Bus also does not require parking spaces. Energy intensity and emission of a single bus is also comparatively lower than 60 cars (Chester & Horvath 2009).

Furthermore, the traditional way of relieving traffic congestion by increasing capacity of the road network has been shown to only provide a temporary fix. By improving a congested road, land along the road becomes more accessible, making it more valuable and attractive to developers. New development built around these new roads will eventually cause the roads to become congested again. The cycle is depicted in **Figure 5.22**, and continues until it is physically or economically impossible to expand the capacity.

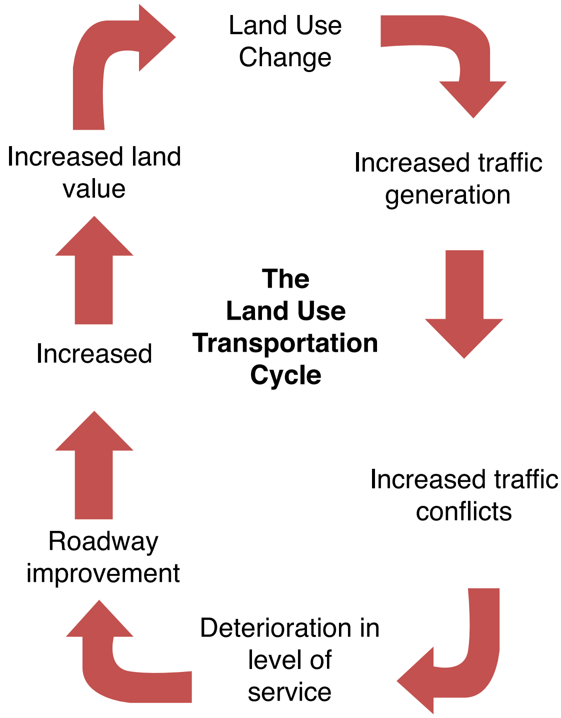


Figure 5.22 The land use – transportation cycle

Source: Stafford Regional Planning Commission 2003

This method of providing mobility also only benefits those who can afford private vehicles from the high and middle-income population while neglecting the low-income population's travel needs. The traditional approach of increasing mobility by providing more road space is therefore neither economically productive nor environmentally sustainable. The environmental gains of improving the vehicular technology have been offset by the increasing number and travel distance of private transport activity. It is now a necessity for cities around the world to develop a green and sustainable transportation system to meet the growing transport demand to maintain the quality of living for the city residents (UNESCAP 2012).

However, the public transport system in Malaysia is still lacking. Ask any motorists on the road why they are not using public transport the answer would come back the same: public transport is too unreliable, especially the bus service. It is almost impossible to properly plan daily activities accurately around an unreliable public transport system. If a journey takes 30 minutes on car, it may take 1½ hour on public transport. Unlike private cars which offers the convenience of door-to-door travel, public transport users usually needs to go through several modes of transport between their origin and destination as shown in **Figure 5.23**.

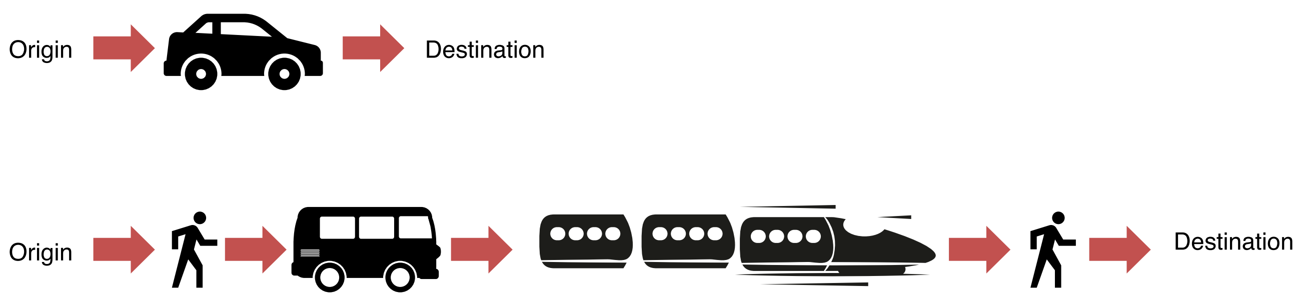


Figure 5.23 Transport modes in private car travel and travel by public transport

Thus, even after the introduction of the KTM Komuter in 1995, the LRT and monorail the modal share of public transport continues on a downward trend to reach 10% in 2008 (SPAD 2012). The problem was each of rail system was developed in silos. At the time, each system was treated as a stand-alone separate system. Each system was in competition of each other. Nonetheless, a multi-modal trip does not function in that manner. Rather than competing, the system functions to complement each other. Rail system functions as the backbone of the system, which carries higher passenger capacity along a high demand route on its dedicated rail.

Nevertheless, its reach is limited to areas along the rail corridor. Bus expands the reach of public transport service beyond the area of the rail system. These system needs to work in tandem with each other in order to provide a reliable public transport system. Public transport provision must also not just address the issue of connectivity between the different modes, service levels, safety and convenience to users it must also be integrated with measures to improve NMT infrastructure provision as the first mile/last mile component of the trip.

The SPAD Act and the establishment of SPAD was an effort by the Government to rectify this issue and transform the landscape of land public transport system in Malaysia. The National Land Public Transport Master Plan (NLPTMP) drafted in 2012 by SPAD documents the strategy to deliver a high-impact transformation of land public transport with a vision to make public transport the public's choice of mobility by 2030. The macro policies and principles in the Master Plan provide a platform for an integrated and coordinated approach that will be implemented by multiple authorities and agencies throughout the country.

The NLPTMP highlights five strategic imperatives to improve accessibility, quality and safety of the land public transport system:

(i) Strategic imperative 1: Enhance Land Public Transport connectivity across urban conurbations and access in rural areas;

(ii) Strategic imperative 2: Ensure affordable and accessible public transport services by enhancing industry structure;

(iii) Strategic imperative 3: Enhance service levels and convenience by improving monitoring and enforcement, as well as "soft integration";

(iv) Strategic imperative 4: Enhancing safety levels of public transport; and

(v) Strategic imperative 5: Reduce congestion, pollution and increase incidence of cycling and walking at the first mile/last mile.

These strategic imperatives translate directly to the objectives of the transformation of land public transport:

(i) *Physically well-connected*

Increasing connectivity is fundamental to making public transport the rakyat's choice for mobility. Travellers are more likely to use public transport if they are able to access the network from and to as many locations as possible.

(ii) *Affordable and accessible to all*

In line with the national aspiration of inclusive growth, land public transport should be available to rakyat from all walks of life, regardless of income levels.

(iii) *High service levels, quality and convenience*

The national public transport system should be the transport option of choice. It should therefore meet the public expectations of service, reliability and all-round user-friendliness.

(iv) *Safe and secure*

Ensuring the safety and security of land public transport users is of paramount importance. The rakyat needs to be convinced that they and their family can safely use any form of public transport.

(v) *About a better quality of life*

Land public transport transformation should aspire towards a clean and green environment, which would enhance the overall quality of life of the public.

The document proposes various measures and plans to transform the land public transport system in Malaysia. This comprises among them the Construction of the GKL MRT Sungai Buloh – Kajang Line; the extension of the Kelana Jaya and Ampang LRT line; stage bus network planning; improving the service standards for operators, drivers and vehicles; interchange and integration hub; bus stop enhancement; passenger information system and travel demand management. **Figure 5.24** provides an overview of the land public transport policies and plans in the NLPTMP.

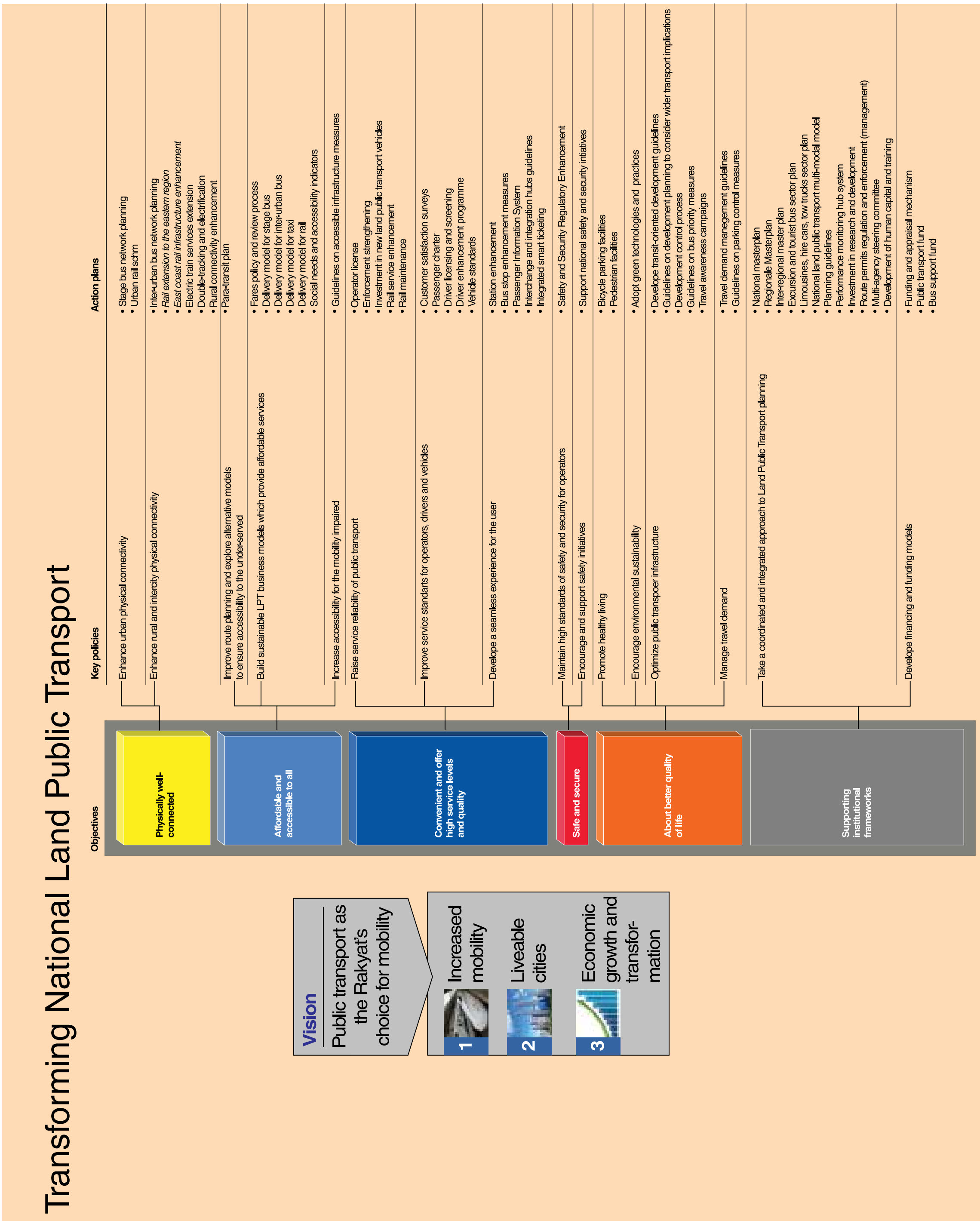


Figure 5.24 Overview of land public transport policies and plans

Source: SPAD 2012

Keeping in line with the NPP-2, SPAD has also developed a GKL/KV Land Public Transport Master Plan (GKL/KV LPTMP) to deliver the desired solutions in the National Growth Conurbations. The GKL/KV LPTMP comprises of six subsidiary plans that outlines specific action:

(i) **Subsidiary Plan 1: Urban Rail Development Plan (URDP)**

The URDP assumes that the currently funded rail projects will not be sufficient to meet future demand. While the introduction of the MRT1 and the LRT extensions will improve conditions on key routes, further measures are required to alleviate congestion and provide greater comfort and reliability. The URDP has identified broad routes where new and enhanced lines are needed to provide capacity.

(ii) **Subsidiary Plan 2: Bus Transformation Plan (BTP)**

The BTP states that there is a need to move to a revised delivery structure both on the road and in terms of regulation and procurement. Better coordination of delivery is also required to achieve high levels of consistency and integration

Core initiatives include:

- BRT corridors
- Network planning
- Enforcement of bus priorities
- Improvement of driver and vehicle standards
- Improvement of bus stop infrastructure
- Improvement of information systems
- Revision of the regulatory framework

(iii) **Subsidiary Plan 3: Taxi Transformation Plan (TTP)**

A market-led approach will be adopted to transform the taxi industry by enhancing quality standards and tightening licensing requirements. Incidentally, this emphasis on quality over numerical regulation is the World Bank's favoured approach.

Core initiatives include:

- Revision of the regulatory framework
- Raising of driver standards
- Raising of vehicle standards
- Improvement of booking systems
- Branding
- Infrastructure
- Enforcement of regulations

Further subsidiary plans aim to reduce the barriers to modal shift and encourage further land public transport usage through collaborative planning and guidance.

(iv) **Subsidiary Plan 4: Integration and Interchange Plan (IIP)**

The IIP considers the "first and last mile" requirements across land public transport modes to maximise potential land public transport usage.

(v) **Subsidiary Plan 5: Land Use Plan (LUP)**

The LUP has identified mechanisms to influence land use and development policies and processes in the KL/KV region to favour land public transport provision and performance. It outlines available policy levers that allow land public transport to drive land development, such as prioritising high-density developments at land public transport-accessible locations. Rather than reacting to pre-established constraints, land public transport can thus play a direct role in land use.

(vi) **Subsidiary Plan 6: Travel Demand Management Plan (TDMP)**

There is also a need for demand-led shifts to increase the usage of land public transport in tandem with supply-based measures. A range of measures has been reviewed to assess those with potential in KL/KV. However these will be sequenced only after sufficient land public transport alternatives are in place.

These documents indicate an agency that is in full control of the issues plaguing the current public transport system and are clear in the way the problems should be solved. With clear plans documented in the Master Plans, it is hoped that the national vision of public transport mode share of 40% in urban areas can be reached.

- **Technology Application**

Advance Public Transport System is the adoption of advanced technology in the provision of public transportation service with the aim to improve the service quality of public transport. This is in line with SPAD's public transportation transformation programme to make public transport the mode of choice of travel for the people. The technologies highlighted here are the AVL, Transit Operations Software, Travel Information Services, Traffic Signal Priority System and Electronic Payment Systems for transit fare collection.

1. Automatic Vehicle Location (AVL) systems are computer based vehicle tracking systems that utilises real time position measuring mechanism on the transit vehicle (e.g. GPS) and relaying the information to a central location. AVL systems are also equipped with a communication terminal for the driver to communicate with dispatch, and to get direct feedback on on-time status. The system offers the following benefits:

(i) improved dispatch and operational efficiency;

(ii) improve overall reliability of service;

(iii) quicker responses to distruptions in service, such as vehicle failure and unexpected congestion;

(iv) quicker response to threats of criminal activity on the bus

(v) extensive information for planning purposes

The schematic of an AVL system used in transit agency is as shown in **Figure 5.25**.

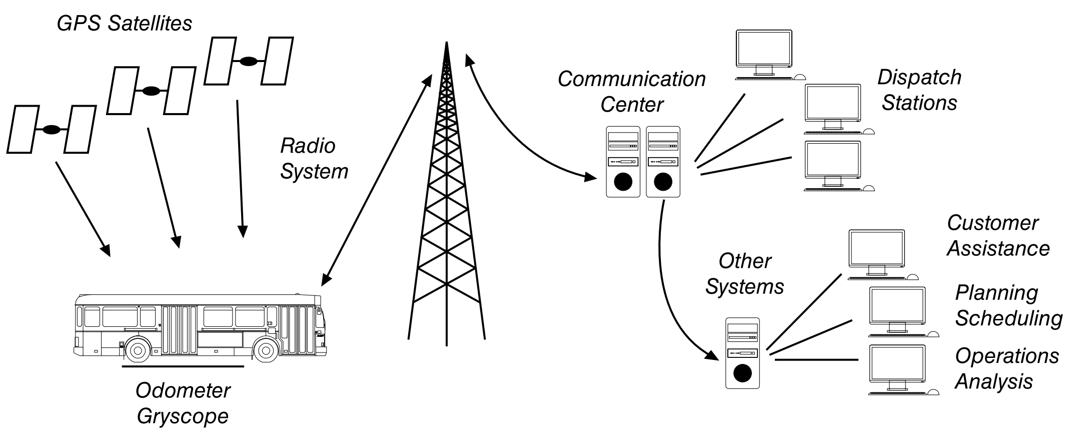


Figure 5.25 Schematic of an AVL system used in transit agency

Source: FTA 2000

2. Transit Operations Software (TOS) assists transit agencies with route planning, driver scheduling and vehicle assignments. Combined with AVL, the system gives operators the capability to monitor, supervise and control operations with real time data. This information can then be relayed to customers via Travel Information Service.

3. Travel Information Services (TIS) as shown in **Figure 5.26** are services that disseminate information on public transport service to the users. TIS enable users to plan their journeys around the scheduled services of public transport such as details on the bus route, bus arrival time at bus stops and estimated time of arrival at destination.

In a way, TIS is the most important component in public transport services to entice people to shift from using their private vehicles. Currently public transport users are often in the dark on what time their bus will arrive and when they will arrive at their intended destination. This usually results in them spending significantly more time on their journey than is actually necessary. Thus, this makes public transport an unreliable mode of transport. TIS takes on many forms and among them are:

(i) pre-trip information through web applications for travel planning such as the PublicTransport@SG in Singapore;

(ii) in-terminal/way side transit information through variable message signs;

(iii) in-vehicle transit information providing en route information to travellers about their transit trips; and

(iv) real time information through smartphone applications such as the SeoulBus appllication in Korea.

Figure 5.26 Real time passenger information display

Source: Data Display, http://data-display.com/news-3

4. Traffic Signal Priority (TSP) System is aimed to reduce delay for mass transit vehicles sharing road-space with other traffic (e.g. bus, trams) at signalised intersections.

There are 2 types of TSP technique:

(i) Passive TSP – Optimised signal timing to create a "green wave" for all traffic along the transit line's route.

(ii) Active TSP – The signal controller is programmed to detect oncoming transit vehicle fitted with transmitters and the signal timing is dynamically adjusted by the system to allow the transit vehicle to pass through with minimum delay. More complex systems integrate the TSP function with AVL and APC to also include occupancy level of the bus as the determining factor to accept or reject priority request.

5. Electronic Payment System (EPS) for transit fare collections enables cashless payments through the use of smart cards. The importance of this technology is two-fold: eliminating the need to purchase transit tickets; and to ensure integration between the different modes of public transport service. The Touch 'n Go card is an example of smartcard application in public transport fare collection system in Malaysia.

The problem is the uptake of the use of the card by the public. The issue here is the same as toll payments. Some people still prefer to pay cash through toll lanes even though the queue is horrendous during peak hours. Yet, it is only through cash payment they can obtain receipt for travel claim from their employer. The hassle is worth the effort when there are incentives. The right incentives have to be put in place to entice people to go contactless. EPS also offers the opportunity for integration to ensure the entire public transport system can be used as seamlessly as possible. A single transit card can be used across the Komuter, LRT, KL Monorail, the future MRT and bus services. A case in point: the RapidKL card introduced by Prasarana can be used only on LRT and monorail, but not on RapidKL buses. Public transport users usually need to commute in different modes from their origin to intended destination: walking-bus-rail-bus-walking, a single ticketing system would ensure a smooth journey which will greatly increase the "pull factor" towards public transport.

The AVL, TOS, TIS, TSP and EPS are stand-alone technologies, but they provide highest value when incorporated together to form a comprehensive system. Combined, this system provides a fully automated operation of information gathering and dissemination to the public: the AVL functions to feed information on vehicle locations to a central monitoring station equipped with TOS, which then relays this information to public transport users through TIS.

However, application of the technologies discussed here must also be accompanied by policies that would benefit the public transport system: dedicated lanes for buses, better physical and ticketing integration between the different modes of transport, improve non-motorised transport facilities for first-mile and last-mile journey. All these measure must be addressed in order to meet the demand of the public for a better public transport service.

Medium-Term Strategy (2035)

d. Parking Management

Managing parking spaces revolves around the concept that trips by car begins and ends at a parking space. The availability and cost of parking space therefore has a direct impact on whether cars are used for a specific journey (UNESCAP 2012). Plentiful and cheap parking encourages people to drive. As a result, public transport becomes a less attractive alternative. Parking management is an effective tool in Travel Demand Management (Department of Urban Affairs and Planning 2001). UNESCAP pointed out that in city centres with good public transport, restricting supply of and increasing the cost of parking, private car trips can be significantly reduced. However study by Barter for the ADB (as in **Figure 5.27**) emphasises that the alternatives in parking policy is more complex than selecting from a list of best practices. The choice is more than an option between a policy that favours supply of parking and a supply-constraining approach.

Approaches to parking policy		What is parking? And whose responsibility	Central goals	View of spillover	View of supply and demand
Conventional	Auto-centric	Infrastructure. Government and property owner responsibility.	Avoid parking scarcity	A free rider problem. Avoid by ensuring sites handle own parking	Supply planned to meet demand (based on auto-dependent assuptions, including zero price)
	Demand-realistic		Avoid both scarcity and wasteful surplus	To be avoided but small risk of spillover accepted and mitigation planned for	Supply planned to meet demand based on actual context
Parking management	Multi-objective	Infrastructure. Government responsibility mainly.	Plan parking to serve wider urban & transport policy goals	A source of conflict, but expected and manageable with active policy efforts	Supply and demand both need to be managed
	Constraint-focused		Key relevant goal is constraint of car travel (to certain locations)		Constraint of parking supply is a key mobility management/TDM tool
Market-based		Real-estate based service. Justified by private actors' willingness to pay	Ensure demand, supply and prices are responsive to each other. Avoid market failure	Defused as a problem and an expected part of parking market workings	Supply and demand to be shaped by arket actors' behavior. Informed by market prices

Figure 5.27 Approaches to parking policy in Asian cities

Source: Barter 2011

(i) **Conventional parking policy**

The primary goal of conventional parking policy is to meet demand. Regulations require that enough parking spaces to be provided to meet a predicted peak demand as a condition for building approval. Two streams within this approach can be distinguished by their differing treatments of demand for parking:

- *Auto-centric conventional parking policy* – The parking requirements are estimated based on the assumption that most travel will be by car at locations with poor alternatives to automobile access. These standards are then applied inflexibly without taking account of context or the specific users of the building.

- *Demand-realistic conventional parking policy* – parking requirements are based on more realistic assessments of demand for each site in its actual context, taking account of any pricing and of accessibility by alternatives to the car. This method is a refinement of the simplistic auto-centric conventional approach.

(ii) **Parking management**

Parking management includes parking policies that views parking as a tool for serving wider goals in transport policy and urban planning. Matching supply with demand becomes secondary to other goals of policy, in contrast with the conventional approaches. Two streams were identified based on their objectives:

- *Multi-objective parking management* – Parking management policies that serves multiple objectives such as efficiency, reducing parking conflict, revenue, urban regeneration, and mobility management. A multitude of policies could fall under this category. Parking requirements are not a necessary feature of parking management but, if present, tend to resemble demand-realistic conventional parking policy requirement.

- *Constraint-focussed parking management* – The central objective of parking management is traffic demand management. Parking supply is seen as a policy instrument and is actively constrained to reach wider transport objectives. This policy is usually constrained to CBDs with high market prices for parking and is only viable with availability of other transport options.

(iii) **Market-oriented parking policy**

The market-oriented parking policy is essentially market-driven. The supply and prices of parking are responsive to supply and demand conditions. This approach tends to see parking demand as a vicinity-by-vicinity phenomenon in park-once localities, not as something associated with specific buildings. The study by Barter also compares current conditions of parking policy in Asian countries. **Figure 5.28** shows car parking space required for commercial buildings in Asian cities.

	CDB office building	Non-central office building	Shopping center (non-central)	Commercial requirement average
Beijing	0.5	0.5	0.3	0.35
Tokyo	0.3	0.3	0.4	0.36
Singapore	0.2	0.5	0.5	0.42
Hong Kong	0.4	0.6	0.4	0.46
Dhaka	0.5	0.5	0.5	0.50
Guangzhou	0.6	0.6	0.6	0.60
Ahmedabad	0.7	0.7	0.7	0.65
Taipei city	0.7	0.7	0.7	0.67
Seoul	0.1	1.0	1.0	0.78
Hanoi	1.0	1.0	1.0	1.00
Manila	1.3	1.4	1.0	1.19
Jakarta	1.0	1.0	1.7	1.33
Bangkok	1.7	1.7	2.6	2.15
Kuala Lumpur	1.5	2.6	2.7	2.40
Sydney	0	3.3	4.0	2.83

Figure 5.28 Car parking space required for commercial buildings in Asian cities

CBD = central business district

Note:

1. The "standard buildings" used for the comparisons here were: a CBD office building of 25,000m^2 gross floor space; a "non-central" office building of 25,000m^2 gross floor space; and a medium-sized, non-central shopping center with 25,000m^2 gross floor space.
2. The "average" column is the average of the shopping center figure and the average of the two office figures.

Source: Barter 2011

The Kuala Lumpur metropolitan area stand out from the others with especially high requirements, averaging above two spaces per 100m^2 of floor space for the building types examined. The parking requirement for residential buildings in Kuala Lumpur is also relatively high compared to other countries, as shown in **Figure 5.29**.

Urban Area	Small flats (slots per unit)	Small flats (slots per 100m^2)	Medium flats (slots per 100m^2)	Average of small and medium (slots per 100m^2)
Jakarta	0.1	0.2	?	?
Hong Kong	0.03, 0.1	0.05, 0.2	0.03, 0.6	0.24
Ahmedabad	0.1	0.2	0.3	0.24
Hanoi	0.2	0.3	0.2	0.25
Tokyo	0.2	0.3	0.2	0.28
Dhaka	0.1	0.2	0.5	0.33
Beijing	0.4	0.7	0.4	0.52
Bangkok	0.2	0.3	0.9	0.62
Taipei city	0.4	0.7	0.7	0.67
Manila	0.3	0.4	0.9	0.67
Guangzhou	0.5	0.8	0.6	0.74
Singapore	1.0	1.7	0.9	1.30
Kuala Lumpur	1.0	1.7	1.0	1.35
Seoul	0.8	1.3	1.5	1.44
Sydney	0.9	1.6	1.2	1.36

Figure 5.29 Car parking space required for residential buildings in Asian cities

Note:

1. The specific hypothetical buildings used to derive these requirement were: small flats (middle-suburb, slots for a 100 unit block of flats each of 59m^2) and medium flats *middle-suburb, slots for a 100 units block each of 110m^2
2. The Singapore figures are the regulations that apply toprivate sector housing, a small segment of the market serving mainly high-income residents.
3. For Hong Kong two figures are given in each column, the left ones are for subsidised housing and the right figures are for private housing. The average is a weighted one, assuming subsidised housing accounts for about 48% of the population.

Source: Barter 2011

	How extensive is pricing of on-street parking?	Differences in prices from place to place or time to time?	Highest price fount (PPP$/hour)	Time limits used
Dhaka	Limited to the busiest commercial streets	Higher price in Motijheel CBD than elsewhere		No
Ahmedabad	Very limited	Single price. Few locations priced	4.0	No
Jakarta	Extensive in commercial streets	Two zones		No
Kuala Lumpur	Extensive in commercial streets	Uniform price within each municipality		Yes (3 hours)
Bangkok	Limited to the busiest commercial streets	Uniform price, where priced		No
Hanoi	Extensive	Two zones		No
Guangzhou	Extensive	Zones with different prices		?
Beijing	Extensive	Two(?) zones with different prices		?
Hong Kong	Many streets, throughout	Uniform legislated price		Yes (2 hours if demand high)
Manila	Extensive within Makati but in few other commercial areas of Metro Manila	Different prices around Metro under various cities		Yes (3 hours)
Singapore	Extensive in older commercial streets	S$1/half hr in central area, elsewhere S$0.50/ half hr		No
Tokyo	Scattered in many locations but not extensive	Uniform legislated price		Yes (usually 60 min)
Taipei city	Extensive	Prices higher in high-demand locations. Occupancy influences price revisions		No (price per hour escalates)
Seoul	Extensive in commercial streets	Five zones (Area 1 has parking constraints)		No

Figure 5.30 On-street car parking pricing and time limits in Asian cities

Source: Barter 2011

It is clear from the figures that Malaysia practices the conventional parking policy (auto-centric and demand-realistic) which aims to fulfil demand for parking. Parking, especially on-street is also priced comparatively lower than other country. Local governments should consider implementing the constraint-focussed parking management to manage travel demand. This is the stream in parking policy that is most closely associated with efforts at a mode shift and sustainable transport agendas.

Parking management involves the combination of a subset of different measures, to target both on-street and off-street parking (UNESCAP 2012):

- Parking regulation can limit parking outright, for certain times of the day, or the maximum length of stay in one location.
- Parking fees could be introduced where currently non-existent, and increased where demand outstrips supply. Parking fees could be made flexible to reflect time of day, amount of demand, etc.
- Planning can consider dedicated residential parking areas, maximum parking standards for new buildings, Park & Ride facilities, and parking guidance systems to reduce the need for on-street parking in city centres.

Nevertheless, the study also mentions that there is so far little enthusiasm for constraining parking in Malaysia and that over the last two decades, politicians and planners in Kuala Lumpur have often mentioned the possibility of parking constraint but there has been little action on this except for central parking requirements that are slightly lower than elsewhere. Despite serious traffic congestion problems in most Asian cities, parking constraint is generally seen as something for the future considering the limitations of existing public transport.

I. Technology Application

Parking information and guidance systems simplifies the hassle of finding parking. The guidance system provides motorists with real time information on how many spaces are available and where they are located. With less time spent on finding parking, traffic congestion, fuel consumption and air pollution are directly reduced. The system integrates bay sensors, parking software and real time updates of LED parking information display panels. This kind of technology is pictured in **Figure 5.31**.

Figure 5.31 Bay detection equipped with bay sensors

Source: Intelligent Parking (http://www.intelligentparking.com/)

e. Congestion Charging

The idea of implementing congestion charging in Kuala Lumpur had been mooted by the Government before. The proposal was, however, shelved due to widespread objection and lack of efficient public transport (Loh 2013). The arrival of a comprehensive public transport system in GKL/KV as envisioned by SPAD calls for the re-examination of the implementation of congestion charging. The concept of congestion charging is to charge road users for the costs that are inflicted by them driving their private vehicles such as congestion, air pollution, noise and vibration. Congestion charging rationalises road space so that they are used only by those who are prepared to pay for the costs imposed on the wider society, while also generating revenue. The direct impact is the reduction of traffic levels entering the city centre and thereby the social and environmental costs.

There are three main forms of urban congestion pricing systems:

(i) Single Facility Congestion Charging: Charges are applied for the use of a single facility (such as a single road) at peak times. Often achieved by altering existing road pricing schemes (e.g. at toll bridges/tunnels/roads) to vary with time;

(ii) Cordon Area Congestion Charging: Drivers are charged to enter into the charging zone; and

(iii) Distance-based Congestion Charging: Drivers are charged according to the distance they drive whilst inside the charging zone.

To illustrate, Singapore was the first country to implement cordon area congestion charging through its Area Licensing Scheme (ALS) in 1975. Without the technology to implement the programme electronically at the time, drivers were required to display daily or monthly windshield licenses to enter the central Restricted Zone. The charge in the beginning was only for entry during morning peak hours. Evening peak-hour charge was introduced in 1989 while the charges were extended to all-day charging in 1994. The ALS was implemented as part of an overall package of road pricing measures and public transportation improvements. Congestion charging in London also implemented the same measures (Comminnd). With advancement in technology, the fully automated Electronic Road Pricing replaces the ALS in 1998. The electronic system has the ability to vary the prices based on traffic conditions and by vehicle type, time and location. The example of such an initiative is as shown in **Figure 5.32**.

Figure 5.32 ERP Gantry at North Bridge Road in Singapore

Source: Wikipedia (http://en.wikipedia.org/wiki/Electronic_Road_Pricing_(Singapore)

I. Technology Application

Open Road Tolling (ORT) or Multilane Free Flow (MLFF) is an innovative solution to the collection of tolls without the use of toll booths. Gantries over roadways are used to install Electronic Toll Collection (ETC); enabling toll payment while vehicles pass through near highway speed. ORT can be installed as the technology for congestion charging or solve congestion issues at toll plazas that we have now in Malaysia. The example of such a system is shown in **Figure 5.33**.

Figure 5.33 Open road tolling lane

Source: Mrschimpf 2009

ORT, requires the ETC to be capable of long distance transaction at high operating frequency to match the speed in which vehicles are travelling. Two types of technology are commonly employed:

(i) RFID transponder - Each vehicle carries a transponder as in **Figure 5.34** that deducts payments when it passes through a gantry (e.g. 'tag and beacon'); and

Figure 5.34 RFID tag for electronic toll collection

Source: Wikipedia (http://en.wikipedia.org/wiki/Radio-frequency_identification)

(ii) Automatic Number Plate Recognition (ANPR) - Optical Character Recognition (OCR) as in **Figure 5.35** is used to read licence plate numbers captured by video cameras.

Figure 5.35 ANPR cameras mounted on a vertical pole

Source: BBC

Often times, both systems are required: RFID functions as the toll collection system while ANPR functions to identify unequipped vehicles and record the identification for enforcement purposes.

ORT offers significant advantages over the current tolling system that we have now: cash payment, Touch 'n Go card and Smart Tag. Current system requires vehicles to stop or slow down for toll collection while ORT enhances throughput and lessens congestion impact of toll collection activities. ORT has the potential to lower operational cost requiring no human operators near the gantries. Safety is also increased as there are no conflict points: vehicles do not have to weave near the toll plazas to go to the lanes that they want. Safety also increases without toll barriers, allowing the road user to maintain the same cruising speed. Reducing congestion also has the direct impact of reducing GHG and pollutant emissions.

The main challenge to implementation of ORT is road user's preference to stay on using cash payment even when ETC is available as we are seeing now. Complex relations between different institutions also create a problem in determining the agency responsible for enforcement.

e. Improve Vehicle Technology and Fuel Standard

These measures are aimed at reducing the environmental impact of each kilometre travelled. It is a broad measure aimed towards improving vehicular and fuel technology to improve environmental efficiency. This measure requires the Government to set regulations on three fronts:

(i) set statutory fuel efficiency standard to improve the fuel economy of vehicles;

(ii) set statutory fuel standards to improve quality of fuels; and

(iii) set statutory emission limits for motor vehicles to reduce exhaust emissions.

The implementation of fuel economy standards began in 1975 with United States as a reaction to the Middle East embargo in 1973. At the time U.S. saw the establishment of the Corporate Average Fuel Efficiency (CAFÉ) standards as a way to reduce their dependency on foreign oil. However fuel economy standard has become one of the most promising strategies to reduce fuel consumption. As GHG emissions is directly tied to fuel consumption, fuel economy standard have also been formulated as GHG emission standards in certain countries. **Figure 5.36** shows fuel economy and GHG standards around the world.

Country/ Region	Type	Measure	Structure	Test method	Implementation
USA	Fuel	mpg	Cars and light truck	US CAFE	Mandatory
EU	CO^2	g/km	Overall light duty fleet	EU NEDC	Voluntary
Japan	Fuel	km/L	Weight based	Japan 10-15	Mandatory
China	Fuel	L/100 km	Weight based	EU NEDC	Mandatory
Canada	Fuel	L/100 km	Cars and light trucks	US CAFE	Voluntary
California	GHG	g/mile	Car/LDT 1 and LDT 2	US CAFE	Mandatory
Australia	Fuel	L/100 km	Overall light duty fleet	EU NEDC	Voluntary
Taiwan	Fuel	km/L	Engine size	US CAFE	Mandatory
South Korea	Fuel	km/L	Engine size	US CAFE	Mandatory
Austria	Fuel	3 L/100 km	Engine size	EU NEDC	Voluntary
France	CO^2	150 gram/km	Overall light duty fleet	EU NEDC	Voluntary
Germany	Fuel	km/L	Engine size	EU NEDC	Voluntary
Pakistan	Fuel	L/100 km	Engine size	Japan 10-15	Voluntary

Figure 5.36 Fuel economy & GHG standards around the world

Source: Mahlia *et al.* 2011

Under these programmes several countries have introduced fuel economy labels as a tool to help consumers compare performance of different vehicles. **Figure 5.37** shows the EPA fuel economy label. The labelling includes information that compares the fuel efficiency of different vehicles, expected on-road fuel efficiency and estimating annual fuel cost.

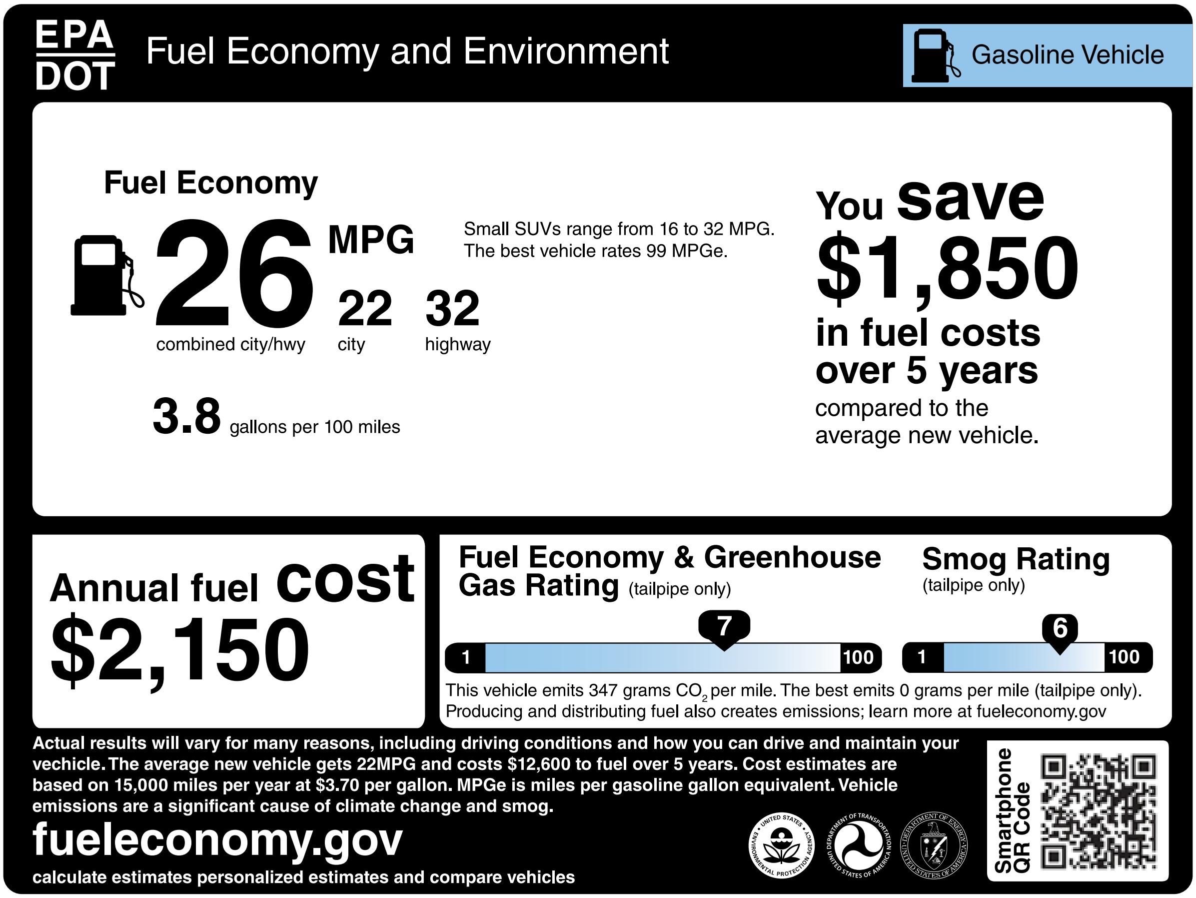


Figure 5.37 EPA fuel economy label

Source: Mahlia *et al.* 2011

However, Malaysia has yet to establish fuel efficiency standard for motor vehicles. Yet, the Malaysian Government has developed several policies to control emission from vehicles (CAI 2010):

- Environmental Quality (Clean Air) Regulations 1978;
- Environmental Quality (Control of lead concentration in automobile gasoline) Regulations 1985;
- Environmental Quality (Control Emission from Diesel Engine) Regulation of September 1, 1996; and
- Environmental Quality (Control of Emission from Gasoline Engines) Regulation on November 1, 1996.

As shown in **Figure 5.38**, Malaysia applies the Euro emission standards beginning from 1997. Malaysia is currently applying the Euro 2 emission standards for gasoline and diesel vehicles.

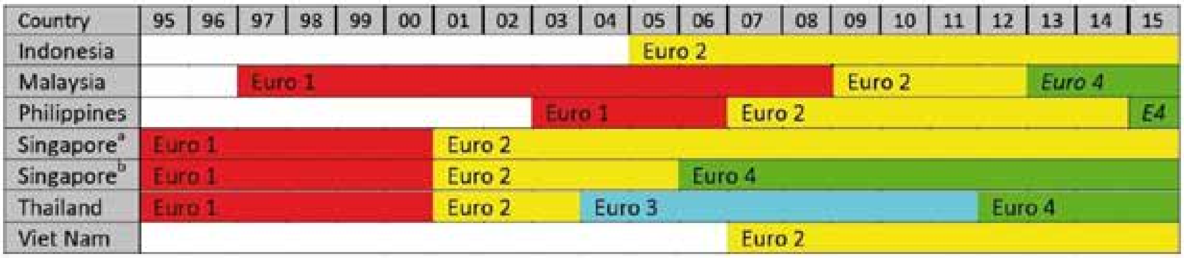


Figure 5.38 Emission Standards for New Light-Duty Vehicles in representative ASEAN countries

Notes: Italics – under discussion; a – gasoline; b – diesel

Source: CAI-Asia 2010

The current fuel quality for gasoline and diesel are still at Euro 2. The recent National Automotive Policy indicated that the master plan for implementation of Euro 4 quality fuels will be out in 2014.

These three standards will act as catalyst to stimulate vehicle manufacturers to invest in and promote technological changes that will improve the fuel economy and reduce exhaust emissions. The onus is on the manufacturers to find ways to reach these standards: engine technology, reducing weight of vehicle, aerodynamic design, alternative fuels, etc. These measures are also in line with the aim of making Malaysia the production hub of energy efficient vehicles as outlined in the National Automotive Policy 2014.

Long-Term Strategy (2050)

f. Removing Fuel Subsidies

Fuel pricing is considered one of the major components in travel demand management. Fuel subsidies are often applied at the national level as an incentive by the Government to ease financial burdens of the people. This move, whether intentionally or not, often promote the use of private vehicles.

GIZ in their biannual publication International Fuel Prices identifies three dimensions to fuel pricing policy. The first dimension refers to three fuel pricing regulation approach:

(i) *Ad hoc regulation* – Unsystematic price changes over long intervals or constant prices over several years;

(ii) *Active regulation* – Prices are regulated and reviewed based on pre-determined criteria and/or formulae and often at regular intervals (weekly, monthly); and

(iii) *Passive or no regulation* – Regulation is limited to the level of taxes and framework conditions (e.g. fuel qualities).

The second dimension refers to the four levels of taxation or subsidies:

(i) Very high subsidies – retail price is below the level of crude oil price;

(ii) Subsidies – above the price of crude oil but below the prices in US;

(i) Taxation – above the price of US but below price of cheapest EU-27 country; and

(ii) High taxation – above price level of cheapest EU-27 country.

The third dimension of fuel pricing is how transparent the composition and regulation of fuel prices are shown in **Figure 5.39**.

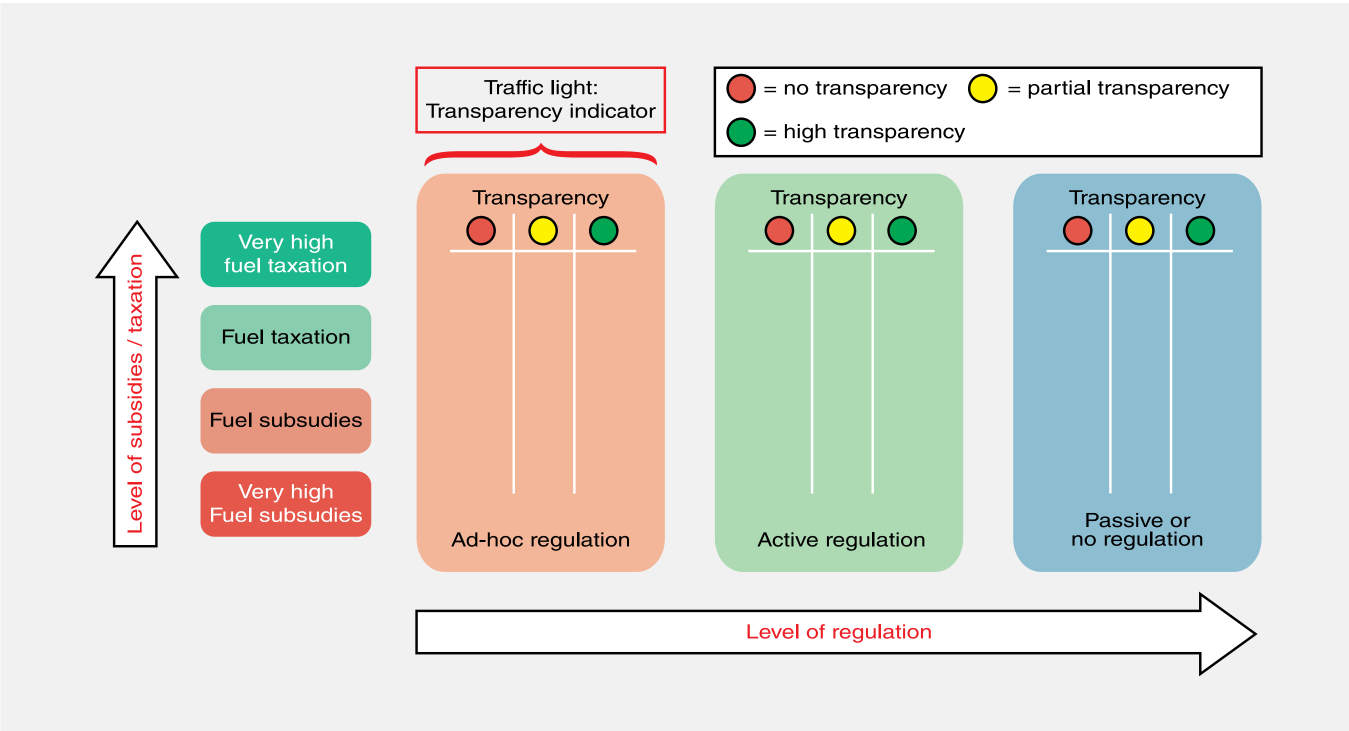


Figure 5.39 The relationship between the three dimensions of fuel pricing policy

Source: GIZ 2012

Malaysia falls under the category of country that provides fuel subsidy. Petroleum fuels have been heavily subsidised in Malaysia where subsidies have been put in place to alleviate the potential effects of external energy shocks and lighten the burden on consumers. **Figures 5.40** to **5.43** illustrate the statistics compiled by GIZ, for countries including Malaysia, as of November 2010.

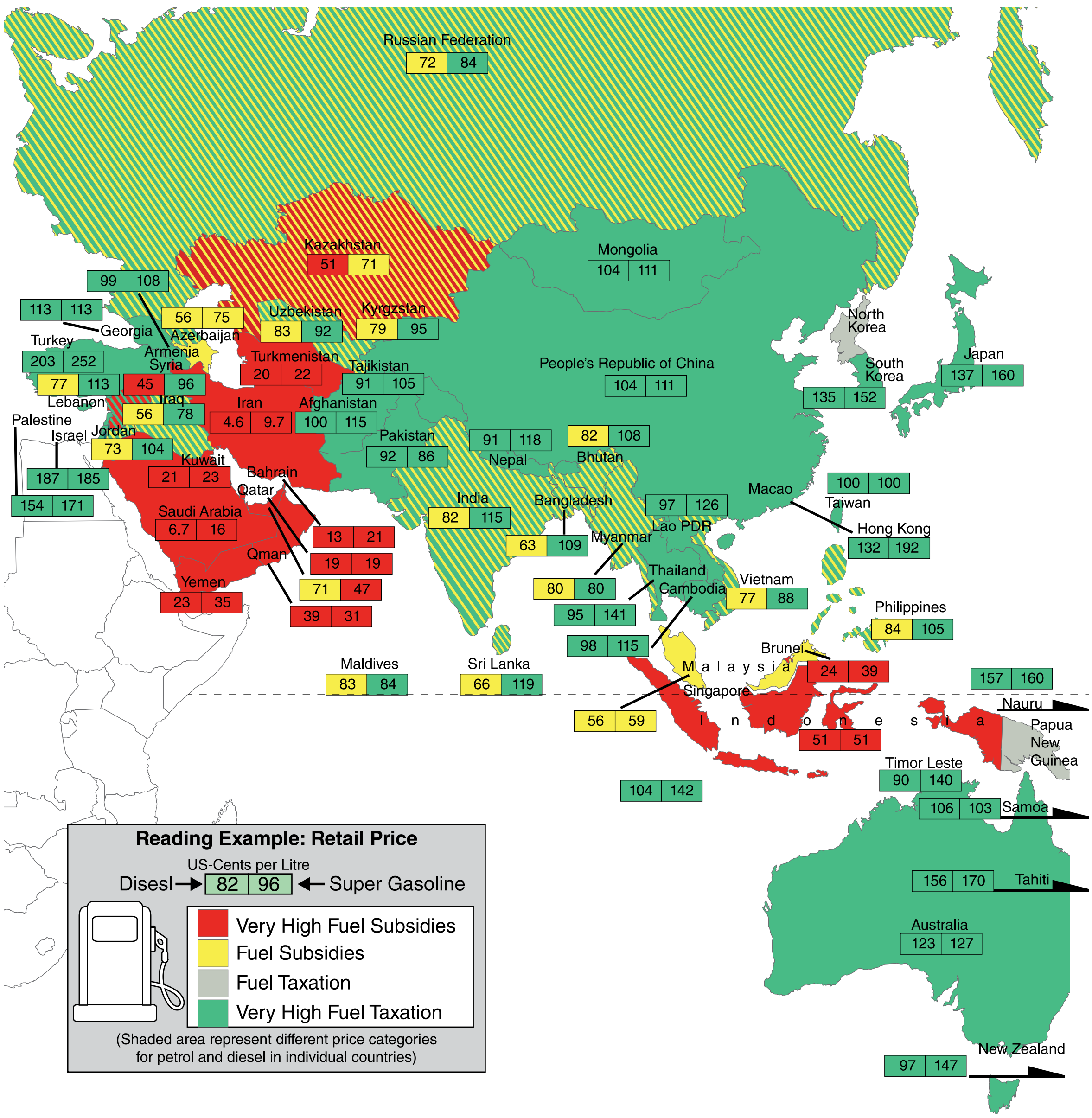
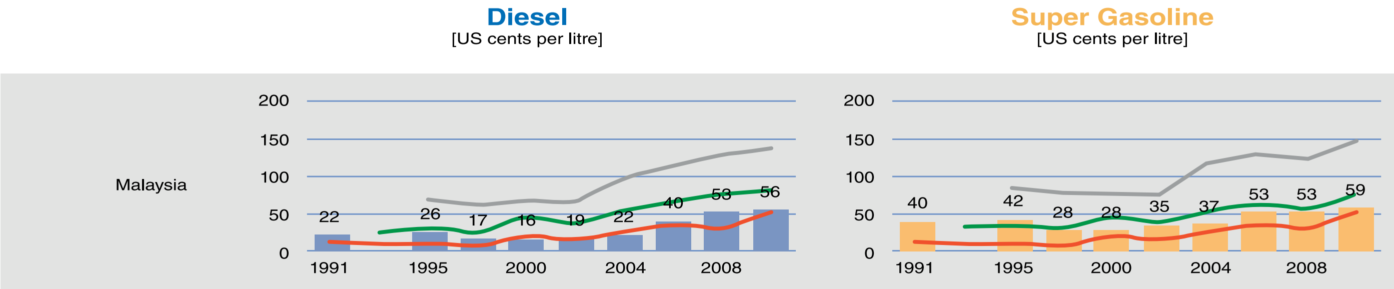


Figure 5.40 Retail fuel prices in Asia, Australia and Pacific as of November 2010 in US-cents/litre

Source: GIZ 2012



Grey Benchmark Line : Retail price of gasoline and diesel of Romania/Luxembourg. In November 2010, gasoline (diesel) prices in Romania (Luxembourg) were the lowest in Europe. Prices in EU countries are subject to VAT, specific fuel taxes as well as other country specific duties and taxes.

Green Benchmark Line : Retail price of gasoline and diesel in United States. Cost-covering retail prices incl. industry margin, VAT and incl. approx. US 10 cents for 2 road funds (federal and state). This fuel price being without other specific fuel taxes may be considered as the international minimum benchmark for a non-subsidised road transport policy.

Red Benchmark Line : Price of crude oil on world market.

Figure 5.41 Detailed time series of fuel prices in Malaysia, 1991 – 2010

Source: GIZ 2012

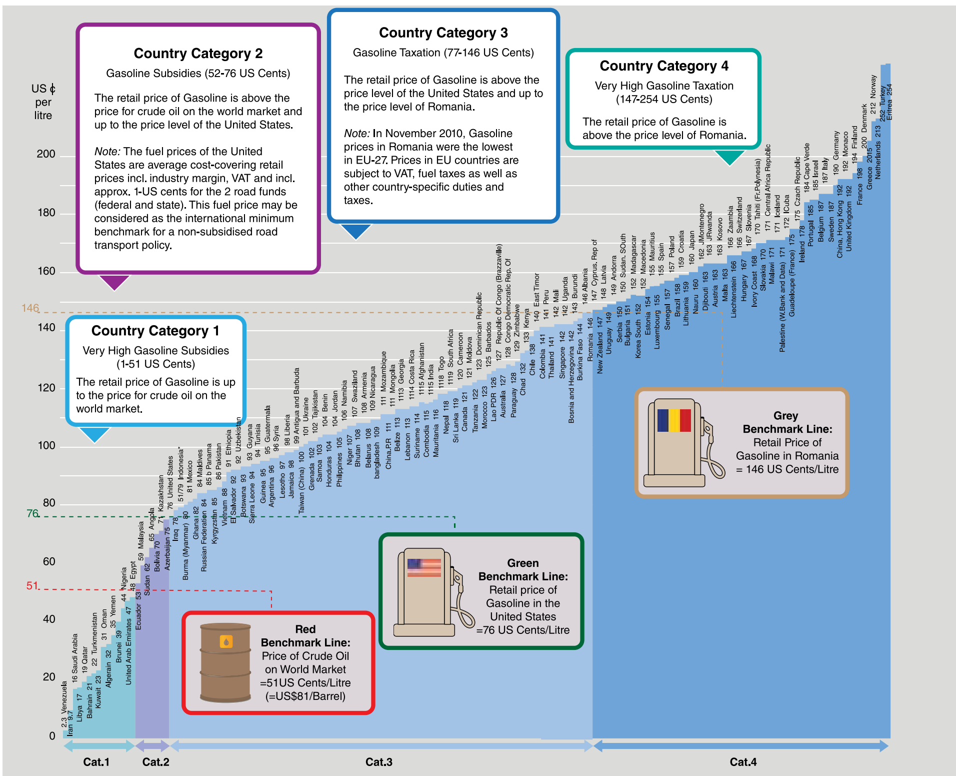


Figure 5.42 Retail prices of gasoline in 174 countries as of November 2010 in US-cents/litre

Source: GIZ 2012

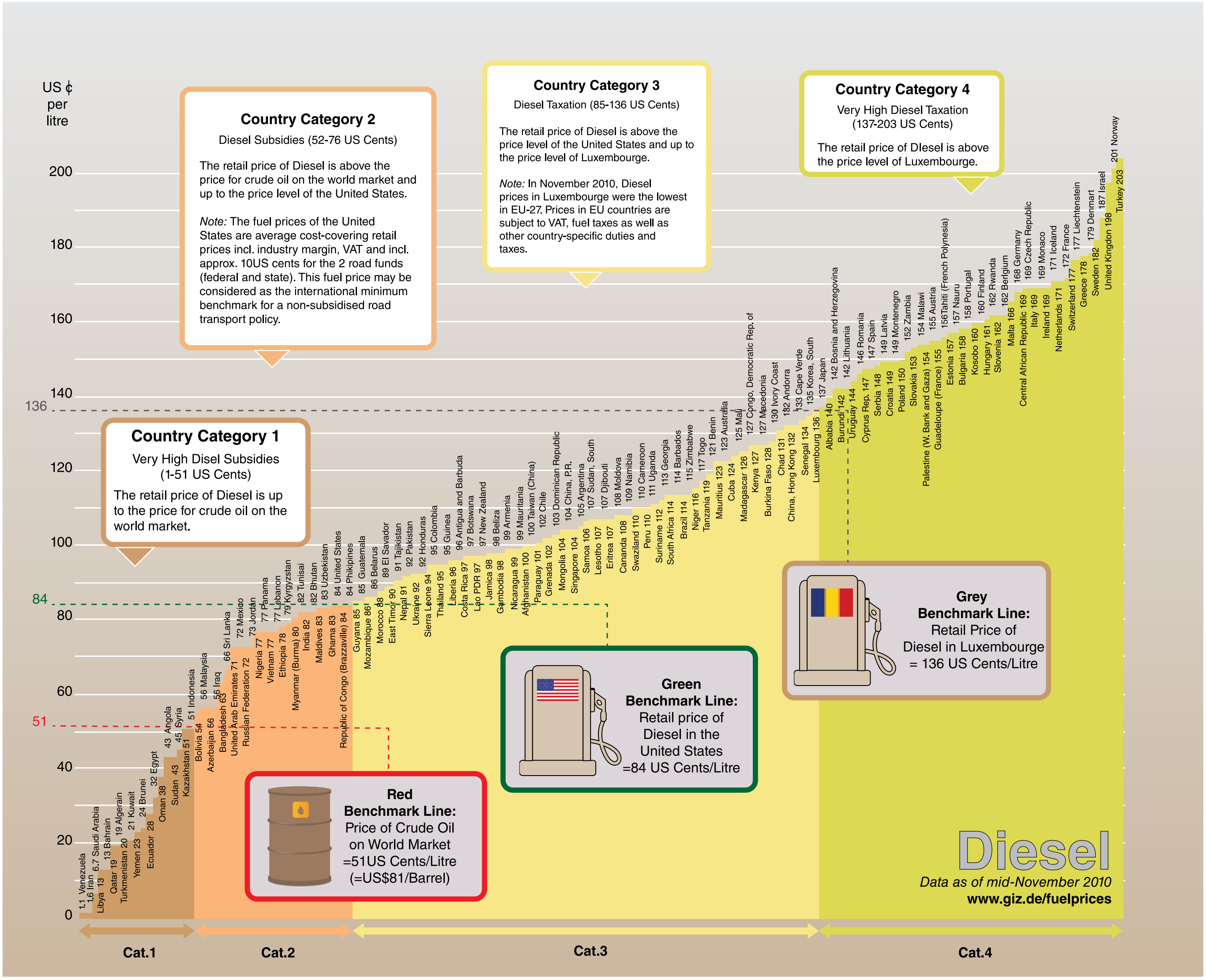


Figure 5.43 Retail prices of diesel in 174 countries as of November 2010 in US-cents/litre

Source: GIZ 2012

As of 2010, Malaysia's per capita subsidy is the highest among other ASEAN countries at USD 200 per capita (National Economic Briefing 2010).

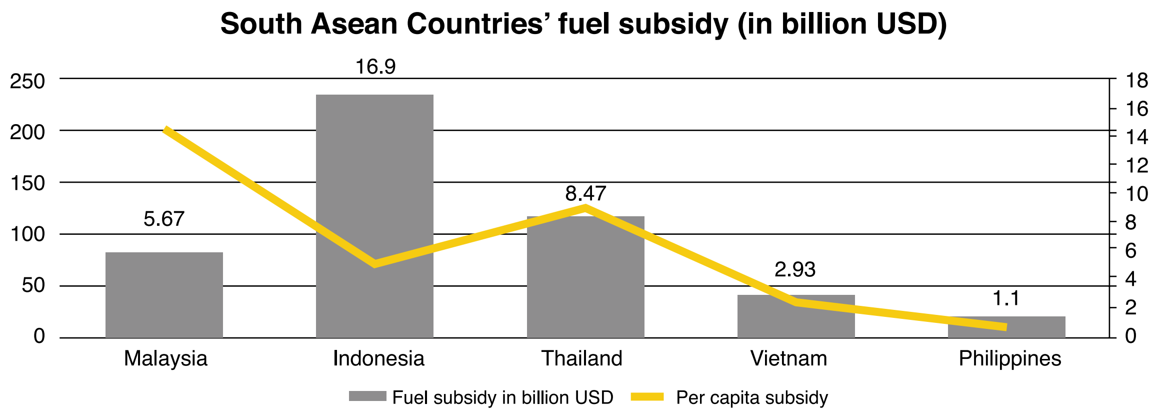


Figure 5.44 Fuel subsidy of representative ASEAN countries

Source: National Economic Briefing 2012

Fuel subsidies are a burden to the economy and encourage wasteful fuel use. Removal of subsidies would reduce impact on economy and reflect the real cost of travel to users. This will directly foster an energy efficient transport system and make walking, cycling and public transport more attractive in financial terms. Rising fuel prices offers countries like Malaysia an opportunity to reassess fuel price policies. The fuel subsidies of representative ASEAN countries are shown in **Figure 5.44**.

In 2008, the Malaysian Government announced its intention to rationalise subsidies to reduce the Government's financial burden. The decision was grounded on three main concerns (Razak 2010):

(i) Fuel subsidies also benefits foreigners and wealthier Malaysians who can well afford to pay unsubsidised prices.

(ii) Highly subsidised prices often lead to illegal smuggling across the border.

(iii) The quick depletion of domestic fuel resources.

The decision to reduce subsidies for fuel is based on the fact that reducing fuel subsidies will have the greatest impact on Government spending while targeting investments on targeted social subsidies for education and healthcare (Razak 2010).

Effective 16 July 2010, subsidies for fuel, specifically petrol, diesel and Liquefied Petroleum Gas (LPG) was reduced as the first step of a gradual subsidy rationalisation programme. Subsidies for RON 95 petrol and diesel were reduced by 5 cents per litre while LPG was reduced by 10 cents per kilogram. RON 97 petrol is no longer subsidised and is subjected to a managed float, where prices are determined by the automatic pricing mechanism. Even after these changes the Government estimates to spend RM7.82 billion in 2010 and the fuel prices are still among the lowest in the region (Razak 2010). The latest price adjustment to the RON95 gasoline was on September 3rd, 2013 to RM2.10/litre. Diesel is currently priced at RM2.00/litre.

In light of rising cost of living, any effort by the Government to further reduce fuel subsidies has hit a snag. Malaysia should focus on reform efforts on a long-term perspective. Even if subsidies are maintained, regular price adjustments should be introduced with the emphasis on transparency of the pricing mechanism. The reform timeline should be outlined as follows:

(i) Government plans and the motivation behind them; and

(ii) The phasing out of subsidies by a given date and the price increase increments.

There may be opposition from consumers to the increase in cost of transport. Public grievances with regard to increasing prices are caused among other things by often inappropriate regulatory approaches and limited transparency. The emphasis here is a transparent process: case studies in several studies have shown that there are less opposition from consumers if the mechanism of fuel pricing can be clearly understood and the reasoning behind it is sound. Rather than a blanket fuel subsidy, targeted subsidies can also be provided to the most vulnerable members of society that may be affected by the rise in fuel price.

The taxation of fossil fuel is a powerful instrument to generate revenue for supporting sustainable transport initiatives. However, current economic climate in Malaysia indicates the Government should focus on fuel subsidy removal first and foremost, before answering the question of fuel tax.

5.3 THE FUTURE AND MEGA TRENDS: RAIL TRANSPORTATION

5.3.1 R&D

R&D plays an important role in the development of rail transport in Malaysia. Based on the discussions during the ASM workshop, it was pointed out that Malaysia needs to develop its own rail transport technology to reduce the reliance on foreign expertise. In the light of this, there is a need to establish a research institute designated for conducting R&D in the field of rail transport.

The establishment of national research centre for rail is common in countries where rail transport is given due emphasis. Such research institutes include Railway Technical Research Institute (RTRI) in Japan, Rail Research UK association in the UK, China Academy of Railway Science in PR China etc. The main role of these research institutes is to spearhead R&D in the field of rail transport to ensure continuous and sustainable development of rail transport in the country. Apart from conducting and coordinating research activities, once established, the national rail research institute can provide consultation to the governing bodies on policies and plans where rail transport is involved. The research institute can also form a platform for industry and universities to converge and share knowledge and experiences.

In order to have a clearer idea on the R&D for rail, there is also a need for a R&D roadmap dedicated to the development of rail technology. So far, the rail-related policies in Malaysia have been focusing on a general view of how rail will act as part of the national transport system. In the National Rail Industry Roadmap prepared by MIGHT, even though more details on the desired development of rail industry have been covered, not much has been discussed on the expected technological development.

In order to have a clear direction on the development of rail technology, it is important to first outline the technology development road map for rail industry. In this case, the research institute mentioned earlier can serve as the coordinator and gather opinions from the governing bodies, industry players and academic researchers, in order to formulate the technology road map. This road map can then act as a blue print for directing the R&D activities for rail transport system in Malaysia. An example of such technology road map is the "On track to 2040 – Roadmap" prepared by ANU Edge. In the documents, 80 technology developments have been identified and broadly categorised into three categories, namely material and manufacturing, monitoring and management, and power and propulsion. Out of these, six high priority areas were selected and detailed road maps for their development were designed.

5.3.2 EDUCATION AND TRAINING

The development of rail industry will never be possible without well trained human capital. So far, there is little emphasis on the development of human capital in rail industry. This is evident from the fact that only one university, e.g. UTHM, is offering rail-related course. Other rail-related academies are providing technical courses rather than professional degrees. It is hence important to provide more education and training opportunities in the rail technology. The development of rail-related education should also be coordinated with the growth of the rail industry to ensure that there is sufficient job market for the graduates.

5.3.3 SAFETY

Safe, efficient and cost effective railway systems are features that both railway operators and passengers demanded in the future. With all safety aspects are implemented, it is expected that the number of accidents or fatalities related to rail to be gradually decreasing. There are several factors that should be taken into account to ensure that high-level of safety in rail transportation is achieved, as discussed below:

a. Research and Development (R&D)

Continuous research and development has to be conducted where the findings in terms of technology, database and policies can be used to advance railway safety. The technology under development for instance shall be related to equipment, track, signalling and level crossings. Database on accidents occur can be used to identify the weakness of the system. The findings can be used to provide recommendation for improvement that may involve acquisition of new system and also new policy development. This also includes providing tangible solutions out of equipment and system failures that can save lives and minimise economic loss. The research and development does involves financial and manpower resources.

b. Rail Safety Education

Safety awareness campaign on rail safety has to be regularly conducted and should not targeted to motorists and pedestrians only but also to children. Resources need to be developed to educate children about rail safety beginning in primary school. Learning about safe behaviour around the rail corridor is very important to strive towards a safe community. The lesson plan should illustrate the risks involved when crossing railway tracks and educate children the behaviours they need to adopt to keep them safe.

c. Rail Infrastructure

In order to ensure reliable and safe system operation, the rail infrastructure must satisfy high level of safety standards which are recognized internationally. This includes the railway system design, installation, operation and maintenance. Among others is EN50126, an international standard which give the specification and demonstration of reliability, availability, maintainability and safety in railway applications.

d. New Rail Safety Technology

Positive Train Control (PTC) is among new technology that shall be adopted to make travel by rail even safer. It is a life-saving innovation that is capable of preventing train-to-train collisions, over-speed derailments, unauthorized incursion into work zones and train movement through switches left in the wrong position. PTC communicates with the train's onboard computer and sends the real time visual and audible information to train crew members. When PTC senses danger, PTC audibly warns the train crew member to take safety action. However, if there is no respond, PTC will take action automatically by activating the brakes and safely stop the train.

e. Others

By 2050, innovative combination of signaling and automation with GPS, enhanced communications and computers will improve safety of railways. Electronically controlled braking will also be important for heavy haul railways. One part of this type of efficiency improvement will be standardisation of operations through programs like European Rail Traffic Management System (ERTMS) in the EU. More sophisticated strategies to enhance rail safety include real time monitoring of all equipment condition and maintenance planning, which are currently being done by many airlines and some US freight railways; real time system management of all trains without wayside signals; including tighter integration of rail services into logistics chains. Added to that, all signaling systems and communication systems should be wholly secured. Supervision systems for the management of degraded modes are implemented. Vision systems connected to a public security system are tracking activity, which permits fast response in cases of acts of aggression, terrorism or vandalism.

Research studies and simulation of scenarios to enable the fastest possible reaction in the event of an emergency should be the milestone target in mid-term. By 2050, freight transport is well managed. By utilising scanning systems and advanced tracking and surveillance technologies, vehicle cargos and loading details are known from the operators. In addition, dangerous materials can be tracked throughout the world. Detection systems are installed on-board to detect explosives and toxic substances along the track.

5.3.4 TARGET FRAMEWORK

Short-Term Strategy (2020)

As a short term target, there is a need to establish a research institute designated for the development of rail transport system and its related technology in Malaysia. The institute can spearhead the research and development activities, bringing together government agencies, industry players and universities on these matters. The institute should coordinate and establish a roadmap for the development of rail industry in Malaysia, covering all the important aspects such as policy, spatial allocation, technology and industry development. With the specialised knowledge and expertise in the field of rail transport, the institute can play an important advisory role to the Government in related policies and plans.

Even though various rail development projects have been proposed by the Government, through policies such as National Physical Plan 2, the Economic Transformation Plan and National Land Transport Master Plan, there is a need to verify the feasibility of the proposed project before embarking on them. In particular, the high speed rail project requires in depth analysis on it sustainability. Similarly, other projects such as the East Coast Rail Link and the Sarawak railway require feasibility studies as well. It is well aware that these are currently being conducted by the relevant bodies; this should nevertheless be highlighted here in this report for its completeness.

Improving the service level to increase customer satisfaction is also an important target for the rail transport. It is suggested that as short term goal, information and communication technology should be utilised, to provide real time information on rail services. This allows accurate knowledge of the train schedule, and timely information on any delay or interruption on train service. With such information, the passengers can decide their travel plan better and improve their satisfactions.

In the coming few years, it is expected that several important rail transport projects will be completed, notably the Klang Valley Mass Rapid Transit (KVMRT), the BRT system in Sunway, the extension of the existing light rail network etc. In the light of this, there is also a need to monitor and evaluate the performances of these projects. These should be part of the short term goals for the rail transport in Malaysia.

Mid-Term Strategy (2035)

The development of local human capital in the field of rail transport technology is suggested as one of the mid-term strategy for the rail industry. By this stage, the rail research institute should be established enough to be able to start focusing on human capital development. Besides providing talents in the aspect of operation and management, the country should develop local talents on the aspects of technology and engineering for rail transport, namely on MRO activities. In turn, this will cut down Malaysia's reliance on foreign expertise and provide the foundation for developing local rail industry into regional or even global players.

Depending on the outcomes of the feasibility study, conducted as part of the short term goals for the rail industry, there is should be a clear idea on whether or not Malaysia should embark on the high speed rail project. Should be feasibility study results turned out to be positive, the government should strategise itself for the funding and coordination of the projects. Thus, the improvement on feeder system should be part of the mid-term target for rail transport.

Another important mid-term strategy will be to improve the rail network coverage in Malaysia. New railways need to be constructed to connect important cities, especially those on East coast of the Peninsular Malaysia. Apart from intercity rail, the mass rapid transit system needs to be integrated into major cities outside Klang Valley, such as Johor Baharu and Penang.

Long-Term Strategy (2050)

In terms of connectivity, the long-term strategy is to establish Malaysia's railway system as part of the Trans-Asian Railway. On the connectivity within Malaysia, the local rail networks should provide sufficient coverage such that rail transport can be the main mode of transportation for intercity travelling, as proposed in NPP 2. Intra-city rail system should be a integrated part of urban transportation system in all main cities in Malaysia, including East Malaysia. Utilising the knowledge gained from the in the Klang Valley, efficient feeder system for rail transport needs to be implemented together with the development of intra-city rail system.

In terms of R&D, with the initiative from the Government and under the lead of the rail research institute, local rail industry should have gained sufficient technological know-how and have grown to become global players in the international rail market. In terms of high speed train, Malaysia needs to development local technology and expert on high speed Maglev trains as part of its long-term goals for the rail industry.

In terms of improving customer experience, it is suggested that integrated tickets should be used by the rail service providers. Apart from being usable as train ticket, the integrated ticket will be usable for all public service provision and other retail industries.

5.4 THE FUTURE AND MEGA TRENDS: AEROSPACE TRANSPORTATION

5.4.1 TRANSPORTATION SYSTEM AND TECHNOLOGY

As the demand for our nation's increasingly congested airspace continues to grow there is a need for a new generation of technologies that is able to guide and track aircraft more precisely. A smarter satellite-based system coupled with digital technologies will enhance safety, reduce delays, save fuel and reduce aircraft exhaust emissions.

A network of Automatic Dependent Surveillance — Broadcast (ADS-B) ground-based transceivers receiving GPS position reports from aircraft equipped with ADS-B Out will enhance air traffic surveillance and aviation safety. The transceivers transmit data on air traffic (Traffic Information Service-Broadcast TIS-B) and weather information (Flight Information Service-Broadcast FIS-B. This will benefit pilots of aircraft equipped to receive and display this information.

The use of Airport Surface Detection Equipment-Model X (ASDE-X) will provide real time surface data to airport and aircraft operators. This will enable better use of capacity. Vehicles in the airport movement area can be installed with ADS-B Out transponders transmitting their GPS position so that airport operations centres can see in real time airport operations. Pilots of aircraft equipped with ADS-B in cockpit displays also will also be able to see vehicle locations.

Real time data sharing with highly accurate operational data from flight and airport operators will enhance decision-making for guiding aircraft in and out of airports more efficiently. Consequently, the delays can be shifted from the runway to the ramp or gate area where aircraft can wait with engines off, and thus, burning less fuel that reduces the impact on airport air quality. Therefore, an airport operation system is required that will able to predict capacity and demand at individual airports, give frequent updates on the departure schedules, disseminate information on an impending imbalance between capacity and demand and efficiently manage queues at such times.

Nonetheless, the air quality and environment at airports and surrounding areas are expected to deteriorate as the demand for travel increases. This is contributed by aircrafts landing and take-off, their ground movements and by ground vehicles and equipment. The installation of air and noise monitoring will be necessary to provide historical data that will help in developing more specific solutions to these negative impacts. Such solutions may include the use of alternative fuels and innovations on aircraft procedures on ground.

5.4.2 EDUCATION AND TRAINING

The growth of aircraft movements at regional airports will create a demand for MROs to be more distributed across the nation's airports which are now concentrated at KLIA. Coupled with this would be increasing demand for licensed aircraft engineers and pilots thus there is need for more training facilities at the regional level.

5.4.3 RESEARCH AND DEVELOPMENT (R&D)

There are numerous opportunities for R&D. The proposed satellite-based system for air traffic control would require in depth and extensive studies to establish its reliability and applicability in the regional airports. Duly, at the regional level scaled down solutions to increasing passengers and aircraft movements are needed. Air emissions studies and mitigation solutions are required to reduce the impact of increasing aircrafts landing and take-off as well as ground vehicle emissions at airports. There are no one fit all solutions which have been implemented elsewhere in the world that can be immediately be implemented in Malaysia.

5.4.4 SAFETY

Increased fuel costs, and congested traffic in the air and on the ground are some of the factors that cause delays on the ground and in the air and prevent airlines from reaching better fuel efficiency. In addition, inadequate runway length causes aircraft accidents and also causes the engine to run inefficiently before takeoff and after landing. These factors do not only consume more fuel, but also contribute to higher carbon dioxide levels. Aircraft manufacturers such as Airbus had started with a programme called 'Smarter Skies' (Airbus, 2014) to highlight innovative technologies of aviation industry by 2050 to solve carbon emission problems and reduce the number of aircraft incidents or accidents. Five components have been highlighted by this programme:

a. "Eco-climb"

Aircrafts are launched by assisted takeoffs using propelled acceleration for steeper climb. The aircraft is guided onto a track system and accelerated using either electromagnetic motors built into the track or an inductive circuit within the aircraft itself. It is a similar concept to the one used by maglev trains. When mega-cities become a reality, and space and land are limited, this method could minimise land use and shorter runways can be used.

b. Express skyways

Flight corridors and flight patterns that are currently practiced nowadays are not efficient. Hence, more fuel are consumed and wasted. Airbus has proposed express skyways in which the aircrafts employ advanced 4-D navigational systems that will allow them to make flight formations similar to flocks of birds. The trailing planes can "surf" on the energy coming from the wing tip vortices of the leading aircraft, which will reduce drag, increase fuel efficiency, and minimise engine emissions (Airbus 2014). Air Traffic Control (ATC) will be able to treat such formations as one unit and streamline its workload.

c. Free-glide approaches and landings

Noise and pollution created in and around airports can be reduced by this method. An advanced navigational system should be able to determine the best time to leave cruising altitude so the plane can start a continued descent into the airport without the need of holding patterns in the air or use much thrust to maneuver from one altitude to another. In other words, the plane engines will be idle as the aircraft will glide down, making shorter landing distances achievable with shorter runway.

d. Ground Operations

The aircraft is maneuvered to the gate by an autonomous renewable energy-powered tug. At this stage, engines will be turned off during taxiing to the gate. According to the International Air Transport Association, carbon dioxide emissions during taxiing can be reduced up to 6 million tons each year if airplanes simply turn off their engines soon after landing.

e. Power

The use of renewable energy (such as electricity, hydrogen, solar, etc.) and sustainable fuels to power the aircraft and infrastructure will be necessary to secure supply and further reduce aviation's environmental footprint in the long term.

In 2050, security processes for air travelers should be nonintrusive, while also preserving privacy without interruption and delay. The assessment of risk is thus integrated into the security screening process for passengers as well as cargo. Air transport data networks, including navigation, air ground communications and on board processing elements, are fully secure and resilient to cyber-attacks.

5.4.5 MEGA TRENDS

5.4.5.1 AIRPORT AND AIRCRAFT SECURITY

Security concerns have become an essential part of airport and aviation operations. The MH370 strategy is a strong reminder of the need for a vigilant security system. With increasing air traffic expected in the next 50 years, airport and aircraft security will be the biggest issues. The Federal Aviation Administration are introducing the conceptofAdaptive Layered Security. In this approach, various technologies, policies, and procedures are being developed in multiple layers of screening that will reduce the vulnerability of airports and aircrafts. At the same time, it ensures the full mobility of people and cargo with minimal impact on the efficiency and flexibility of operations.

Furthermore, in light of the MH370 tragedy, a comprehensive security framework should be developed to reduce the risk level of a threat to airport and aircraft operations in Malaysia. One mega trend is in flight streaming of flight data to a database or a virtual cloud. To illustrate, new satellite-based air traffic management systems are being implemented in the United States, Asia and Europe, which have made it easier to track airplanes and monitor aircraft systems in flight. The bombardier, for instance, has announced that their new series of narrow body jets will have the capability to transmit telemetry data directly to ground station or through a satellite relay. FLYHT Aeronautical services may be the only company in the world providing telemetry services as an aftermarket retrofit. It should be noted that FAA requires 88 parameters to be monitored once or twice every second. By 2015, it is required that critical measurements such as position of flaps be monitored 8 times per second. Modern jetliners generate 3000 data points, thus it presents a great technical challenge to stream huge amount of data. Nonetheless, this data may provide valuable information such as in predicting the possibility of crashing.

5.4.5.2. AIRPORT BAGGAGE SYSTEMS

Except for the baggage handling systems in the international airports in Malaysia, baggage handling in regional airports is much to be desired. With the expected increase in passenger flow, baggage handling can be a particularly miserable aspect of the air travel experience for passengers. The advancement of digital communications, robotics and other technologies has open more options for future airports to improve airport operations. Some of the possible innovations in baggage handling include.

a. Robotic baggage handling

An intelligent robotic system can be used to replace manual labourto reduce the time-consuming baggage handling jobs. All checked-in and transferred luggages can be moved to one central storage facility, where a robotic arm automatically loads ramp-carts and containers as and when they are required.Baggage handling performance can be optimised to shift manual operations to more complex tasks.

b. RFID baggage systems

Unlike the traditional barcode-based sorting systems, there is no requirement for line of sight to read RFID tags which employ radio waves to send information. A much higher read-rate is thus achievable resulting only in a few bags having to be sorted manually. Although RFID baggage systems have been installed in airports since 2008,only a few airports used these systems namely big airports such as KLIA. The development of an integrated RFID system for baggage handling in all Malaysian airports with the airport management system will provide accurate and timely baggage delivery as well as resolving security issues.

c. Self-service concept

The self-service concept saves passengers' time spent in waiting lines and provides a more efficient strategy for airlines and airport operators. An automated self-service baggage drop-off system will increase the efficiency for baggage screening and handling. Passengers will be in command of their own process giving them a pleasant experience at the airport. The concept can be extended on line for reporting and reclaiming missing luggage. Instead of having to queue at a missing baggage counter to register the problem, travellers now have the option to declare their bag missing on a specialised website once they arrive at home or their destination.

5.4.6 TARGET FRAMEWORK

Short-Term Strategy (2020)

In the short term there is a need for a detailed study on individual airports and the resulting impact of rising passengers and aircrafts movements. The study should specifically outline issues that will affect each individual airport operation. The study should identify the technologies that are needed to mitigate these issues in the long term particularly low cost indigenous solutions. In particular deployment of technologies such as ADS-B, airport surface detection equipment and a real time data sharing and decision making system should be seriously considered.

The short term strategy for air quality at airport includes implementation of air and noise monitoring equipment. The data collected will be valuable in developing a long term strategy for mitigating environmental impacts of airport activities.

The Government should also look into establishing a panel of experts or a unit for air safety to investigate aircraft mishaps somewhat similar to NTSB in the United States. An incentive scheme that would encourage the establishment of MROs at regional level will help alleviate issues on aircraft safety at regional level. This should be coupled with human resource development at regional level of licensed aircraft engineers and pilots.

Mid-Term Strategy (2035)

The mid-term strategy involves activating an initiative between stakeholders for R&D in developing a pilot solution for a selected airport that would best illustrate the technologies that are being deployed. Results of the pilot implementation will be used in developing a plan for a nationwide implementation solution for all airports. In terms of air quality, data collected at airports will pave the way for implementing practical solutions. These include the use of alternative fuels for ground vehicle and equipment and other innovative aircraft operations on the ground.

Long-Term Strategy (2050)

In the long term it is expected that the solutions to mitigate the projected demand in 2050 will be fully implemented at all airports. This is expected to include ADS-B, airport surface detection equipment, real time data sharing and decision making system, alternative fuel or electric vehicles and efficient aircraft ground operations.

5.5 THE FUTURE AND MEGA TRENDS: MARITIME AND INLAND WATER TRANSPORTATION

5.5.1 TRANSPORTATION SYSTEM AND TECHNOLOGY

The projected demand for containers in 2050 will see the advent of larger container ships calling at major ports in Malaysia. Growth in ship width and container volume will force ports to replace their cranes with bigger ones. The growth in the number of containers to be handled per ship will also see an increasing demand for dual hoist cranes and automated stevedoring. The average turnaround time will have to be reduced so that mega-ships can efficiently call at major ports with minimal dwelling time. Therefore, port authorities will have to invest a great deal in the improvement of terminal facilities and landside intermodal access. Technical challenges may include special berths to allow 15,000 TEU vessels to be worked from both sides. Ports may need to increase their depths so as to be able to handle vessels drawing 16.5m.

There is also a need for a comprehensive information system that can provide information on carrier scheduling, rail scheduling, link to shipping companies, links to truck companies and links to rail companies on top of information on maritime transport will also contribute to the efficiency of the port as container volume and ship calls increases. A well-developed integrated intermodal transport system would help alleviate the problem of distributing containers efficiently.

As the vessel traffic increases in the Straits of Melaka there is a need to enhance the current Vessel Traffic Services and Vessel Traffic Management Systems. This may include predicting vessel arrival to plan for towage, pilotage, berth optimisation and other resource planning, real time alerts of arrivals, departures and vessels passing amongst others. The Port of San Diego monitors the maximum speed of all vessels as part of its ocean-going vessel speed reduction programme, to reduce emissions. The Port of London Authority uses AIS to monitor all passenger boats, tugs and commercial vessels over 50gt throughout Central London.

The Inland waterway transport system of Malaysia such as in Sabah and Sarawak plays a significant role as the primary means of transportation. In some areas the only means of mobility and access to basic services are on river or inland water transport. In Peninsular Malaysia, the inland waterway transport is focussed on the tourism sector, such as ferryservice to islands. There is a need for strategic planning of an integrated inland water transport system in Sabah and Sarawak.

5.5.2 EDUCATION AND TRAINING

The increasing size of ships will also require MROs in Malaysia to upgrade their capability to handle these large vessels. This will required more skilled craftsman to be trained. At present, there is a lack of institutions offering such programs. A possible approach is to develop collaboration with shipbuilders such as Hyundai to set up local training institutes.

5.5.3 R&D

There are numerous opportunities for R&D. The proposed Global AIS system would require in depth and extensive studies to establish its reliability and applicability in the Malaysian ports. Local universities can conduct studies on the negative impact of ports particularly of ballast water and solutions to such problems. Industrial engineering aspects of port operations should be studied to increase its efficiency. This is as there are no “one fits all solutions” which has been implemented elsewhere in the world that can be immediately implemented in Malaysia.

5.5.4 SAFETY

The scenario in maritime transport in 2015 and beyond is the introduction of ASEAN Single Shipping Market (ASSM) (ASEAN 2010). The key requirements of this strategy are rationalisation, synchronisation, liberalisation and harmonisation of shipping services and trade procedures. Practical actions will have to be devised in these areas, taking the differences in the level of development among ASEAN Member States (AMSs) into consideration. With the AMSs pursuing integrated multimodal transport and land bridge corridors, more innovative research and development have to be done to meet the increasing cargo demand in line with economic growth in the AMSs and neighbouring countries, e.g. China, and find measures to enhance the performance and cargo handling capacity will be continuously necessary.

a. Advanced Safety Navigation System and Maritime Security System: The Strait of Malacca is one of the most important shipping routes connecting East Asia and India/Europe/Middle East. Countries located along the Strait of Malacca have a significant role of aiding safe navigation for vessels passing the Strait. As the maritime landscape and technology evolve beyond 2015, AMSs should continue to ensure that the navigation system and security measures in ASEAN waters meet international maritime safety and security standards.

b. Shipping ports will also have to be enhanced with security such as video surveillance, limited access control to outsiders, and intrusion detection measures. Smart software and sensors with new detection methods can detect anomalies, sense and identify trace amounts of explosives and chemical and biological agents in an abandoned package a totally non-intrusive way can be developed. The software will be able to inform the control centre operator in real time for him to take the necessary action. These measures will enhance protection on all transportation modes against terrorists without constraining traffic flow.

5.5.5 MEGA TRENDS

5.5.5.1. VESSEL TRAFFIC MANAGEMENT

In ensuring parallel technological development of Vessel Traffic Management with regards to shipping industry, several technologies can be applied in the future. Current technologies such as Long Range Identification and Tracking (LRIT), Automatic Identification System (AIS), Galileo (Position/Communications), and Synthetic Aperture Radar/Side-looking Airborne Radar/Satellite based sensors will be integrated in a single operative fronting system, known as the Maritime Operations Service (MOS) centre. MOS was first introduced by the European Union (EU). Thus, it is a more practical system compared to reactive VTM. Through this system, MOS operator(s) can view and utilise information from specialised services at one operator station, including: Coastal VTS, Oil Pollution Response, Search & Rescue and Maritime Assistance Services (MAS).Apart from that, operatorscan set alarms when vessels enter certain predetermined areas. Information can be integrated to smoothly handle requests and utilise information from other internal/ external specialised systems in addition to fusing the additional information with existing electronic navigational charts. It will also handle service requests made by other internal/external systems using international standards for information access and exchange.

Hence, MOS is the future solution for ports and inland transportation in Malaysia. As such, it provides a strong architecture for the future of VTM and the safety, security and efficiency of a port.

5.5.5.2 AUTOMATED PORT LOGISTICS

One of the ideas for future implementation in Malaysian ports in order to support the growth of shipping industries is automated port logistics. The demand for fully integrated solutions has risen sharply for over the past few years. Shipping traffic has increased in a larger volume of goods passing through the ports. The variety of goods has grown, requiring port equipment to become more specialised.

In order to improve cargo movements, rail-mounted gantry cranes can be used by port operator to move cargo. Terminal management networks can be integrated with the crane to optimise the turnaround of incoming and outgoing cargo. Through this, it is believed that the throughput of cargo at ports can be maximise

The Vessels when entering the port now need to declare their cargo manually. It will consume a lot of time and will affect total ship calls that can be supported by the port. Through the implementation of the electronic vessel declaration before they even dock, the port performance can be improved a lot. The data are collected in a reservation system, which allows operators in the control tower to create a logistics plan and provide the ships with information about gates and storage locations. The system also simplifies the planning of container movement processes such as those performed by the rail-mounted gantry cranes. Containers are transported through the yard before being lifted by rail-mounted gantry cranes and placed in their assigned storage location.

5.5.6 TARGET FRAMEWORK

Short-Term Strategy (2020)

In the short term, there is a need for a detailed study on individual ports and the resulting impact of rising cargo and vessel movements. The study should specifically outline issues that will affect each individual port operation. The study should identify the technologies that are needed to mitigate these issues in the long term particularly low cost indigenous solutions. In particular deployment of technologies such as global AIS should be seriously considered. The short term strategy for air quality at port includes implementation of environmental impact monitoring equipment especially of air quality and ballast water. The data collected will be valuable in developing a long term strategy for mitigating environmental impacts of port activities.

An incentive scheme that would encourage the establishment of MROs for larger vessels is desirable. This could include collaboration with shipbuilders such as Hyundai to establish training institutions in the country. Hence, a river classification system is to be developed. This is an inventory that will include information such as minimum depths, width, and vertical clearance of waterways, marking and minimum equipment with navigational aids, number of vessels, State of infrastructure and the fleet and transport performance.

Mid-Term Strategy (2035)

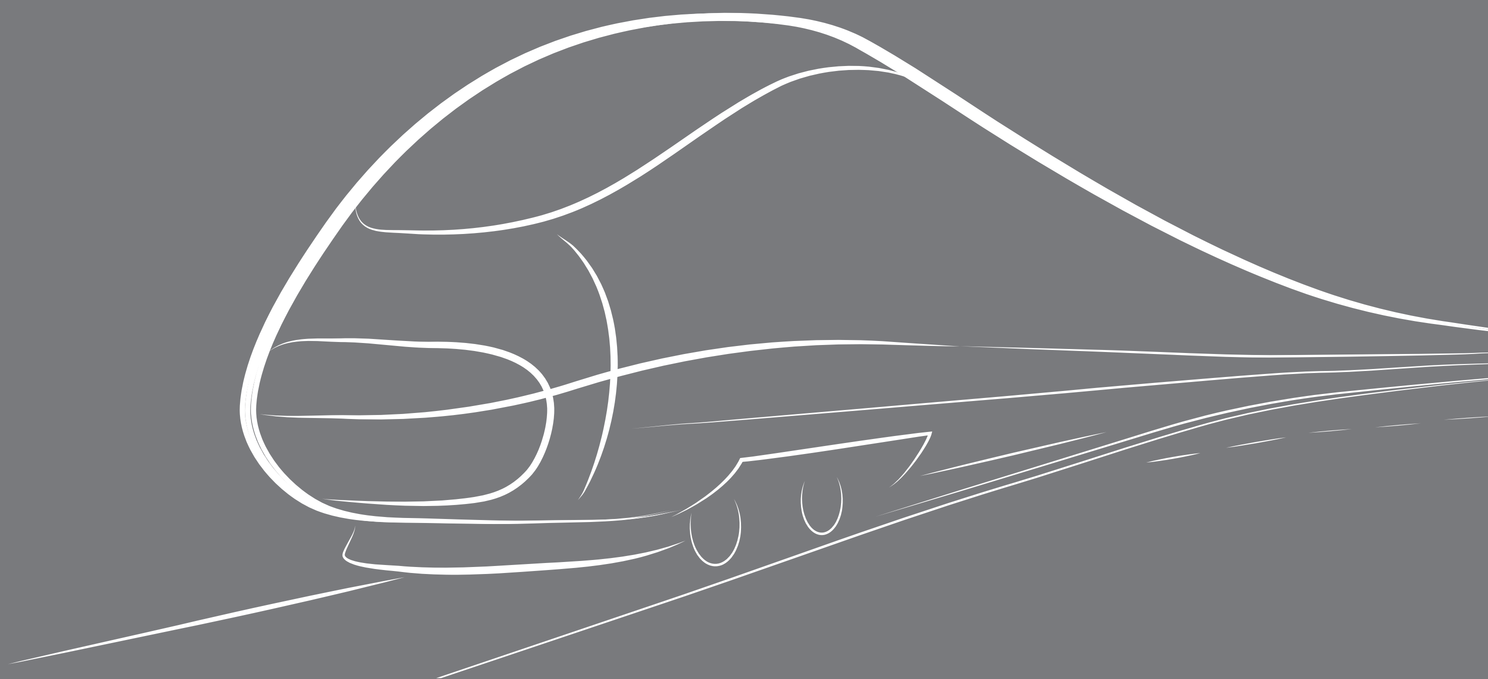
The mid-term strategy involves activating an initiative between stakeholders for R&D in developing a pilot solution for a selected port that would best illustrate the technologies that are being deployed. The results of the pilot implementation will be used in developing a plan for a nationwide implementation solution for all ports.

The data collected at ports will pave the way for implementing practical solutions. These include the use of alternative fuels for cranes, equipment and port vehicles. The impact of ballast waters requires an immediate solution due to its devastating impact on biodiversity and health. For inland water transportation the development of intermodal connections will make river transport more cost effective.

Long-Term Strategy (2050)

In the long term, it is expected that the solutions to mitigate the projected demand in 2050 will be fully implemented at all ports. This is expected to include global AIS, alternative fuel equipment and vehicles, intelligent port operation management system and measures to mitigate negative impact of port activities.

APPENDICES



LIST OF STAKEHOLDERS

We are very grateful for the participation and cooperation given by these stakeholders during the Transportation Sector Stakeholders Workshop held on 22 January 2014 (Wednesday) and 10 February 2014 (Monday) at Menara MATRADE, Jalan Khidmat Usaha, Off Jalan Duta, 50480 Kuala Lumpur. The collective insights and experiences provided during the workshops are invaluable. These stakeholders also have contributed in formulating the needed short-term, medium-term as well as long-term milestones and targets for the Transportation sector of the country.

Sharifah Allyana Syed Md Rahim
Head of Unit
Accident Database System and Analysis Unit
Malaysian Institute of Road Safety Research (MIROS)

Joyce Melai Chan
Assistant Director (Policy and Innovation Division)
Road Safety Department (JKJR)

Dr Harlina Suzana Jaafar
Deputy Director (Research and Industrial Linkages)
Malaysia Institute of Transport (MITRANS)
MARA Univeristy of Technology (UiTM)

Syed Mohd Faizal Said Ahmad
Assistant Senior Director
Planning I
Malaysian Highway Authority (LLM)

Wee Ah Sah
Hon. Secretary General
Selangor Freight Forwarders & Logistics Association (SFFLA)

Nur Farizan Tarudin
Researcher
Malaysia Institute of Transport (MITRANS)
MARA University of Technology (UiTM)

Mohd Nazmi Mohd Nur
Researcher
Research Intelligence
Malaysia Automotive Institute (MAI)

Nor Syahira Sahari
Analyst
Malaysian Industry-Government Group for High Technology (MIGHT)

Fadzillah Mansor
Science Officer
National Oceanography Directorate (NOD)
Ministry of Science, Technology and Innovation (MOSTI)

Ir Zainal Abidin Kamarul Baharin
Senior Fellow
Malaysia Institute of Transport (MITRANS)
MARA University of Technology (UiTM)

Associate Professor Sallehuddin Muhamad
Lecturer/Deputy Director
Transportation Research Alliance (TRA)
University of Technology Malaysia (UTM)

Dr Hj Mohd Hafizzuddin Dato' Hj Damiri
Public Service Department Malaysia.

Tn Hj Shahruddin Hj Yusof
Principal Assistant Secretary
National Oceanography Directorate (NOD)
Ministry of Science, Technology and Innovation (MOSTI)

Hairulliza Abdul Rahman
Town Planner Officer
Federal Department of Town and Country Planning

Nadzrol Fadzilah Ahmad
Director
Professional Service and Technical Cooperation,
Malaysian Highway Authority (LLM)

Cheryl Rita Kaur
Senior Researcher
Maritime Institute of Malaysia (MIMA)

Siti Nur Fatimah Noodin
Researcher
Emerging Technology
Malaysian Industry-Government Group for High Technology (MIGHT)

Izzatul Huda Mohd Jalil
Analyst
Malaysian Industry-Government Group for High Technology (MIGHT)

Professor Dr Omar Yaakob
Professor
Department of Marine Technology
University of Technology Malaysia (UTM)

Dr Istas Fahrurrazi Nusyirwan
Lecturer
Transportation Research Alliance (TRA)
University of Technology Malaysia (UTM)

Associate Professor Dr Erwin Sulaeman
Lecturer
Department of Mechanical Engineering
International Islamic University of Malaysia (IIUM)

Dr Sany Izan Ihsan
Lecturer
Department of Mechanical Engineering
International Islamic University of Malaysia (IIUM)

Dr Fadly Jashi Darsivan
Lecturer
Department of Mechanical Engineering,
International Islamic University of Malaysia (IIUM).

Nabilah Ramli
Lecturer
Department of Mechanical Engineering,
International Islamic University of Malaysia (IIUM).

Ahmad Ezan Mustapha
Head
Track Network Department
Rapid Rail Sdn. Bhd.

Syahmi Farhan Mohamed
Assistant Manager
Rolling Stock Department
Rapid Rail Sdn. Bhd.

Dr Mohamed Amin Mohd Kassim
Deputy Managing Director
Century Logistics Holdings Bhd.

Hafeiz Murshidie Hassan
General Manager
Strand Aerospace Malaysia

Mohd Nawi Dul
Independent Consultant and Writer
ND Consult

Sharanjit Kaur
Admin Manager
NB Group

Ezwan Hazli Abdul Malek
SVP
Syarikat Prasarana Negara Berhad

Mohd Shahrir Amin Ahmad
Civil Engineer
Malaysian Highway Authority (LLM)

Mohd Shazrizal Safri
Principal Assistant Secretary (EM)
Maritime Division
Ministry of Transportation Malaysia (MOT)

Professor Ir Dr Abu Bakar Jaafar
Co-Chair UTM-OTEC/Senior Adjunct Fellow
UTM & MIMA

Professor Dr Ho Chee Cheong
Senior Fellow
Academy of Sciences Malaysia

Appendix A: Passenger Movement

STATE	AIRPORTS	2002	2003	2004	2005	2006	2007
MALAYSIA	-	34,013,942	34,138,751	39,431,000	41,570,634	42,467,956	45,185,959
Johor	Senai International Airport	874,278	651,352	1,500,000	1,246,000	1,308,000	1,320,000
Kedah	Sultan Abdul Halim Airport	287,465	353,778	346,502	323,669	292,549	291,006
	Langkawi International Airport	712,988	726,817	845,276	830,334	934,024	1,122,911
Kelantan	Sultan Ismail Petra Airport	534,959	589,950	639,871	635,397	678,306	759,316
Melaka	Malacca International Airport	7,438	31,108	46,692	27,683	18,509	27,209
Pahang	Sultan Haji Ahmad Shah Airport	388,746	351,179	349,375	298,184	273,005	262,486
	Tioman Airport	64,067	56,900	57,957	54,054	57,559	46,260
Perak	Sultan Azlan Shah Airport	132,314	115,286	103,123	74,451	64,711	814
	Pangkor Airport	8,811	6,095	10,247	11,193	9,866	8,906
Penang	Penang International Airport	2,508,693	2,334,669	2,987,993	2,834,993	3,103,772	3,173,117
Sabah	Kota Kinabalu International Airport	3,256,212	3,302,366	3,918,201	3,975,136	4,015,221	4,399,939
	LahadDatu Airport	108,151	107,914	117,584	116,973	108,697	77,024
	Sandakan Airport	449,613	497,999	574,213	621,513	633,194	626,192
	Tawau Airport	495,462	551,168	620,847	680,901	660,331	736,646
	STOL SABAH	–	6,945	7,099	6,009	5,933	1,942

2008	2009	2010	2011	2012	2020	2035	2050
47,447,876	51,335,307	57,829,465	64,009,658	67,195,720	126,922,920	143,513,809	193,286,476
1,470,000	1,310,000	1,240,000	1,340,000	1,380,000	2,290,299	2,543,160	3,301,743
307,564	421,314	400,997	407,717	433,644	696,766	769,855	989,124
1,196,956	1,359,271	1,374,729	1,504,697	1,594,106	3,180,118	3,620,677	4,942,354
836,060	1,003,162	1,047,755	1,132,345	1,259,205	2,562,847	2,924,970	4,011,339
23,751	18,576	21,687	21,322	34,355	82,805	96,264	136,639
259,529	226,912	220,878	248,846	280,074	301,281	307,172	324,844
48,767	49,057	54,056	62,010	60,141	110,112	123,993	165,636
5,376	21,937	48,508	71,169	73,354	93,073	98,550	114,983
8,132	7,617	2,588	547	4,068	12,582	14,947	22,042
4,689,164	4,868,526	5,223,454	5,808,639	5,848,135	11,859,130	13,528,851	18,538,014
4,689,164	4,868,526	5,223,454	5,808,639	5,848,135	10,513,591	11,809,551	15,697,431
99,983	98,558	113,442	131,054	142,733	204,980	222,271	274,144
618,927	672,469	741,674	788,515	834,626	1,527,649	1,720,155	2,297,675
768,967	866,601	897,848	922,452	982,153	1,858,196	2,101,542	2,831,578
3,741	0	793	5,046	5,970	14,286	16,596	23,526

Sarawak	Kuching International Airport	2,935,052	2,923,633	3,317,879	3,354,973	3,196,352	3,236,468	
	Bintulu Airport	422,715	427,894	464,576	487,077	449,673	381,158	
	Miri International Airport	1,292,004	1,377,312	1,509,684	1,594,855	1,559,379	1,454,167	
	Sibu Airport	759,704	817,687	903,108	920,930	898,923	809,955	
	Mulu Airport	–	41,280	54,767	52,914	48,825	37,463	
	Limbang Airport	–	83,459	96,209	105,652	89,814	50,107	
	STOL SARAWAK	–	165,704	167,805	173,956	153,199	134,079	
Selangor	Sultan Abdul Aziz Shah Airport	1,130,169	72,491	90,593	83,602	83,502	95,583	
Terengganu	Sultan Mahmud Airport	309,202	394,240	435,620	419,475	398,252	430,800	
	Redang Airport	–	–	20,750	30,650	28,928	33,738	
WP Kuala Lumpur	KLIA	17,454,564	17,454,564	21,058,572	23,213,926	24,129,748	26,453,379	
WP Labuan	Labuan Airport	635,458	696,961	686,103	642,582	575,684	535,294	

3,238,614	3,574,632	3,684,517	4,286,722	4,186,523	6,439,170	7,064,906	8,942,112
417,918	487,060	557,459	590,253	661,553	1,091,461	1,210,880	1,569,137
1,537,840	1,620,345	1,694,915	1,856,626	2,018,415	3,325,954	3,689,160	4,778,776
831,772	939,732	1,009,002	1,133,093	1,204,267	2,004,480	2,226,761	2,893,606
43,652	49,255	66,575	67,041	49,670	66,449	71,110	85,093
49,181	45,512	50,044	56,211	57,852	85,734	93,479	116,714
145,807	148,674	170,506	173,289	162,760	266,011	294,692	380,735
307,747	819,840	1,118,309	1,320,227	1,442,514	2,004,735	2,160,907	2,629,425
487,495	523,619	520,611	502,966	550,831	985,763	1,106,577	1,469,021
34,957	28,246	48,610	46,159	35,960	99,891	117,650	170,926
27,529355	29,682,093	34,087,636	37,704,510	39,887,866	80,267,809	91,484,460	125,134,413
550,859	476,876	505,903	567,928	617,130	741,468	776,007	879,622

Appendix B: Aircraft Movement

STATE	AIRPORTS	2002	2003	2004	2005	2006	2007
Johor	Senai International Airport	9,291	8,848	9,278	9,967	10,568	12,346
Kedah	Sultan Abdul Halim Airport	2,940	3,646	3,568	3,267	2,820	2,668
	Langkawi International Airport	7,910	7,168	7,352	8,021	8,287	10,828
Kelantan	Sultan Ismail Petra Airport	6,255	7,520	8,888	8,765	10,368	13,074
Melaka	Malacca International Airport	182	1,102	2,135	1,328	596	714
Pahang	Sultan Haji Ahmad Shah Airport	3,764	3,743	3,748	3,500	2,748	3,253
	Tioman Airport	2,357	2,173	1,885	1,668	1,836	1,597
Perak	Sultan Azlan Shah Airport	1,662	1,572	1,402	1,145	954	12
	Pangkor Airport	519	511	534	530	514	517
Penang	Penang International Airport	28,861	26,516	29,182	31,173	31,448	34,508
Sabah	Kota Kinabalu International Airport	42,177	42,491	50,313	49,680	50,594	49,881
	LahadDatu Airport	2,886	2,882	2,948	3,010	3,203	2,195
	Sandakan Airport	9,474	9,985	10,184	10,876	10,034	7,719
	Tawau Airport	6,928	7,450	8,019	8,531	8,005	6,863
	STOL SABAH	–	936	812	814	800	338

	2008	2009	2010	2011	2012	2020	2035	2050
	13,310	12,124	11,934	15,167	12,506	18,293	19,900	24,723
	2,934	4,578	4,513	4,841	5,274	9,475	10,642	14,143
	12,242	12,638	13,274	14,510	15,162	28,215	31,841	42,719
	14,083	13,709	13,180	15,304	17,112	36,654	42,083	58,368
	700	616	584	466	1,053	3,675	4,404	6,589
	3,334	2,947	2,628	3,178	3,395	5,411	5,971	7,651
	1,603	1,591	1,662	1,766	1,682	1,988	2,073	2,328
	183	384	844	1,536	1,515	1,704	1,756	1,914
	503	502	174	32	324	390	408	463
	38,335	38,343	44,753	50,610	49,966	87,955	98,507	130,165
	52,463	52,677	55,089	59,638	58,366	87,506	95,600	119,884
	2,922	2,922	2,860	2,941	3,058	3,367	3,453	3,711
	8,991	10,214	12,095	10,757	12,177	17,042	18,394	22,448
	7,334	8,885	9,723	9,328	9,689	14,658	16,039	20,180
	459	0	167	264	192	417	479	667

Sarawak	Kuching International Airport	39,477	38,676	41,353	39,430	37,167	34,192	
	Bintulu Airport	14,111	13,288	13,240	13,146	11,388	6,542	
	Miri International Airport	39,545	40,468	42,306	40,302	39,462	33,022	
	Sibu Airport	16,791	16,593	17,162	16,683	15,092	11,765	
	Mulu Airport	–	3,422	3,066	2,620	2,220	1,638	
	Limbang Airport	–	4,994	5,625	5,490	4,242	2,300	
	STOL SARAWAK	–	13,173	13,816	14,322	14,718	12,457	
Selangor	Sultan Abdul Aziz Shah Airport	14,685	5,140	6,981	8,988	9,158	7,234	
Terengganu	Sultan Mahmud Airport	3,196	4,221	4,776	4,623	3,792	4,533	
	Redang Airport	–	–	741	1,110	934	1,053	
WP Kuala Lumpur	KLIA	127,462	139,101	164,483	181,341	182,548	192,304	
WP Labuan	Labuan Airport	8,358	9,661	10,450	9,292	9,332	10,127	

36,087	41,437	42,940	49,613	43,981	52,088	54,340	61,096
8,933	10,948	10,994	11,270	11,444	29,091	33,993	48,699
35,178	38,836	39,509	40,931	42,351	47,401	48,804	53,013
14,307	16,275	17,899	18,211	15,923	18,830	19,637	22,060
1,642	1,570	1,726	1,912	1,760	4,838	5,693	8,258
1,860	1,697	1,947	1,896	1,880	2,978	3,283	4,198
12,716	12,140	13,538	14,118	13,534	21,008	23,084	29,313
11,448	19,897	24,509	30,779	33,224	66,594	75,863	103,672
6,038	6,006	5,959	6,006	6,506	12,464	14,119	19,084
1,083	862	1,356	1,319	877	2,218	2,590	3,708
209,681	225,251	244,179	268,265	282,290	560,980	638,394	870,636
11,212	10,868	11,988	12,645	13,448	22,610	25,155	32,790

Appendix C: Cargo Movement

STATE	AIRPORTS	2002	2003	2004	2005	2006	2007
Johor	Senai International Airport	3,849	3,697	3,445	4,596	4,848	5,046
Kedah	Sultan Abdul Halim Airport	30	17	67	118	111	55
	Langkawi International Airport	210	287	325	449	487	524
Kelantan	Sultan Ismail Petra Airport	404	315	235	168	210	163
Melaka	Malacca International Airport	49	214	602	370	146	219
Pahang	Sultan Haji Ahmad Shah Airport	96	64	64	75	109	103
	*Tioman Airport	–	–	–	–	–	–
Perak	Sultan Azlan Shah Airport	388	498	735	437	357	10
	*Pangkor Airport	–	–	–	–	–	–
Penang	Penang International Airport	202,044	197,567	212,369	221,971	225,952	208,582
Sabah	Kota Kinabalu International Airport	28,112	25,638	27,191	25,473	28,356	35,638
	LahadDatu Airport	469	400	390	334	170	*–
	Sandakan Airport	2,665	3,713	4,053	4,531	5,475	6,224
	Tawau Airport	3,612	2,701	2,968	3,885	3,030	2,134
	STOL SABAH	–	2	2	1	1	–

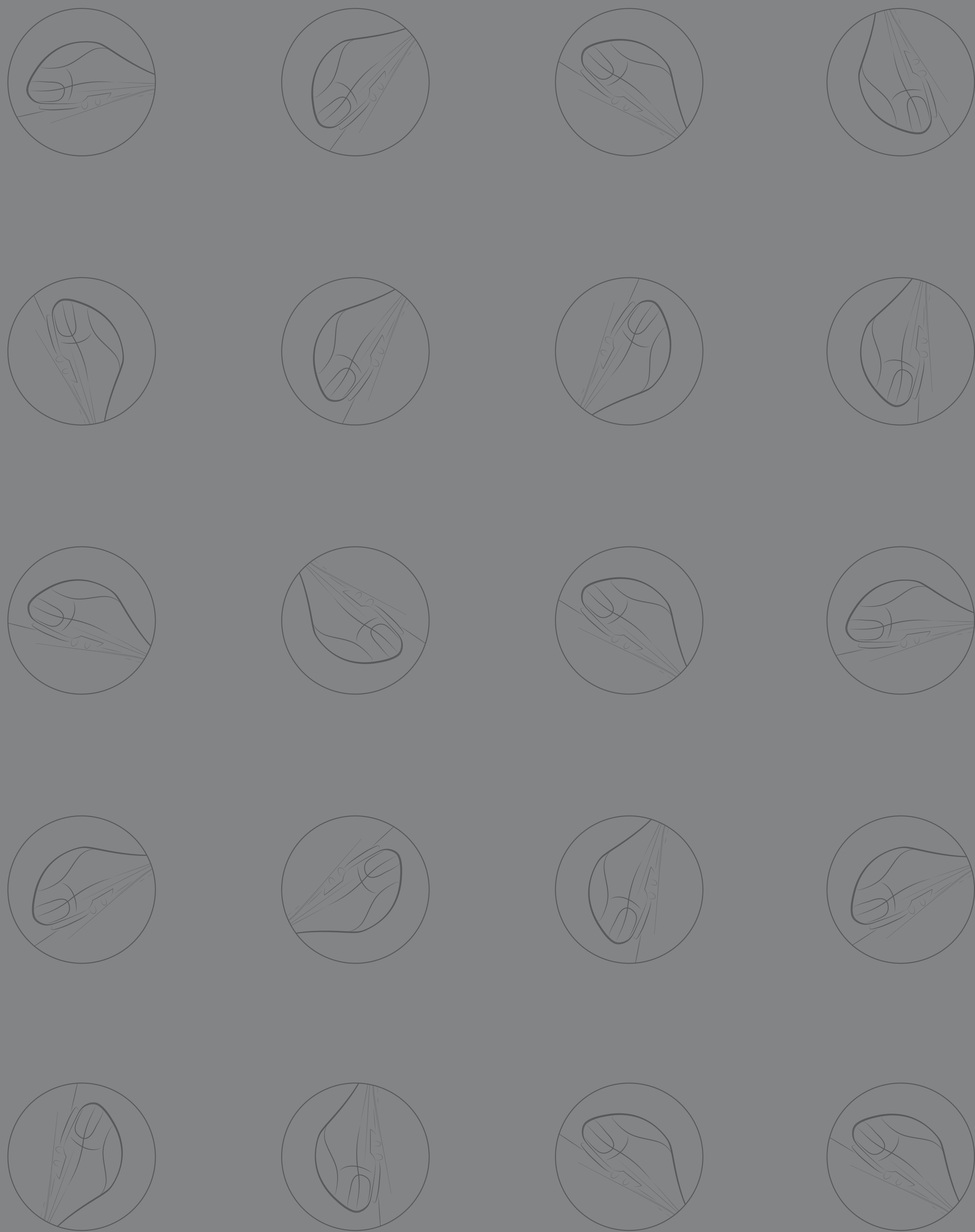
	2008	2009	2010	2011	2012	2020	2035	2050
	5,068	5,328	6,239	5,438	3,149	6,952	8,008	11,178
	41	34	34	46	123	290	337	476
	589	572	434	646	754	1,733	2,005	2,821
	181	185	177	164	147	345	400	565
	179	127	144	139	195	603	717	1057
	70	70	49	38	57	115	131	180
	–	–	–	–	73	NIL	NIL	NIL
	–	–	–	–	34	NIL	NIL	NIL
	–	–	–	–	5	NIL	NIL	NIL
	192,936	137,775	147,057	131,846	123,246	245,493	279,450	381,323
	34,532	25,079	26,733	28,534	23,563	50,656	58,182	80,760
	–	–	–	42	185	NIL	NIL	NIL
	3,055	2,099	2,806	2,300	2,479	4,759	5,393	7,293
	1,262	1,951	3,045	3,198	2,489	4,769	5,403	7,303
	–	–	–	–	–	NIL	NIL	NIL

Sarawak	Kuching International Airport	24,835	26,278	26,073	28,407	29,716	23,818	
	Bintulu Airport	1,176	940	1,375	2,110	2,205	2,252	
	Miri International Airport	3,903	3,881	4,721	5,392	4,080	3,564	
	Sibu Airport	1,916	1,701	1,567	1,377	1,040	892	
	Mulu Airport	–	4	102	459	240	191	
	Limbang Airport	–	226	179	289	379	440	
	STOL SARAWAK	–	847	862	540	403	845	
Selangor	Sultan Abdul Aziz Shah Airport	12,261	14,358	18,670	46,082	71,953	63,382	
Terengganu	Sultan Mahmud Airport	151	160	124	94	70	47	
	*Redang Airport	–	–	–	–	–	–	
WP Kuala Lumpur	KLIA	527,124	586,195	651,747	653,654	672,888	644,100	
WP Labuan	Labuan Airport	3,176	2,733	2,653	3,077	3,207	3,985	

	19,166	20,830	26,977	24,787	15,811	37,775	43,876	62,180
	1,978	1,903	1,703	2,071	2,574	5,090	5,789	7,886
	4,146	3,921	6,770	8,198	9,879	20,635	23,623	32,587
	735	856	1,133	1,153	1,612	5,558	6,654	9,943
	262	346	396	370	322	1,024	1,219	1,804
	475	530	560	498	744	1,874	2,188	3,130
	692	402	543	622	630	1,998	2,378	3,518
	18,473	18,536	19,988	19,928	22,680	41,434	46,643	62,272
	24	24	50	103	147	700	854	1,315
	–	–	–	–	27	NIL	NIL	NIL
	649,077	584,559	674,902	669,849	673,107	935,876	1,008,867	1,227,842
	4,566	4,165	4,592	5,294	6,072	12,750	14,605	20,170

Appendix D Tourist Arrival and Receipts to Malaysia

TOURIST ARRIVAL & RECEIPTS TO MALAYSIA		
YEAR	**ARRIVAL**	**RECEIPTS (RM)**
2012	25.3 Million	60.6 Billion
2011	24.71 Million	58.3 Billion
2010	24.58 Million	56.5 Billion
2009	23.65 Million	53.4 Billion
2008	22.05 Million	49.6 Billion
2007	20.97 Million	46.1 Billion
2006	17.55 Million	36.3 Billion
2005	16.43 Million	32.0 Billion
2004	15.70 Million	29.7 Billion
2003	10.58 Million	29.7 Billion
2002	13.29 Million	21.3 Billion
2001	12.78 Million	25.8 Billion
2000	10.22 Million	17.3 Billion
1999	7.93 Million	12.3 Billion
1998	5.56 Million	8.6 Billion



Appendix E: Total Container Throughput by Ports, Malaysia

Port	2002	2003	2004	2005	2006	2007	2008
Kelang	4,533,000	4,840,000	5,244,000	5,544,000	6,326,000	7,120,000	7,974,000
Penang	634,042	688,171	772,024	795,289	849,730	925,991	929,634
Bintulu	104,081	128,000	159,000	147,800	199,700	251,800	290,167
Kuching	117,000	139,000	141,000	143,096	152,394	163,338	171,943
Miri	7,421	13,300	14,402	14,823	16,837	21,159	28,085
Rajang	54,012	53,641	53,668	54,377	53,741	65,908	74,320
Sabah Ports	171,00	195,00	208,000	208,488	227,084	271,471	292,688
Johor Port	684,000	750,000	806,000	842,303	880,611	927,284	934,767
Kuantan	91,524	108,108	122,745	119,067	124,834	127,600	127,061
Tanjung-Pelepas	2,660,000	3,487,000	4,020,000	4,177,000	4,770,000	5,500,000	5,600,000

Sources: 1. The Joc Top 50 World Container Ports, Global port throughput, 2011 vs 2010
2. Various ports, Statistics Department Malaysia (Nazery Khalid, Research Khalid, Port Privatisation in the context of a developing Nation: The Ma

Appendix F: Total Ship Calls by Ports, Malaysia

Port	2002	2003	2004	2005	2006	2007	2008
Kelang	*15,600	*16,500	*15,500	15,050	16,399	17,149	16,864
Penang	*7,500	*6,200	*7,200	*6,050	6,176	6,036	5,779
Bintulu	*5,000	*4,900	*5,800	*5,900	6,024	6,087	7,015
Kuching	*2,100	*3,000	*2,050	*3,200	2,951	2,080	2,190
Miri	*1,000	*1,900	*2,100	*3,000	2,499	2,456	1,615
Rajang	*2,100	*2,050	*2,010	*2,010	*1,932	*1,867	1,692
Sabah Port	*12,050	*14,000	*15,100	*15,000	15,502	15,367	14,785
Johor Port	*6,400	*6,500	*6,300	*6,200	6,335	6,347	5,815
Kuantan	*2,010	*2,050	*2,100	*2,030	2,321	2,354	2,315
Tanjung-Pelepas	*3,700	*3,400	*3,500	*3,400	3,263	3,320	3,760

*Data based on chart published by Maritime Institute of Malaysia, MIMA

2009	2010	2011	2012	2020	2035	2050
7,310,000	8,872,000	9,603,000	9,933,604	19,654,684	22,354,984	30,455,884
958,476	1,106,098	1,198,843	1,160,000	2,106,724	2,369,703	3,158,640
248,390	251,296	215,451	231,053	459,602	523,088	713,546
161,091	190,642	214,820	231,826	438,512	495,925	668,164
25,102	28,959	31,839	31,499	74,839	86,878	122,995
66,210	80,333	88,700	89,531	153,465	171,224	224,503
277,905	98,873	357,946	374,624	747,134	850,609	1,161,034
844,856	876,268	830,340	801,058	1,011,762	1,070,291	1,245,878
132,250	142,080	132,796	136,101	216,339	238,628	305,493
6,000,000	6,540,000	7,500,000	7,770,000	16,968,000	19,523,000	27,188,000

alaysian Experience, 2006)

2009	2010	2011	2012	2020	2035	2050
16,116	17,940	18,117	17,849	21,897	23,021	26,395
5,779	6,136	6,327	7,796	12,285	13,532	17,273
7,514	7,601	7,606	7,566	12,897	14,379	18,822
1,899	2,111	1,982	1,933	5,762	6,826	10,017
1,613	1,645	1,691	1,763	2,295	2,443	2,887
1,748	1,821	1,679	1,367	2,528	2,850	3,818
13,674	13,125	12,754	14,577	19,125	20,389	24,179
5,247	4,882	4,899	4,252	decrease	decrease	Decrease
2,354	2,405	2,440	2,470	3,298	3,528	4,218
4,051	4,162	5,125	5,041	8,322	9,234	11,969

Logical Framework Analysis (LFA) - Land

FOCUS AREAS	CURRENT STATUS	CURRENT TECHNOLOGY	CHALLENGES	GAPS IN KNOWLEDGE
Transport-land-use planning	Automobile-oriented cities, urban sprawl - encourages private vehicle, discourages public transport Structure Plan and Local Plan are following NPP2 guideline for transportation National Transport Strategy by EPU		Lack of consideration on land use-transport interaction. Transport was planned separately from land use. Implementation of NPP2 guideline for transportation is ineffective at local level Low density housing causing people to travel far to work	
Parking system	Building by-law requiring parking provision, low parking charges – encourages private vehicle use, lack of parking management (between operators).		Parking charges doesn't reflect real value of space. Lack of realisation that parking space attracts traffic.	
Road congestion	Supply-demand issue, over-dependent on private cars, lack of public transport, travel behaviour.		View that way to solve congestion is by providing more road space - the extra road space will induce more traffic. Opposition from the public because of limited option/lack of public transport facilities and reliability issue/pricing of public transport Traffic pattern:	
Fuel Price	Subsidy encourages private vehicle use.		High public cost of living means very strong opposition to any price hike. Lack of political will. Reducing subsidy will affect the livelihood	

FUTURE NEEDS (R&D)	PROPOSED RECOMMENDATIONS / ACTION PLANS	STRATEGIES		
		2020	2035	2050
Research to tie land use- transport, human behaviour, etc. (VTPI – Malaysia condition)	Develop integrated land use - transport planning, innovative development measures (TOD, Smart City). High density housing – Town and city layout design/ planning by Grid System “We live where we work, we work where we live” for higher productivity per sq km Mobility of Federal-State-Local talent to ensure effective implementation of NPP	2020		
Willingness to establish threshold on parking fees.	Limit parking spaces, increase parking charges, parking availability guidance, innovative parking solutions.	after 2020 *TDM to be implemented after comprehensive public transport provision		
	Road pricing (toll), congestion pricing during peak hour, in support of other measures after public transport/ alternative is in place for personal mobility (walk, bicycle, bus) and connectivity Regulated community taxi service to improve connectivity	after 2020 *TDM to be implemented after comprehensive public transport provision		
	Reduce subsidy/open to market forces to determine price, in support of other measures. Targeted subsidy	after 2020 *Removal of subsidies to be implemented after comprehensive public transport provision		

Fuel standard	Low standard - higher pollutant (Euro 2).		Price of fuel will increase Conflict with the various parties including government and industry		
Lack of Non-MotorisedTransport as component of land transport system	Serve first/last mile, serve short trips – but facility is usually severely lacking JPBD has guideline in place for the Local Authority to implement Safe City Certain cities has the infrastructure already in place for personal mobility (walking, bicycle lane)		Local Authority - high maintenance cost for the infrastructure Lacking enforcement for road safety Issue of climate		
Financing car ownership	Long payback period, Low financing rate, Encourages car ownership.				
Lack in Public Transport provision	Public transport financing is lacking, return on fare box, low level of service, not optimal fleet management.				
Public Transport in rural areas					
Lack of feeder service for public transport	Lack of integration, service does not cover first mile and last mile.				

		Set statutory fuel standards to improve standards. Future energy carrier – hydrogen fuel cell, Natural Gas Vehicle, electrical vehicle	2020		
		Improve NMT infrastructure. Microclimate (fountain, trees, chilling the soil, pavement and roof of sky bridge through solar thermal chill water system). Awareness, road safety education	* part of public transport		
		Reduce payback period, High financing rate	* not supported – car ownership can be high, but daily commute can still be achieved through PT		
		Improve public transport financing system, improve overall public transport LOS, improve PT systems (BRT, LRT, MRT, etc.). Car tax collected to be dedicated for improvement of public transport	* part of public transport		
			* part of public transport		
		Improve feeder services.	* part of public transport		

Logical Framework Analysis (LFA) – Rail (22 January 2014)

FOCUS AREAS	CURRENT STATUS	CURRENT TECHNOLOGY	CHALLENGES	GAPS IN KNOWLEDGE
Intercity Rail	**1) Limited connectivity.** • E.g. Melaka, Penang Island (connection only up to Butterworth) are not connected • Limited coverage in Sabah and Sarawak(due to the short and limited legacy tracks used – terrain factor) • No railway tracks in the main cities (e.g. Kuantan, Terengganu, Kota Bahru) • Inconvenient access between West and East coast railway in Peninsular Msia. • Connection only at Gemas. Intention to form East Coast Rail Link (ECRL), connecting KL-Tumpat	Electric multiple unit train (EMU) Steam locomotive used in Kota Kinabalu, Sabah and Sarawak for limited kilometres (for tourism purposes) Diesel locomotive – diesel engine	Only limited cities are currently connected. Geographical limitations E.g. the proposed (ECRL) which connects KL and Kuantan, requires cutting through the mountain range.	Railway network planning
	2) Low speed train with low density • High speed train is >200km/h. Currently the commercial high-speed trains are operating at around 350 km/h • Malaysia's current train system capable of operating up to 180 km/h. • E.g. For TokaidoShinkansen, every hour there are 14 trains leaving Tokyo station, with each train consisting of 1232 seats	Single track, moving towards double track, Ipoh-Padang Besar. Gemas – JB yet to be started. The electrified double track system allows top speed up to 180 km/h, but currently maximum operating speed is expected to be 140-160 km/h.	Short distance coverage Many stops(except KL-Ipoh, where there is express train, ETS, option) Lack of infrastructure and technology for high speed train Potential impact on business of other modes of transportation, especially aviation industry	High speed train technology and the associated infrastructure and geographical factors Economic feasibility of high speed train - A large density is needed for it to be feasible e.g. Under the NPP2, cities with more than 0.5 million population should be connected via the high speed train Potential impact on housing and population patterns

FUTURE NEEDS (R&D)	PROPOSED RECOMMENDATIONS / ACTION PLANS	STRATEGIES		
		2020	**2035**	**2050**
R&D on transport system planning to evaluate the master plan for future rail network in Malaysia, such as outlined in NPP 2. Civil and construction research, capable for mitigating terrain and geographical limitations, capable to catering local environment need.	In the National Land Transport Master Plan by SPAD, improved connectivity has already been suggested. For ECRL, a feasibility study is currently being conducted by ECER, but results are yet to be released. Research institutes should participate in the human capital development and knowledge transfer (in transport system planning).	Upgrading the Peninsular railway into Electrified Double Track (from Johor Bahru to Butterworth). Connection to Melaka (According to SPAD). Sabah: Undergoing feasibility study	East Coast Rail Link Connection through KL-Kuantan. A third line: east coast rail network from Johor Baharu to Kuantan to Tumpat(according to SPAD). Railway in Sarawak, as part of SCORE plan (Announced by Sarawak Government, without revealing the timeline).	Connection from 1) Butterworth to Penang Island 2) Kedah to Langkawi Undersea connection between West to East Malaysia (similar to Eurostar concept) Connection from Melaka to Sumatra
High speed train technology (E.g. the use of simple single line instead of complex compound line for powering high speed train in Shinkansen). Economic feasibility studies	NPP2 A national integrated high-speed rail shall be established to complement the existing rail network - feasibility study is currently being conducted by SPAD. Instead of insisting on high-speed rail, study on the most feasible rail system for Malaysia should be conducted - Fast train instead of high-speed train Develop the relevant human resources, to avoid over relying on foreign expert for constructing, operating and upgrading the rail infrastructure, e.g. sending potential researchers to be trained, and provide planned career path Identify Centre of Excellence (COE) or set up designated research institute specialised on rail technology.	Study on the most feasible rail system, and the viability of the high speed rail. Identify COE/Setup research Institute on Rail Technology.	If positive outcome is obtained from the feasibility studies is positive, then high speed trains could be implemented	Maglev trains

	3) Lack high speed transnational train operation • It takes about a day (24 hours) to travel from Butterworth to Bangkok using current train service, and 8 hours from KL to Woodland • KL-Singapore high speed train is proposed, but details of the project is yet to be announced • Singapore – Kunming line has been proposed by • ASEAN secretariat		Investment & technology (Check KTM's evaluation on transnational). Investment from private companies (to refer to Japanese, and Taiwan's models for high speed train investment)	Impact of transnational railway, in terms of economic, social (population and migration), political, legal as well as other aspects that need to be carefully evaluated.	
Intra-city Rail (LRT, Star Monorail, MRT)	**1) Stagnant 80 per cent utilisation - limited LRT passengers during off-peak priod** Could not increase or extend number of coaches because of i) track way length limitation, ii) design limitation (only up to 4 coaches) iii) istation design (catered for 4 coaches train) vi) the minimum 2 minutes headway	4 coaches EMU train Regenerative linear induction motor (for the Kelana Jaya LRT line) – less maintenance, gearless technology (driverless) Monorail/EMU – traction motor	Rely on external expertise for facility and technology upgrade (Bombardier – Kelana Jaya line, CSR China - Ampang line, Scomi – still relying on foreign technology). Limitation of the traction technology and facility.	Traction technology and rail facilities, especially in terms of local experts.	
	2) Limited Usage Intracity rail is only used in Klang Valley area.		The high initial and operating cost requires a minimum passenger density (25,000 per hour) in order for intracity rail to be economically sustainable. Low awareness of using public transport	Rail-oriented city planning.	

	Multidisciplinary research is required to understand the economic, social, legal and political impacts.	NPP 2 suggested the implementation of high-speed rail from Singapore – KL – Bangkok, as part of the Trans-Asian Railway (NPP29 – IP23). Feasibility study on transnational rail needs to be completed first.	Complete evaluation of theapplicability of high speed international rail. G2G MOU	Malaysia (KL)-Singapore line should be established. Upgrade from double to 4 dedicated tracks	Trans-Asian Railway (until Kunming)
	Local experts on traction technology and rail facilities. Transfer technology	Develop relevant human capital, which allows upgrading of the technology using local expertise. Technology transfer Increase collaborations with local universities and COEs in terms of technology Upgrade facilities based on a master plan for intracity rail. This is outlined through NPP. Ensure the facilities are scalable for future needs.	Using regenerative linear induction motor – less maintenance, gearless technology (driverless) Complete feasibility studies	Under the NKEA, there is intention to develop new local technology such as the rail maintenance, repair and overhaul (MRO) (lead by SPAD. MIGHT will lead the offset programme to ensure local technology is used to promote in-house capabilities)	Malaysia will be the world leader in train manufacturing (such as the Bombardier)
	R&D on city planning incorporating the concept of transit (rail) oriented development.	NPP 2 suggested that rail transport should be incorporated into the transport system in the major cities (NPP32). Evaluate the potential of using rail as main mode of transports in cities beyond Klang valley. Rail-oriented city development. Increase public awareness to use public transport	Evaluation on the potential for rail-based transport in cities throughout Msia completed. Master plan for rail-oriented city development.	Development and implementation of railway system in major cities, e.g. JB, Penang.	Full implementation in all cities in Malaysia.

	3) Customer service RAPIDKL's customer satisfaction survey shows 80% However, some intracity lines (e.g. KTM) services could be improved	The use of CSI every 3 months to evaluate train operators' service Self-ticketing machine Touch-and-go prepaid card	To ensure complaints are dealt with and resolved timely To ensure the train's air-conditioning system is fully functioning To encourage the public to use auto-reload card (e.g. Myrapid card) A fully integrated system	Use of STI for improving planning and monitoring of the train movements, to give frequent and reliable service. Continuous passenger improvements using ICT and social media network (such as Twitter).	
	4) Inefficient Feeder Limited, low quality service. Very often unreliable.	Mini bus	Rely on bus, which share road resource with other public transports. Subjected to road condition (e.g. traffic, physical, weather).	Effective feeder system planning	
Other types of rail transports	Some other types of rail transports is not utilised in Malaysia, for instance: 1) Tram 2) Monorail (to solve land scarcity issues)	Not available in Malaysia currently	Public education to improve driving etiquette and attitude	Feasibility studies	

	Study on effective rail planning to give frequent and reliable service Use of ICT to improve rider's comfort.	Use of Intelligent Transportation System (ITS), allowing open and accessible information on movement of train (accurate information on arrival and departure of each train) for passengers SPAD to monitor service performance via auditing and direct feedback from customers	Real time internet access to monitor train schedule, delays, train failures Improve connectivity by expanding the intra-city rail, with high passenger carrying capacity, such as mass rapid transit (MRT) (this is currently being done)	Integrated tickets for all transports, and infrastructures	Integrated tickets for all public service provision and other retail industries
	Effective feeder system planning	Improve feeder service to be frequent and reliable by usingdesignated/ elevated bus lane for feeder bus. (e.g. elevated lane used in Sunway)	Master plan for Klang Valley area that outline the development of intrarail and its supporting feeder system. Bus Transit System – BTS under development in Sunway Electric vehicles on dedicated lane	Implement improved feeder system for Klang Valley area.	Implement feeder system for other parts in Malaysia.
	Feasibility studies	Explore the possibility of using other types of rail transport.	Depending on the outcome of the feasibility studies, other modes of rail transports should be included in the Master plan for transportation		

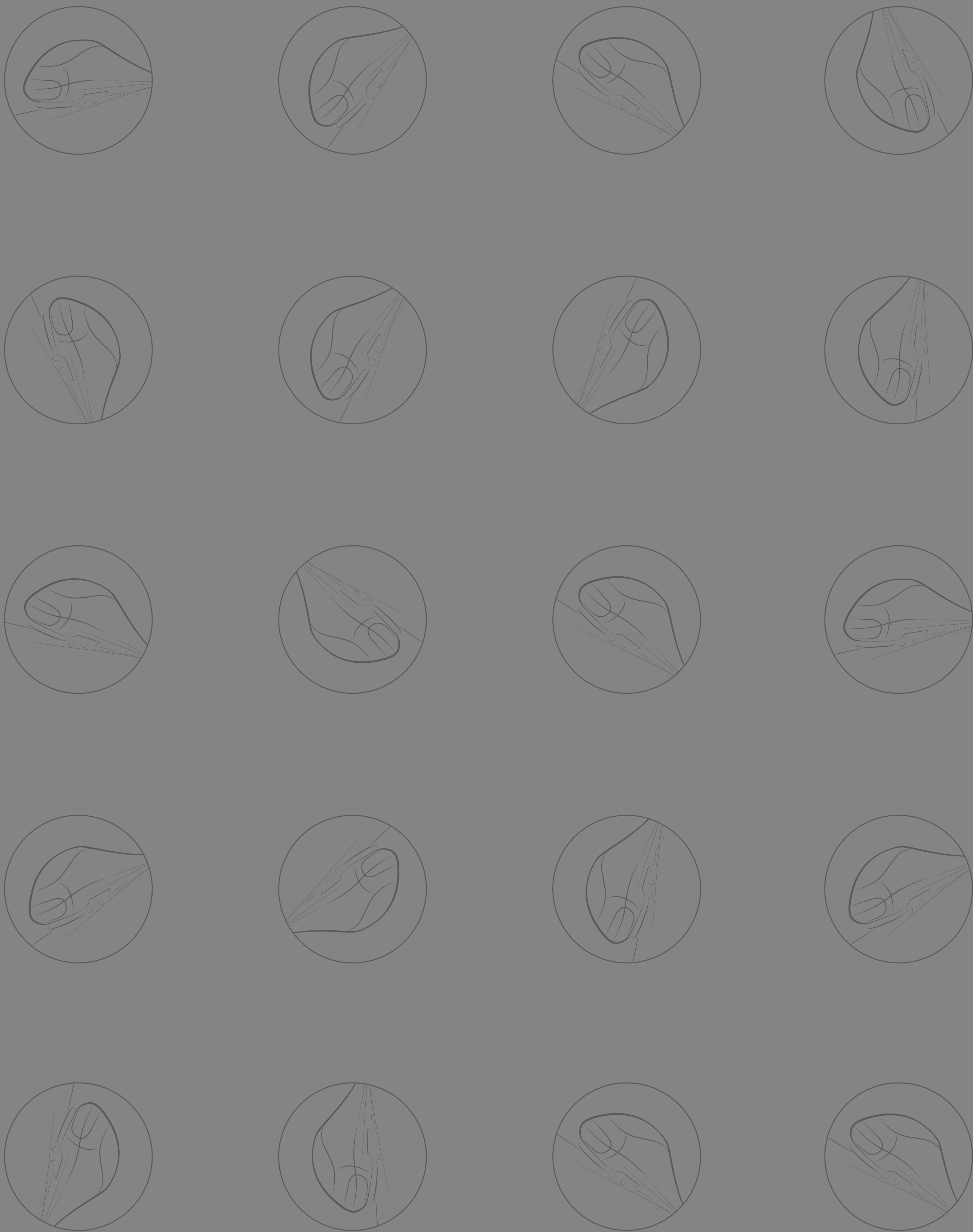
Logical Framework Analysis (LFA) – Aerospace

CURRENT STATUS	CURRENT TECHNOLOGY	CHALLENGES	GAPS IN KNOWLEDGE	
Passengers increasing at 4 million a year: 2020- 102 million, 2035- 120 million, 2050 -182 million. Increase of 78 per cent Air movement: 2020- 1.04 million, 2035-1.19 million, 2050,1.64 million- increase of 57 per cent Cargo movement stagnant at 800 million kg Major Airports: KLIA Penang Senai Kota Kinabalu Miri Kuching	Terminal Size (no of international and domestic passengers) - KLIA is designed to handle up to 100 million passengers per year KLIA is the first airport in the world to use the Total Airport Management Systems (TAMS) Runaway (Numbers and length) – KLIA has two full-service runways that can handle 120 movements per hour; when one runway handles taking off, another handles landing Terminal Capacity – KLIA transport baggage by Siemens between the two terminals at speeds of up to 36 km per hour, compared to the previous rate of 7.2 km per hour. The new system uses a high-speed tray conveyor system in which bags are placed on individual trays for better control and tracking at high speed Number of aircrafts that can be accommodated – KLIA with its 75 ramp stands, is capable of handling 120 aircraft movements at a time Size of aircrafts -The runways at KLIA are able to accommodate the Airbus A380 Air traffic control system - airport has CAT II Precision Landing ILS to guide landing aircraft safely under all weather conditions with visibility as low as 350 metres (1,150 ft)	Airport with advanced technology focussed only at KLIA Terminal facilities not able to handle increasing passenger volume, e.g. baggage handling system, air traffic controller, airport security Insufficient runaways Runaway length cannot accommodate larger size aircrafts Existing air traffic control system cannot cope with the growing traffic Limited capability of local companies to support bigger aircrafts than 737 Components and parts not manufactured locally Lack of local expertise/ companies to develop technology for local conditions	Expertise on airport design.Technology used in airport e.g. baggage, handling, face recognition system, weapon/ explosive detection system. Technology used in air traffic control, particularly on landing and takeoff. Technical support for large aircrafts, e.g. A380. Insufficient engineers trained in advanced manufacturing technology of aircraft parts/components.	

FUTURE NEEDS (R&D)	PROPOSED RECOMMENDATIONS / ACTION PLANS	STRATEGIES		
		2020	2035	2050
R&D should be relevant to the aircraft industry. R&D should be focussed on technology that supports existing aircraft, improvement in safety and airport management such as efficient baggage handling, passenger movement, and security. R&D focussed on improving aircraft fuel efficiency, passenger comfort, safety etc. Developing local R&D specialised companies.	Identify focus area for training and R&D Increase training facilities and trainers for existing aircraft technology Training researchers on existing and future aircraft technologies in collaboration with aircraft makers such as Boeing and Airbus Develop local companies that support future aircraft and airport technologies Special funding for companies conducting R&D on aircraft support and airport technology	Establish joint venture research and training institutes with major aircraft manufacturers Establish programs in local universities on airport management and technology Establish R&D focussed on developing technology to support aerospace transportation such as in airport security, etc	Local vendors producing aircraft components and parts Local R&D companies to support research on aircraft development of major manufacturers Local R&D companies developing technologies for airport design, construction and management	Developing Malaysian aircraft for rural transportation in Sabah and Sarawak. Developing indigenous technology for airport management such as baggage RFID tracking, landing system for minor airports etc.

Logical Framework Analysis (LFA) – Aerospace

CURRENT STATUS	CURRENT TECHNOLOGY
	KLIA Advance Cargo Centre covers 108 acres (0.4 km2) of land and can handle one million tonnes of cargo per annum, with the capability to expand to 3 million tonnes/year. MAS Engineering aircraft maintenance of only existing fleet ATR 42/72, B737 Series, A320 family, B747 Series, B777 Series, A330 Family, A340 Family. Engineering specialised services- component workshop is equipped to carry out repair and overhaul on landing gear for B737, airframe accessories, hydraulics systems, fuel systems, hydrostatic bottles and sanitary equipment's. -Facilities to perform repair and overhaul for electrical components, instrumentations, ATEC systems and radios.



Logical Framework Analysis (LFA) – Maritime Industry (Transportation)

CURRENT STATUS	CURRENT TECHNOLOGY	CHALLENGES	GAPS IN KNOWLEDGE	
Container increase 1,100 million TEU's per year: 2020 - 39,800 million TEUs 2035 - 45,300 million TEUs 2050 - 61,800 million TEUs. (67 per cent increase) Total ship calls increase 457 per year: 2020 - 72,841; 2035- 75,127; 2050- 81,984. (29.9 per cent increase) Major Ports: Port Klang Port of TanjungPelepas Penang Port Johor Port Kuantan Port Bintulu Port Inland transportation: Inland waterway transport system of Sarawak plays a significant role as the primary means of transportation Sarawak has an extensive express boat service which connects various coastal towns and the rural areas of the interior	Port Klang handles almost 50 per cent of Malaysia's sea-borne container trade Port Klang's vessel traffic management system (VTMS) for navigational safety in the port waters The ACC or Area Control Centre's radar covers a radius of 26 nautical miles offshore. The other two radar sites are located on Pulau Angsa and Bukit Jugra This system provides information on vessels transiting the harbour, such as cargo on board, last and next port of call and the vessel's particulars The centre also provides an attending pilot accurate information on the vessel's position and the density of traffic converging on the same destination, thus enhancing passage planning This system is linked to other VTS centres, including coast radio stations, the Maritime Rescue and Coordination Centre, pilot offices, harbour masters and the Maritime Enforcement Coordinating Centre in Lumut, Perak Ballast water Fouling Port Equipment Automatic system (port) IMO (international maritime organisation) references Electronic highway (MEH) Address the tech. issues by sub-sector Look at regional policies Identify the stakeholders	Exceeding port capacity by 2050 Vessel traffic system unable to cope with increasing number of vessels Terminal operators are faced with continuous increase in demand for storage space which they have difficulty accommodating due to physical constraint on space Limited capability of local companies to support tankers, larger ships Inland transportation With regards to express boat services, residents frequently State their concerns about cost, reliability, comfort and safety, particularly with regard to embarking and disembarking at passenger landings and jetties	Expertise in logistics information network system Knowledge in technologies to improve port efficiency Knowledge and skills in maintaining larger ships Inland Transportation: Design knowledge of larger, safer and efficient boats for rivers Lack of expertise on larger, safer and economical landings and jetties Usage of Biodiesel in water transport Design for shallow water – small boat	

<table>
<tr><th rowspan="2">FUTURE NEEDS (R&D)</th><th rowspan="2">PROPOSED RECOMMENDATIONS / ACTION PLANS</th><th colspan="3">STRATEGIES</th></tr>
<tr><th>2020</th><th>2035</th><th>2050</th></tr>
<tr>
<td>Should implement solutions to integrate technologies required to realize a seamless logistics systems

Technologies to make ports more efficient such asTag System / RFID Flow-through Gate System,Electronic Port Clearance,Nationwide E-commerce System,Container Terminal Management System,Synchronous Planning and Real time Control System

Increase capability to build larger, modern ships and innovative design

Increase capability to service larger ships

Inland transportation:

R&D on efficient and safe river vessels

Integrated and comprehensive river transport system</td>
<td>Identify strategic thrust areas of maritime transportation

Develop training and research institutions on advance ship technologies, logistics and transportation in collaboration with ship makers such Hyundai and Samsung

Focus funding on research that support advance ship technology and logistic systems

Innovative transport vessels for inland transportation system</td>
<td>Establishjoint venture research and training institutes with major ship builders

Establish programmes in local universities on port management and technology

(UiTM, UMT currently available)

Establish R&D focussed on developing technology to support maritime transportation

Formulation of strategic plan for an integrated and comprehensive inland river transport system

Shipping act and policy

National Ocean Policy (currently for cabinet approval)</td>
<td>Local companies building modern and larger ships

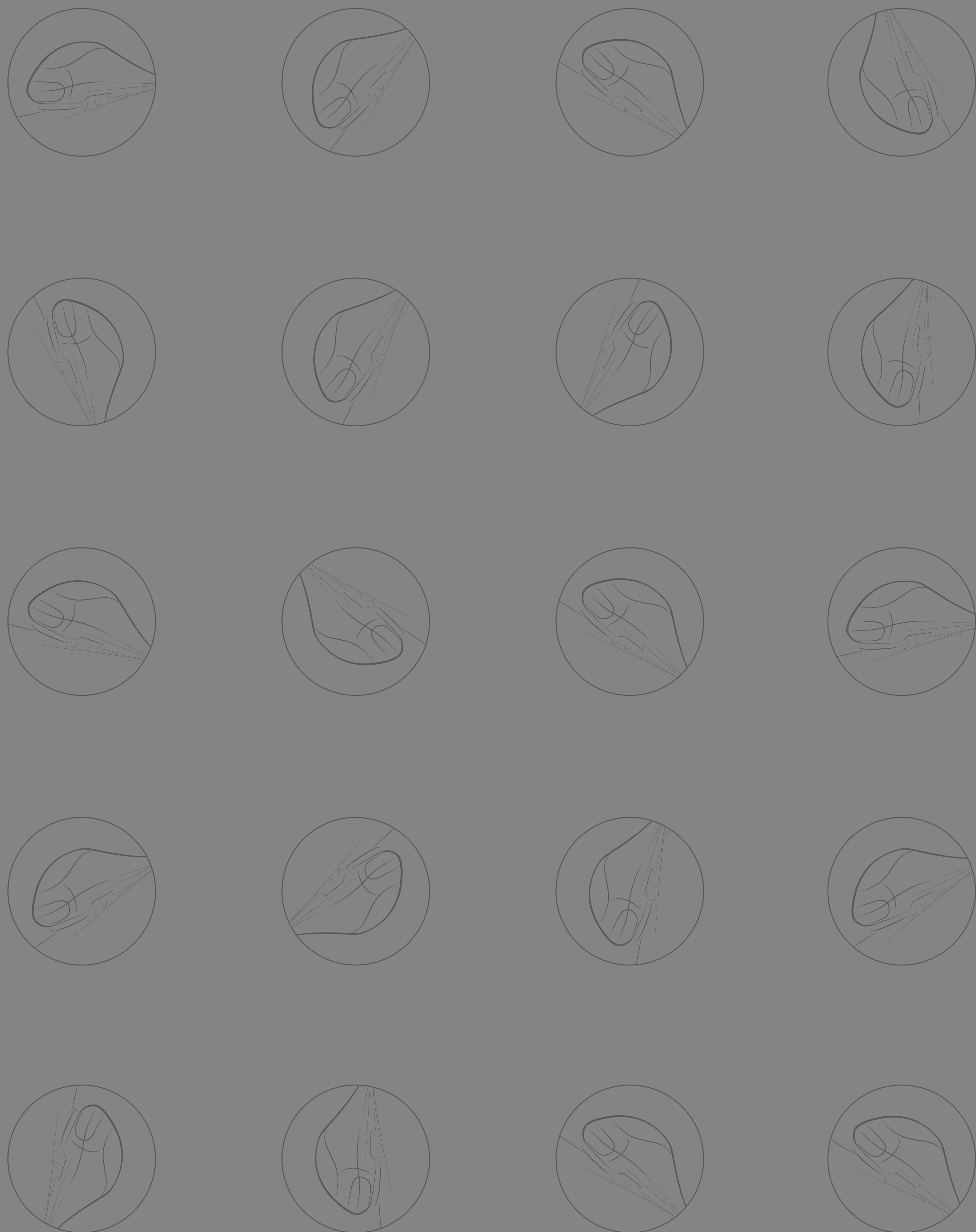
Local R&D companies to develop innovative vessels for inland passenger and cargo transportation

Local R&D companies developing technologies for port logistics such as RFID system, etc</td>
<td>Malaysia building efficient large ships

Integrated and comprehensive inland river transport system

(refer previous MIGHT document)</td>
</tr>
</table>

CURRENT STATUS
83 gazetted wharves and jetties (under the River Traffic Regulation 1993), and available statistics also indicate there are over 900 other facilities operating in Sarawak. Port Klang will have the capacity to handle almost 20 million TEUs (twenty-foot equivalent units) of containers by 2016. MISC: • 29 LNG Carriers • 53 Petroleum Tankers • 19 Chemical Tankers • Offshore Terminals Boustead Naval Shipyard Sdn. Bhd.: Ship repair. The operations are supported by: • 450- ton ship lift • 3000- ton ship lift • Multiple quayside cranes of various capacities • 400 meter long berth via a floating pontoon • Multitude of other specialised facilities and equipment that enable us to provide services that run across the complete range of expertise necessary for carrying out ship repair works for vessels as complex as naval warships. Labuan Shipyard &Engineering Sdn Bhd: • The yard services small coastal craft, cargo ships, naval/fast patrol craft, yachts, tugs, landing craft, Ro-Ro ferries, floating docks, log carriers and coastal tankers. Support system Maritime training & education Support industries National focus R&D Centre (refer from MIGHT document – blueprint for shipping) Marine Tourism



Working Group	Safety And Security
Scope	Road transportation
Objectives	

Areas	Current Sustainable Practices		Issues And Challenges	Gap analysis	Future needs	
	Current State/ existing practice in MY	Current technology				
Vehicle road-worthiness	Assessment programme for vehicles under MIROS (MIROS Vehicle Assessment Programme (MVAP) replaced by NCAP	Database to rate vehicle according to level of safety (MIROS) Crash lab facility (already exist) (MIROS) Vehicle design and safety (e.g. Collision Avoidance System, Electronic stability control systems, Alcohol-Interlock devices)	Important safety features missing in new vehicles	Crash test facilities not an issue, just need more new vehicles to adopt NCAP (since right now still not mandatory)	National Automative Policy (NAP) to be revised every 5 years to update newer vehicles. Need to comply with the Vehicle Type Approval (VTA) system, opportunity to improve safety standard (move towards higher safety standard from time to time), Star-rating on new vehicle allows user to choose according to safety level	
	New Car Assessment Programme (NCAP)) launching 3rd phase	–	Lack of safety features in old vehicles	–	Make it mandatory for newer cars to get NCAP ratings	
	PUSPAKOM (1990) as vehicle inspection agency	–	Maintenance of vehicles	Improve PUSPAKOM efficiency (since audit just done for the first time since its establishment)	now commercial vehicles mandatory inspection every 6 months, so add for private vehicles (maybe annually) eg- roadtax renewal based upon JPJ approval (cert). Passing the vehicle inspection is made a compulsory condition for roadtax renewal	

Authority	Recommendations/ Action Plan	Milestones & Targets		
		Short Term 2014-2020	**Medium Term 2021-2030**	**Long Term Until 2050**
Vehicle manufacturers have to ensure all vehicles meet safety standards	Car manufacturers, JPJ, MOT	Compliance to UN vehicle regulations; 40 per cent of carbon reduction by 2020 (NAP 2014)	Mandatory compliance to UN vehicle regulations	–
Installation of safety features in old vehicles; 15 years revised automative policy for private vehicles	Car manufaturers, JPJ, MOT	Voluntary inspections of private vehicles	Mandatory inpections of private vehicles	–
Apply similar policies for commercial vehicles to private vehicles, inspection officer will held responsible for vehicle inspected, introducing new authorised and regulated vehicle inspection centres to do similar inspections (NAP) "UK - MOT certificate"	JPJ & MOT	–	–	–

	Commerical Rebuilt Vehicles are available and used on roads	—	No data available on the safety & road-worthiness of these vehicles & number of accidents involving CRVs	—	—	
	Compliance to all UN vehicle regulations	—	—	Enforcement of all UN vehicle regulations	Regular updates on changes to UN vehicle regulations	
Enforcement	Available but not adequately enforced	Automated Enforcement System (AES)	Penalty imposed does not serve as a deterrent	Integration of database so all agencies can access and perform enforcement	Review the effectiveness of AES implementation	
	Demerit system					
	Compliance to all UN vehicle regulations	—	—	Enforcement of all UN vehicle regulations	—	
	PUSPAKOM irregular audit by JPJ	—	Improve JPJ current monitoring of PUSPAKOM	—	Stricter monitoring of PUSPAKOM operations by JPJ	
	Ops Sikap/Ops Selamat during festive season	—	Enforcement interfered by political interventions	—	—	
	During crash (Vehicle safety feature, restraint system)	—	—	—	—	
	Post-crash (Trauma-how fast the victim can be brought to hospital, Ambulance services, optimum solution to save life)	—	—	Identify highly-prone crash areas	—	
	One license for all types of heavy vehicle (E-license), short of license holder	—	Different heavy vehicle requires different level of driving skill, expensive and time consuming to obtain license	—	Limitation on driving hours, different driving skills accessment for different types of cargo	

	Start data collection on the number of CRVs on the road		–	–	–
	–	JPJ & MOT	–	–	–
	Review current penalty/ punishment/ fine	PDRM	–	–	–
	–	JPJ	–	–	–
	Annual audit to be done on PUSPAKOM by JPJ	JPJ, PUSPAKOM	–	–	–
	Road safety management	JKJR (MOT), JPJ & PDRM	–	–	–
	–	–	–	–	–
	Standby ambulances at the identified highly-proned crash areas	–	–	–	–
	–	–	–	–	–

Road user behaviour/ human error	Most transport accidents/ fatalities occur on roads are caused by human error, JPJ coming up with new module,	Radar to measure vehicle speed; -Pre-crash (Campaign, Awareness to reduce accident to occur) ; Device to detect alcohol level and drug tests	Driver's attitude (changing lane as they like/cut traffic queue, Rushing to work, speeding, reckless driving, texting, Lack of focus)	Psychology study of road users to address pre-crash research, correct sign board at correct location of the road, perception of personal safety among drivers	Road Safety Department to add more effective awareness campaigns, encourage NGO/ community active participation	
	Drivers of commercial vehicles do not observe driving regulations (hours & number of drivers per vehicle)	GPS (long trucks)	Policies already in place by DOSH but lacking enforcement; vehicle overloading; political will	–	–	
	Road safety education in primary schools in BM subject, traffic wardens, road safety club.	–	–	–	–	
	–	Mandatory use of seatbelt, daytime headlights	–	–	–	
Road Safety Audit	Mandatory practice in Malaysia (include both new & existing roads)	International Road Assessment Programme (IRAP) available	IRAP when implemented can help to improve road safety audit efficiency	Research to enhance safety	Multidisciplinary road safety research (e.g. Road crash injury, post-impact care, biomechanics and vehicle design, behavioural studies, road safety engineering)	
Motorcycle safety	Motorcycle lane	Guardrail/ chevron markings along motorcycle lanes	Poor design undulation (collect water after rain),	–	–	
	–	–	Limited stretches of motorcycle lanes on all types of roads	–	–	
	–	–	Lack enforcement of speed limit	–	–	

	Improve driving school syllabus (ethical driving attitude) , devise safe journeys, use safe vehicles; More funding for road safety measures & research intervention (now 20 deaths/ day = high)	PRDM, National Anti-Narcotics Agency	WHO targets 50% reduction of projected fatality on road crashes by 2020	–	–
	–	–	–	–	–
	Road safety education in secondary school	–	–	–	–
	–	–	–	–	–
	Road safety audit (perform periodically & when needed) using IRAP or alternative similar system	–	–	–	–
	Improve motorcycle lane design	–	–	–	–
	Improve lanes for motorcycles in major roads/ Wider lane	–	–	–	–
	Enforcement of speed limit on motorcycle lanes	–	–	–	–

	National Helmet Initiative	Helmet in compliance with safety standard (SIRIM)	–	–	–	
Road conditions and capacity; road design	–	–	Poorly maintained road (e.g. potholes, uneven surface); poor road design	–	–	
	–	–	Poor visibility (lack of street lamps)	–	–	
	–	Road accident management system with GIS	–	–	–	
	Insufficient facilities for heavy vehicle, forcing them to use roads which are not intended for their use	–	–	–	–	
		–	Heavy traffic on major roads	–	–	
Non-motorised and pedestrian safety	Pedestrian sidewalks are available but not enough	–	Lack of pedestrian sidewalks and	–	–	
bicycle lanes; cyclists on big roads	–	–	Secure walking routes	–	–	
integration of intermodal transport	Lack facilities for first and last mile	–	–	Sky bridge, eg: BTS in Thailand	–	
Traffic control system	–	Integrated Transport Information System	Lack of technology required to monitor and for enforcement	–	–	
	–	Real time measurement of congestion (e.g Waze, Variable Message Sign)	Lack of certainty over impact on traffic (spill overs onto other roads)	–	–	

	–	–	–	–	–
	Safety ratings of the road network;clear definition of maintenance funding allocation (JKR or local Government)	–	–	–	–
	Secure transport routes	–	–	–	–
	Ministry of Works, PDRM, MOT, local govt.	–	–	–	–
	–	–	–	–	–
	Road line marking	–	–	–	–
	–	–	–	–	–
	–	–	–	–	–
	Full integration of the travel path, ensure safe travelling covering the first mile and the last mile	–	–	–	–
	Intelligent transport monitoring system (e.g. speed)	–	–	–	–
	–	–	–	–	–

Environment/ Act of nature	Signage available (e.g. speed limit) in some hazardous roads	Seismometers to record and measure earth movement	Frequent landslides on embankments	—	—	
		Crosswind indicator	Crosswind	—	—	
			Animal crossing	—	—	
	—	—	Vision obstruction at junctions (bushes, branches, illegally-parked vehicles)	—	—	
	—	SMART Tunnel in KL	Frequent flash floods obstructing traffic	—	—	
Dangerous goods	SHE code of practice, ASEAN-Brunei Protocol on road transport	—	Emergency response team (HAZMAT) efficiency time-wise	Special training for the drivers (knowledge about content & label of the goods carried)	—	
	—	—	Too much reliance on foreign experts, who understand less on the local culture and local problems	—	—	

	Identify stretches with dangerous embankments and strengthening them	JKR cawangan cerun	–	–	–
	–	Highway operator	–	–	–
	–	Local authority & *Perhutanan Perhilitan*	–	–	–
	Clear the obstructions at junctions to improve vision	JKR	–	–	–
	Identify flash flood areas and improve drainage	JKR	–	–	–
	Setup regional teams to reduce response time (need to confirm)	–	–	–	–
	Promote local experts for providing advice to local problems, Government can identify COE which can deliver quality research and consultancy services	–	–	–	–

Working Group	Safety And Security
Scope	Rail Transportation
Objectives	

Areas	Current Sustainable Practices		Issues And Challenges	Gap analysis	
	Current State/ existing practice in MY	Current technology			
Collisions (excluding level-crossing accidents)	–	Speed measurement device, speed controller	Excess speed limit	Long-term time-series safety performance data	
	–	–	Carelessness, driver's attitude	–	
	Regular maintenance	–	Failed brakes	–	
	–	–	Faulty rail	–	
	–	–	Overcrowding	–	
Derailments	–	Speed measurement device, speed controller	Excess speed limit	Long-term time-series safety performance data	
	–	–	Carelessness, driver's attitude	–	
	Regular maintenance	–	Failed brakes	–	
	–	–	Faulty rail	–	
	–	–	Overcrowding	–	
	–	–	Landslide	–	

Future needs	Recommendations/ Action Plan	Milestones & Targets		
		Short Term 2014-2020	Medium Term 2021-2030	Long Term Until 2050
—	Speed limit on dangerous zones	—	—	—
—		—	—	—
Integrated maintenance	Improvement of safety standards of train operations and maintenance	—	—	—
—	Rolling contact fatigue inspection esp. on old railways	—	—	—
—		—	—	—
—	Speed limit on dangerous zones	—	—	—
—		—	—	—
integrated maintenance	Improvement of safety standards of train operations and maintenance	—	—	—
—	Rolling contact fatigue inspection esp. on old railways	—	—	—
—	—	—	—	—
—	—	—	—	—

Level-crossing accidents (users and trespassers)	Guardrail/fence	Traffic lights	Carelessness, driver's attitude	—	
			Badly designed level-crossing	—	
	Signage	Traffic lights	Road user's attitude/error	—	
	Signage for unauthorized access	CCTV	Trespassers	—	
Accident to persons caused by rolling stock in motion	—	—	Passengers/ employees fall from train	—	
	—	—	fall/hit by loose objects on trains	—	
Passengers' safety	Auxiliary police personnel, first-aid kit	in-train information screens, emergency communication buttons, CCTV	Accidents/crime on board of the train	—	
	—	CCTV	Accidents/crime at the train station	—	
Employees' safety	competency training programme (Rail Academy)	Train driving simulator	Driver's error	—	
	—	Driver's safety device	Driver's health (illness)	—	
Train and railway design	—	—	Unsafe installation, brake failure, faulty equipment	lifecycle analysis at design stage	
	—	—	Infrastructure failure	—	
Safety management system	Based on rail operator management -- not standardized	—	—	A full risk analysis of all recorded fatalities, casualties, and incidents relating to rail transport over the last decade: a database for tracking future trends.	
Others	SHE code of practice	Speed limits for freight trains	Dangerous goods	—	
	—	—	Suicide victims	—	

–	–	–	–	–	–
–	–	–	–	–	–
–	Safety awareness campaign	–	–	–	–
–	–	–	–	–	–
–	Safety awareness campaign	–	–	–	–
–	–	–	–	–	–
–	Emergency response guidelines	–	–	–	–
–	Install more CCTVs	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
–	Ensure all trains/railways meet safety standards, Technology transfer for support and upgrading purposes	–	–	–	–
Integrated maintenance	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–
–	–	–	–	–	–

Working Group	Safety And Security
Scope	Aerospace transportation
Objectives	

Areas	Current Sustainable Practices		Issues And Challenges	Gap analysis	
	Current State/existing practice in MY	Current technology			
Flight crew	Flight training hours requirement	Flight simulator for training	Pilot error (weather or mechanical related)	–	
	–	–	Loss of situational awareness.	–	
	Age limit for pilots	–	Pilot incapacitation: Mental breakdown during flight, illness (heart attack, etc.)	–	
Aircraft and Engine Condition Monitoring	–	Onboard centralised maintenance system;	Pressurization failure	–	
	–	Real time maintenance information broadcast	Electrical failure	–	
Sabotage / Explosive Device	Posting law enforcement official in airplanes	–	–	–	
Air Traffic Control	–	Global Aviation Information Network	Lack of guidance from air traffic controller during last stages of flight	–	
	–	–	Misidentification of aircraft by the ATC	–	
	–	–	Ambiguous instruction given to crew	–	
	–	–	Procedural error	–	
	–	–	Directing the plane in the wrong direction	–	
	–	–	Conflicting information given to pilot by ATC and what he was receiving on his ACAS.	–	

Future needs	Recommendations/Action Plan	Milestones & Targets		
		Short Term 2014-2020	Medium Term 2021-2030	Long Term Until 2050
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–

Cargo Hold / Cabin Fire	—	Upgrade of cargo compartments to Class C containment standard (as available for the aircraft type / model)	Electrical short	—	
	—	Installation of dual-loop smoke and fire detection systems.	Fire causes by passenger's baggage	—	
	—	—	Discarded cigarette	—	
	—	—	Fire from cargo hold	—	
	—	—	Fire warning system failure	—	
Airplane/helicopter design	—	3D modelling and design testing	Inconsistent Compliance with Regulatory Requirements	Life-cycle assessment	
	—	—	Vented fuel is carried back into the cabin heater air causing fire	—	
Approach and Landing/ take-off Accidents	Short runways on small airports	Thrust reversers.	Runway excursions and overruns	—	
	—	Auto-Land capability		—	
	—	Auto-brake system		—	
Fuel Starvation	—	Flight planning software suites	Pilot negligence/ error	—	
	—	—	Fuel valves error	—	
	—	—	Compass error	—	
	—	—	Auxiliary tanks not maintained	—	
	—	—	Navigation error	—	
	—	—	Engine malfunction causes huge fuel consumption	—	
	—	Automatic fuel leak detection	Fuel tank leak	—	

–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
Identify the economic benefit of safety technology	Air transport design should comply safety standards and regulations	–	–	–
–	IOSA type audits, manufacturer audits, ground handling audits	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	Periodic check of fuel used versus fuel remaining throughout the entire flight	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–
–	–	–	–	–

Weather	Traffic advisory by ATC	ACAS	Thunderstorm, hurricane, snow, haze, cloud, lightning, volcanic ash;	—	
		Pre-flight and in-flight forecasting tools; Onboard weather radars with “turbulence” mode; Onboard “multi-scan” weather radars for horizontal and vertical scanning of weather.	Turbulence	—	
				—	
				—	
		—	Flight visibility reduced	—	
Hijacking (resulting in fatalities)	Placing law enforcement officers in airplanes	—	Bomb detonation	—	
		—	Pilots shot	—	
		—	Mentally ill passenger	—	
Safety Management System	Global Aviation Safety Plan (GASP)	Compliance with ICAO and IATA standards and regulations	Inconsistent Implementation of International Standards	A full risk analysis of all recorded fatalities, casualties, and incidents relating to air transport over the last decade: a database for tracking future trends.	
	—	Airborne Collision Avoidance System (ACAS) and pressure-altitude transponder as required by ICAO for airplanes > 5700kg	Small airplanes are not required to carry ACAS	—	
	The Runway Safety Programme	—	—	—	
	Fatigue Risk Management Systems	—	—	—	
Enforcement	Insufficient manpower	—	Ineffective incident and accident investigation	—	

	—	—	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	Sharing of safety intelligence	Audit	—	—	—
	—	Flight Data Monitoring	—	—	—
	—	—	—	—	—
	—	—	—	—	—
	—	—	—	—	—

Others	—	Vehicle design to withstand bird strike	Bird Strikes	—	
	—	—	—	—	
	SHE code of practice for dangerous goods	—	—	—	
	Baggage weight limit	—	Overloaded planes	—	

	—	Hazard advisory system	—	—	—
	—	Wildlife management at airports	—	—	—
	—	—	—	—	—
	—	—	—	—	—

Working Group	Safety And Security
Scope	Maritime/Inland water transportation
Objectives	

Areas	Current Sustainable Practices		Issues And Challenges	Gap analysis	
	Current State/existing practice in MY	Current technology			
safety management system	Use AIS but not all vessels. To avoid collision visual observation, audio exchanges, and radar or Automatic Radar Plotting Aid are historically used for this purpose. These mechanisms sometimes fail due to time delays, radar limitations, miscalculations, and display malfunctions and can result in a collision.	A full risk analysis of all recorded fatalities, casualties, and incidents relating to water transport over the last decade: a database for tracking future trends.	Inconsistent Implementation of International Standards	The ability to receive very large number of AIS messages simultaneously from a satellite's large reception footprint	
River vessels and boats	Vessels and equipment vary greatly in age, design, condition, life-saving gear, capacity; Risk from overloading; Minimal security measures	–	–	–	
Boat crews (riverine)	Inexperienced, untrained, unfamiliar with regulations	Some operator required the boat crews to attend training while the others are not	Disregard safety measures, and unaware of local procedures and customs	Identifying priority-training needs for the improvement of job competencies	

Future needs	Recommendations/Action Plan	Milestones & Targets		
		Short Term 2014-2020	Medium Term 2021-2030	Long Term Until 2050
Adopt global AIS technology, international best practices and standards for navigation, wharf, and terminal safety and security adapted to river systems	Develop capacity building and a culture of marine safety through a training programme for river/ sea rescue, navigation, cardiopulmonary resuscitation (CPR) and first aid; Promote safety awareness; Enforce safety procedures effectively, so that prevention of problems prevails; Carry out investigations of serious incidents and casualties in order to learn lessons for improving safety.	—	—	—
Technical innovation improved design of transmission systems for very low-water conditions		—	—	—
A systematic training module consists of rules and regulations; and safety procedures conduct by the authority	Conducting workshops, training sessions and seminars to enhance understanding and explore best practice in management and operation of an inland waterway system.	—	—	—

River systems	Hazardous stretches especially in the upper reaches, sand bars and shallows occur in the river estuaries; Express boats, speedboats, logs and tugs with log-barges	Marine and Risk Traffic Analysis (MRTA) requirement for infrastructure construction within rivers	Unmarked wrecks and other submerged objects can be dangerous; Many stretches of river lack navigational aids and signage; Inclement weather can change sailing conditions very rapidly; Routes, rapids, rocks, changing currents: tricky and hazardous navigation; Risk of accidents: collisions; fast large boats create a wake that can overturn light boats.	The ability to design a good river systems	
Terminals and jetties	Safe terminals and jetties are rare or non-existent; Poorly designed; Movement of passengers and cargo between land and boat is often precarious.	Design of adjustable pontoons with landing steps, safety equipment, lighting, and signage.	Standard operational procedures used take little account of safety; Illegal jetties do not comply with regulations and may be difficult and risky to use	Standard terminal and jetty designs that can be used in Malaysia geographical area	
Environmental safety	Lack of facilities at terminals for boats to discharge bilge water, sewage and solid waste.	Minimal equipment to handle basic environmental safety issues	Spillage of fuel and engine oil; abandonment of boat or other wreckage in the river; and loss of cargo on the river which, in the case of hazardous materials,	Fuel stored in the port are minimal; no specific place near the port and jetties to handle solid waste, discharge bilage water and sewage water	

	River system planners who have knowledge in safety and engineering	Education and awareness programme; Apply international performance standards in the development of efficient inland waterway transport; Consultation with local communities before starting a construction project; Alternative by-pass channels may be feasible in some instances, and navigation routes can be established and marked.	—	—	—
	Suitable terminals and jetty infrastructure that follows international standard level	Standard designs for construction and operation to suit varying conditions, with safety equipment and awareness training for frequent users, and proper lighting	—	—	—
	Increase the fuel storage capacity; Specific place near the port to handle waste	Increase the fuel storage capacity; Specific place near the port to handle waste	—	—	—

Enforcement	Exist but problematic since there is no one single authority that have power to prevent robbery and piracy; trafficking of migrant	Some safety and security regulations based on IMO conventions are adopted; Handled by law enforcement and armed forces; Boat/ship inspection by maritime law enforcement agency	Insufficient number of manpower; Lack of training among ship surveyors, inspectors and enforcement officers; There is a need to regularly review and update rules and regulations; Lack of communication and cooperation among enforcement agencies	Lack of integration to control the enforcement issue in terminal and jetty	
Maritime crew	Maritime crews usually send locally / overseas for training for a big operators or no official training for small operators	Naval simulation-based training	Human error accounts for the majority of maritime casualties	Lack of training centre for maritime crew especially in Sabah and Sarawak	
Ship and Port Security	Scanners in the port used by authority not up to date	Compliance with ISPS and ISM codes (IMO conventions); Coastal Surveillance System; Harbour Defense System	Security of ship and port cannot be monitored sufficiently	Some of the safety equipment / system used in the ship and port are not up to date; Safety equipment / system expensive	
Maritime infrastructure and operations	Marine Traffic Risk Assessment (MRTA) requirement for infrastructure construction; IALA Waterway safety assessment; Route analyses from international shipping lanes right to the port limit; Empty containers being sent to our port.	3D modelling and design testing; Navigation Simulation Studies; Vessel Traffic Management Systems (VTMS); Ship & Cargo Simulation System	Cargo storage area not enough; Long turnaround time	Empty container issues is critical since it did not give much benefits to Malaysia; Long turnaround time is not competitive to our cargo transportation industry	

	Station related officers in the terminals and jetties	Employ security armed forces on cargo vessels and station authority officers in terminals and jetties	–	–	–
	Training centre that can conduct training with respect of different types of maritime transportation	Open certified training centre regionally especially in Sabah and Sarawak	–	–	–
	Introduce a more comprehensive ship and port security procedures	Track data vessel accident record; Propose Cargo Security Initiative (CSI); security information of out coming port available in incoming port; Upgrade scanning facility	–	–	–
	Minimise the number of empty containers; Shorten the turnaround period to stay competitive	Introduce a new policy on handling empty container issues; Shorten the turnaround period	–	–	–

Maritime environment	–	Marine Impact Analysis is a mandatory requirement for maritime project developments; Environmental Impact Assessment (DEIA) for environmental risk assessment	–	–	
Ships/Boats design	Ships / boats design done by international organisation outside Malaysia	3D modelling and design testing; oil spill modelling	Design flaws cause some boats/ ships to sink; Lack of regular maintenance	Some aspect of safety issues are not according to Malaysia situation	

	–	–	–	–	–
	Introduce a more comprehensive ship / boat design which suitable for Malaysia geographical conditions especially in Sabah and Sarawak	Ensure all vessels comply with safety standards; Regularly audit the ship / boats manufacturer	–	–	–

REFERENCES

A, Abdulla & O, Linden (eds) 2008, *Maritime Traffc EfFects on Biodiversity In The Mediterranean Sea: Review Of Impacts, Priority Areas And Mitigation Measures*, IUCN Centre for Mediterranean Cooperation, Malaga, Spain.

A, Miola *et al.* 2009, 'External Costs of Transportation. Case Study: Maritime Transport, European Commission', *Joint Research Centre*, Institute for Environment and Sustainability, pp. 1-109.

ADC 2013, *Automotive Development Centre (ADC)*, viewed 28 October 2013, <http://www.adc.utm.my/>.

AE 2013, *Automotive Engineering*, viewed on 20 October 2013, <http://afterschool.my/course-description/automotive-engineering/>.

AEC 2013, *Automotive Engineering Centre*, <http://aec.ump.edu.my/index.php?option=com_content&view=article&id=59&Itemid=62>.

AHH Sabeen, AE Anwar, & ZZ Noor 2012, 'Sustainable Public Transportation in Malaysia', *International Journal of Engineering and Advanced Technology*, vol. 1, no. 5, pp. 71-74.

Ahmad Noor Syukri Zainal Abidin, *et al.* 2012, *MIROS Crash Investigation and Reconstruction (Annual Statistical Report 2007–2010)*, MIROS.

Ahmad Noor Syukri Zainal Abidin, *et al.* 2012, MIROS Crash Investigation and Reconstruction (Annual Statistical Report 2007–2010), MIROS, Malaysia.

AJTP 2013, 'Rail Transport of Malaysia (2004 - 2012) KTMB Statistics', *ASEAN-Japan Transport Partnership*, AJTP.

AM 2013, viewed on 30 August 2013, http://l3d.cs.colorado.edu/systems/agentsheets/new-vista/Automotive/

An, F, Earley, R, & Weiskel, LG 2011,'Global overview on fuel efficiency and motor vehicle emission standards: policy options and perspectives for international cooperation', in *United Nations, Department Of Economic And Social Affairs, Commission on Sustainable Development*, 19th Session, New York, 2-13 May 2011.

Anon, *Trading Economics*, <www.tradingeconomics.com>.

Anon, Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories: Aircraft Emissions, date viewed? <http://www.ipcc-nggip.iges.or.jp/public/gp/bgp/2_5_Aircraft.pdf)>.

Anon, Land Public Transport Act 2010, Act 715 (2010), publisher, place.

Anon, LRT Extension, http://www.lrtextension.com/.

Anon, Malaysia Railways Act 1991, Act 463 (2006), publisher, place.

Anon, The competitiveness of Global port Cities: Synthesis report, www.oecd.org/regional/portcities.

ARD 2013, *Automotive Research and Development*, <http://www.utem.edu.my/fkm/index.php?option=com_content&task=view&id=75&Itemid=143 (28/2013)>.

Ariffin, RNR, & Zahari, RK 2013, 'The Challenges of Implementing Urban Transport Policy in the Klang Valley, Malaysia', in *Procedia Environmental Sciences*, vol. 17, pp. 469-477.

ASEAN 2010, 'Brunei Action Plan (ASEAN Strategic Transport Plan) 2011 – 2015', *ASEAN*, ASEAN.

Aubel, Thomas 2009, 'Benefits of Periodical Vehicle Testing-A Foresight', in the *International Motor Vehicle Inspection Committee Conference 2009*.

Bachok, S, Osman, MM, Khalid, UA & Zainaldin, MF 2012, The application of regression analysis on users' tolerance to prolonged eating times: the case of KTM Commuter Services of Malaysia. *WIT Transactions on The Built Environment*, vol. 127.

Bak Chai, Lim, viewed November 20, 2013, <http://www.efka.utm.my/thesis/images/3PSM/2004/ 3JGP/Geoteknik1/LIMBAKCHAISX010453AWJ- 12D04TT1.doc>.

Beatley, T 1995, *The Many Meanings of Sustainability. Journal of Planning and Literature*, vol. 9, No. 4, May, pp. 339-342.

Berglund, B, Lindvall, T & D, Schwela (eds), *Guidelines for Community Noise*, World Health Organisation (WHO), Geneva.

Black, WR 2010, *Sustainable Transportation: Problems and Solutions,* Guilford Press.

BN 2011, 'The Parking Fee Increases to 15RMB per hour Within the 3rd Ring Belt [in Chinese]', *Beijing News*, <http://epaper.bjnews.com.cn/html/2011-04/01/content_216723.htm?div=-1>.

CAR 2013, *The Centre for Automotive Research (CAR)*, <http://www.ukm.my/car/>.

CBT 2012, *Campaign for Better Transport's, Reopening Railways: the case for growing the rail network and how it can be achieved*, <www. bettertransport.org. uk>.

CES 2013, *Centre for Energy Sciences*, viewed 28/10/2013, <http://aet.um.edu. my/?modul=Research&pilihan=Research_ Centres&subpilihan=Centre_for_Energy_Sciences>.

Convention on Biological Diversity 2013, *Convention on Biological Diversity*, viewed on September 2010, COP-10: <http://www.cbd.int/cop10>.

Dalkmann, H & Sakamoto, K 2012, 'Low Carbon Green Growth Roadmap for Asia and the Pacific', *Urban Transport: Policy recommendations for the development of eco-effcient infrastructure*.

Daniel Brand 1993, 'Intelligent Vehicle Highway System Benefts Assessment Framework', *Transportation Research Record*, vol. 1408, pp. 1-7.

Dargay, J, Gately, D & Sommer, M 2006, 'Vehicle Ownership and Income Growth', *Worldwide: 1960-2030*, pp. 1-28, <http:// citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.168.3895&rep=rep1&type=pdf>.

Daud, MSM, Endut, IR & Jaafar, HS April 2012, 'Analysis of factors threatening the success of freight movement in Malaysia', Business Engineering and Industrial Applications Colloquium (BEIAC), 2012 IEEE, pp.115-120,

Daud, MSM, Endut, IR & Jaafar, HS 2012, 'Analysis of factors threatening the success of freight movement in Malaysia', Business Engineering and Industrial Applications Colloquium (BEIAC), 7-8 April 2012 IEEE , vol.120, no.?, pp.115.

Department of Civil Aviation Malaysia 2008,'Safety Management System', *AIC*, vol. 06.

Department of Civil Aviation Malaysia, 2005,'Inspection and Investigation of Air Accidents', *AIC*, vol. 30.

Department of Statistics Malaysia, *Department of Statistics Malaysia (website)*, Department of Statistics Malaysia, http://www.statistics.gov.my/portal/index. php?option=com_con- tent&id=1215.

Department of Statistics, viewed 20 November, 2013, <http://www.statistics.gov.my/portal/download_Buku_Tahunan/fles/BKKP/2011/TAB_15-PENGANGKUTAN_KOMUNIKASI-[Transport_Communications].xls>.

Ducruet, C, & Van der Horst, M 2009, 'Transport Integration at European Ports: Measuring the Role and Position of Intermediaries', *EJTIR*, vol. 9, pp. 121-142.

Electrifed Double Track Project 2013, *Electrifed Double Track Project, Ipoh-Padang Besar, MMC-Gamuda* [online], viewed 6 January 2014, <http://www.2t.com. my/EN/project/index.html>.

Electrifed Double Track Project 2013, Electrifed Double Track Project, Ipoh-Padang Besar, MMC- Gamuda [online], viewed 6 Jan 2014, <http:// www.2t.com.my/ EN/project/index.html>.

Electrified Double Track Project 2013, Electrified Double Track Project, Ipoh-Padang Besar, MMC-Gamuda [online], viewed 6 January 2014, <http:// www.2t.com.my/EN/project/index.html>.

Elvik, R et al. 2009, *The Handbook of Road Safety Measures*, 2nd Edn, Emerald Group Publishing Limited.

EPU 2010, *10th Malaysia Plan*, EPU, Putrajaya.

European Commission 2009, *A sustainable future for transport: Towards An Integrated, Technology-Led And User-Friendly System*, European Commission.

European Commission 2009, *A Sustainable Future for Transport: Towards An Integrated, Technology-Led and User-Friendly System*, European Commission.

European Environment Agency 2011, *The European environment — State and outlook 2010: assessment of global megatrends*, European Environment Agency.

European Railway Agency 2013, *Annual Report 2012*, European Railway Agency.

European Transport Safety Council 1999, *Safety of Pedestrians and Cyclists in Urban Areas*, European Transport Safety Council.

European Union 2011, *Roadmap to A Single European Transport Area – Towards A Competitive And Resource-Efficient Transport System*, European Union.

European Union 2011, *Roadmap to A Single European Transport Area —Towards A Competitive And Resource-Effcient Transport System.*

Federal Department of Town and Country Planning 2010, *National Physical Plan 2*, Malaysia, Ministry of Housing and Local Government, Putrajaya.

Federal Transportation Advisory Group 2001, Vision 2050 – *An Integrated National Transportation System*, Federal Transportation Advisory Group.

Federal Transportation Advisory Group 2001, *Vision 2050 – An Integrated National Transportation System, Federal Transportation Advisory Group*, n.p.

Frost & Sullivan 2011, *Top 20 Global Mega Trends and Their Impact on Business*, Cultures and Society.

FTA 2014,The Importance of Rail Freight, *Freight Transport Association*, viewed 30 January 2014, <http://www.fta.co.uk/export/sites/fta/_galleries/downloads/rail_freight/importance_of_rail_freight_0408. pdf>.

FTN 2004, *The Future Of Transport A Network For 2030*, Department for Transport, United Kingdom.

FTN 2004,The Future of Transport A Network For 2030, Department for Transport, United Kingdom.

Gasson, Susan 2003, ‘Human-centered vs. user-centered approaches’, *Journal of Information Technology Theory and Application*, vol. 5, no. 2, pp. 29-46.

Goldman, T & Gorham, R 2006, ‘Sustainable urban transport: Four innovative directions’, *Technology in Society*, vol. 28, pp. 261-273.

Goodrich, MA et al. 2000,‘Designing Human-Centered Automation: Trade-Offs in Collision Avoidance System Design, Intelligent Transportation Systems’, *IEEE Transactions*, vol. 1, no. 1, pp. 40-54.

Government of Malaysia 2006, *Malaysia Railways Act 1991, Act 463 CFR*, Malaysia.

Government of Malaysia, 2010, *Land Public Transport Act 2010*, Act 715 CFR, Malaysia.

Government of Malaysia, 2010, *Land Public Transport Act 2010, Act 715 CFR,* Malaysia.

Government of Malaysia, Container Port Capacity and Utilisation Metrics, http://onlinepubs.trb.org/onlinepubs/ conferences/2012/Metrics/presentations/5-Smith. pdf>.

Government of Malaysia, *Lembaga Sungai-sungai Sarawak*, Malaysia.

Government of Malaysia, Population Distribution and Basic Demo- graphic Characteristic Report 2010, viewed February 13 2014, <http://www.statistics.gov.my/portal/index. php?option=com_content&id=1215>.

Government of Malaysia, *Sabah Tourism*, Malaysia.

Government of Malaysia, UNESCAP, <http://www.unescap. org/ttdw/Publications/TIS_pubs/pub_2484/pub_2484_ CH3.pdf>.

Haberkorn, T et al. 2013,‘Requirements for Future Collision Avoidance Systems in Visual Flight: A Human-centered Approach. Human-Machine Systems’, *IEEE Transactions*, vol. 43, no. 6, pp. 583-594.

Haddon Jr, William 1968, ‘The changing approach to the epidemiology, prevention, and amelioration of trauma: the transition to approaches etiologically rather than descriptively’, *American Journal of Public Health*, vol. 58, pp. 1431–1438.

Henriksson, JM, & Paolicchi, S 2012,'The Malaysian Automotive Sector', *EU Delegation to Malaysia – Trade & Economic Section*, n.p.

Higgins, David 2013, *Network Rail, A Better Railway For A Better Britain*, pp. 1-40.

HS1UK, *High Speed 1*, United Kingdom (1998- 2007), viewed 31 January 2014, <http://www.bechtel.com/high_speed_1.html (31/01/2014>).

ICAO 1987, *Airport Planning Manual*, ICAO.

ICAO 2013, *2013 Safety Report*, ICAO.

IHS 2013, 'Guide To Ballast Water Treatment Systems, IHS Maritime', *Fairplay Series*, RWO.

Intan Farhana Zainul 23 August 2013, 'ECER to complete RM30b East Coast Rail Link study by early 2014', *The Star Online* [online], viewed 6 Jan 2014, <http://www.thestar.com.my/Business/Busi- ness-News/2013/08/26/East-Coast-Rail-Link-feasibili- ty-study.aspx/>.

Intergovernmental Panel on Climate Change (IPCC), *Intergovernmental Panel on Climate Change Report*, http://www.ipcc-nggip.iges. or.jp/public/gp/bgp/2_5_Aircraft.pdf).

International Civil Aviation Organisation (ICAD) 2013, *Global Aviation Safety Plan*, International Civil Aviation Organisation, ICAD.

International Energy Agency 2013, *International Energy Agency*, viewed on September 2010, International Energy Agency – Publication, <www.iea.org/publications/freepublications/publication/transport2009.pdf>.

International Traffc Safety Data and Analysis Group (IRTAD) 2013, *Road Safety Annual Report 2013*, IRTAD.

International Transport Forum, *et al.* 2010, *Safety and Regulatory Reform of Railways*, OECD.

IPCC, 'Guidelines On National Green-house Gases Inventories', *Reference manual*, p. 196.

IPCC, *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories: Aircraft Emissions*, <http://www. ipcc-nggip.iges.or.jp/public/gp/bgp/2_5_Aircraft.pdf)>.

Jamilah Mohd Marjan, *et al.* 2012, *Evaluation of the Effectiveness of OPS Bersepadu Hari Raya*.

Jamilah Mohd Marjan, *et al*. 2012, *Evaluation of the Effectiveness of OPS Bersepadu Hari Raya 2011*, n.p.

Jian, Z 2014, *Innovations and Practices of High-Speed Railway in China, The Ministry of Railways of the People's Republic of China*, viewed 20 January 2014, <http://www.uncrd.or.jp/env/5th-regional-est-forum/doc/07_Breakout%20Session2-A/BS2-A-5_MoR_China_Zheng%20Jian.pdf>.

Kaur, Sharen 26 October 2013, 'EDTP works to start next year', The Star Online [online] 2013, viewed 6 Jan 2014, <http://www.btimes.com.my/Current_News/BTIMES/articles/SPAD25/Article/>.

Kaur, Sharen2013,EDTP Works to Start Next Year. *The Star Online* [online] 26th October 2013, viewed on 6 January 2014, <http://www.btimes.com.my/Current_News/BTIMES/articles/SPAD25/Article>/.

Kearney, AT 2012 *Global Mega Trends*, n.p.

Kopanezou, E 2013, 'European Commission', *EU Regional Policy Conferences*, viewed on September 2010, <https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CCoQFjAA&url=http%3A%2F%2Fec.europa.eu%2Fregional_policy%2Fconferences%2Fod2006%2Fdoc%2Fpresentations%2Fe%2Fkopanezou_11e23.ppt&ei=C6AuUoOFGMmXrgfPmICYAQ&usg=AFQjCNEHnhVw2n37yzS5oWA4f3bq>.

KPMG 2013, *KPMG's Global Automotive Executive Survey 2013*, viewed on 6 November 2013, <http://www.kpmg.com/KZ/ru/IssuesAndInsights/ArticlesAndPublications/Documents/KPMGs-Global-Automotive-Executive-Survey-2013.pdf>.

KTMB 2012, *Annual Report 2012*, KTMB, Malaysia.

Kwan, Irene *et al.* 2006, 'Interventions for increasing pedestrian and cyclist visibility for the prevention of death and injuries', *Cochrane Database of Systematic Reviews*, vol. 4.

L, Battistelli, T, Coppola, M, Fantauzzi & F, Quaranta, 'The Environmental Impact of Cruise Ships in the Port of Naples: Analysis of the Pollution Level and Possible Solutions', *Maritime Environment Research II*, pp. 945-958.

Lembaga Pembangunan Langkawi, *Lembaga Pembangunan Langkawi*, LADA, Malaysia.

Lembaga Pembangunan Tioman, *Lembaga Pembangunan Tioman*, Malaysia.

LFRC November 2012,Li & Fung Research Centre (LFRC), An Update on the Transport Infrastructure Development in China, LFRC.

Lloyd's Register Rail 2009, *International Review of Railway Safety Practices for the Independent Transport Safety and Reliability Regulator (ITSRR)*, Lloyd's Register Rail.

Looi, Elizabeth 2008, *Six Injured in LRT Accident*, <http://www.thestar.com.my/story.aspx/?fle=%2f2008%2f9—2f25%2fnation%2f2116102&sec=nation>.

MAA 2013, *Malaysian Automotive Association*, viewed on 10/07/2013, <http://www.maa.org.my>.

Madani, S 2012, Chief Executive Officer, *Malaysia Automotive Institute (MAI)*, viewed September 4, 2012, <http://www.thestar.com.my/story.aspx?file=2f2012%2f9%2f4%2fbusiness%2f11949003&sec=business (27/10/2013)>.

Majlis Perbandaran Manjung, Majlis Perbandaran Manjung, *Majlis Perbandaran Manjung*, Perak.

Malay Mail Online 2013, *Putrajaya To Acquire Two AES Firms, Says Deputy Minister*, <http://www.themalaymailonline.com/malaysia/article/putrajaya-to-acquire-two-aes-frms-says-deputy-minister>.

Malaysia Airports Berhad Holding 2012, *Malaysia Airport Annual Report*, Malaysia Airports Berhad Holding, Malaysia.

Malaysia Marine *Department, Malaysia Marine Department*, <http://www.marine.gov.my/jlm/>.

Malaysian Maritime Enforcement Agency 2011, *Laporan Tahunan 2011*, Malaysian Maritime Enforcement Agency, Malaysia.

Malaysian Maritime Enforcement Agency 2011, *Laporan Tahunan 2011*, Malaysian Maritime Enforcement Agency, Malaysia.

Marine Department Malaysia 2013, *IMO Convention adopted by Malaysia*, Marine Department Malaysia, viewed on February 3 2014, <http://www.marine.gov.my/jlmeng/Contentdetail.asp?article_id=340&category_id=1&subcategory_id=23&subcategory2_id=34>.

Maritime Institute of Malaysia , *Maritime Institute of Malaysia website*,viewed November 21, 2013, <http://www.mima.gov.my/mima/web-links/malay- sian-ports/>.

Maritime Knowledge Centre 2012, *International Shipping Facts and Figures – Information Resources on Trade, Safety, Security, Environment*, International Maritime, Maritime Knowledge Centre.

Melibaeva, Savera, Sussman, Joseph & Dunn, Travis 2011,'Comparative Study of High-Speed Passenger Rail Deployment in Mega region Corridors: Current Experiences and Future Opportunities', in *Proceedings of the ASME/ASCE/IEEE 2011 Joint Rail Conference. March 16-18, 2011*, publisher, Pueblo, Colorado, USA.

Melibaeva, Savera, Sussman, Joseph & Dunn, Travis 2011,'Comparative Study of High-Speed Passenger Rail Deployment in Mega region Corridors: Current Experiences and Future Opportunities',in *Proceedings of the ASME/ASCE/IEEE 2011 Joint Rail Conference*. March 16-18, 2011, Pueblo, Colorado, USA

Ministry of Tourism Malaysia and Culture, <http://www.tourism.gov.my/en/my>.

Ministry of Tourism Malaysia and Culture, *Ministry of Tourism Malaysia and Culture (website)*, <http://www.tourism.gov.my/en/my>.

Ministry of Transport Malaysia 2011, *Transport Statistics Malaysia*, Ministry of Transport Malaysia, Putrajaya.

Ministry of Transport Malaysia 2012, *Malaysia Transport Statistics Year 2011*, viewed November 2013, <http://www.mot.gov.my/en/Publication/Offcialpercent20Publications/Malaysia%20Transport%20Statistics%20Year%202011.pdf>.

MIROS 2007, Kod Amalan Keselamatan, Kesihatan, dan Alam Sekitar untuk Sektor Pengangkutan, MIROS, Malaysia.

MNRN 2013, *Maps of The National Rail Network*, viewed 26 January 2014, <http://www.nationalrail.co.uk/static/documents/content/routemaps/nationalrailnetworkmap.pdf>.

Mohd Rasid Osman, *et al.* 2009, *The Effect of Driver Management System According to SHE COP in Reducing Speed Violations*, MIROS, Malaysia.

MOT 2011, *Malaysia Transport Statistics 2011*, Ministry of Transport Malaysia, Putrajaya.

MOT, *Country Paper for Regional Meeting on Cooperation for Facilitation of International Road Transport, Beijing, China*, Ministry of Transport, viewed November 6, 2013, <http://www.unescap.org/ttdw/com- mon/Meetings/TFS/2011Regional-Road-Tx/Countries/ Malaysia.pdf>.

MSM Daud, IR Endut, & HS Jaafar April 2012, 'Analysis of factors threatening the success of freight movement in Malaysia', *Business Engineering and Industrial Applications Colloquium (BEIAC)*, 2012 IEEE, pp.115-120.

MTAE 2013, *Malaysia's Top Automotive Engineering / Motorsport Technology / Tyre Technology Universities & University Colleges (U&Uc) / Academies*, viewed 20 Oct 2013, <http://www.university-malaysia.com/useful-information/malaysia%E2%80%99s-top-automotive-engineering-motorsport-technology-tyre-technology-universities-university-colleges-uuc-academies/>.

MyMRT, MyMRT, <http://www.mymrt.com.my/en/about-mrt>.

NET 2014, *Nottingham Express Transit: Trams*, viewed 11 February 2014, <http://www.thetrams.co.uk/net/trams/>.

Nick Collins 2013, *British trains among best in Europe*, Transport Correspondent, viewed 20 December 2013, <http://www.telegraph.co.uk/news/uknews/ road-and-rail-transport/10528441/British-trains- among-best-in-Europe.html>.

NM Shariff 2012,'Private Vehicle Ownership and Transportation Planning in Malaysia', *International Conference on Traffic and Transportation Engineering*, IPCSIT, vol. 26, 64-68.

Norsworthy, M & Craft, E 2013, 'Emissions reductions analysis of voluntary clean truck programs at US ports', *Transportation Research Part D*, vol. 22, pp. 23-27.

Ogata, Masaki 2013, 'Creating Sustainable and Liveable Cities: The Transport & Planning Dimension', in *Land Public Transport Symposium 2013*, 2nd Dec 2013, Kuala Lumpur, Malaysia.

Ogden, KW 1996, *'Safer Roads: A Guide To Road Safety Engineering*', Avebury Technical (Ashgate Publ.).

Ong, HC, TMI Mahlia & HH Masjuki 2012, 'A review on energy pattern and policy for transportation sector in Malaysia', *Renewable and Sustainable Energy Reviews*, vol. 16, no. 1, pp. 532-542.

Pan, H 2011, 'Implementing Sustainable Urban Travel Policies in China', in *Discussion Paper No. 2011-12, International Transport Forum*, 2011 International Transport Forum, on 25-27 May in Leipzig, Germany.

PEMANDU 2012b, *ETP Handbook Chapter 5*, PEMANDU, Putrajaya.

PEMANDU, 2012a, *Government Transformation Programme – Annual Report 2012*, PEMANDU, Putrajaya

Peng, ZR, Sun, J & Lu, QC May 2012,'China's Public Transportation: Problems, Policies and Prospective of Sustainability', *ITE Journal*, pp. 36-40.

Peng, ZR, Zhu, Y, & Song, S 2008,'Mobility of the Chinese Urban Poor – A Case Study of Hefei City', *The Chinese Economy*, vol. 41, no. 1, pp.36–57.

Prime Minister's Department, *Economic Planning Unit*, Prime Minister's Department, Putrajaya.

Qi, Y 2011, *China's Battle Against Traffic Treads on Fundamental 'Right to Buy Cars*,viewed October 20, 2011, <http://www.worldcrunch.com/chinasbattle-against-traffic-treads-fundamental-rightbuycars/3524>.

Qi, Y 2011, *China's Battle Against Traffic Treads on Fundamental 'Right to Buy Cars, 2011*, <http://www.worldcrunch.com/chinasbattle-against-traffic-treads-fundamental-rightbuycars/ 3524, accessed October 20, 2011>.

R Umar, *et al.* 1995,'Preliminary Analysis of Exclusive Motorcycle Lanes Along Federal Highway F02', *IATSS Research*, vol. 19.

Rail Safety and Standards Board (RSSB), *The Railway Strategic Safety Plan 2008-2010, Rail Safety and Standards Board (RSSB)*, RSSB.

Rizzuto, E et al. 2010, 'Harbour noise nuisance', *Task 1.3, WP 1 of SILENV FP7 Collaborative Project No. 234182 (Ships Oriented Innovative Solutions to Reduce Noise and Vibrations.*

RNAP 2012, *Revised National Auto Policy Will Allow More Car Models to Come In*, 4 September, 2012, viewed 27 October 2013, <http://www.thestar.com.my/story.aspx?fle=%2f2012%2f9%2f4%2fbusiness%2f11949003&sec=business>.

Rodrigue, JP 2013, 'The Environmental Impacts of Transportation', *The Geography of Transport System*, viewed September 2010, <http://people.hofstra.edu/geotrans/eng/ch8en/conc8en/ch8c1en.html>.

RPNCS 2012,'Rail passenger numbers and crowding on weekdays in major cities in England and Wales: 2012, Rail passenger numbers and crowding statistics, 2012', *Statistical Release*, First released 24 July 2013, Revised 24 October 2013, Department of Transport, <https://www.gov.uk/Government/uploads/system/uploads/attachment_data/file/252516/rail-passengers-crowding-2012-revised.pdf>.

RTBP 2014, *Rail today: Best practices – Living RAIL, Car-free city, Vauban (Freiburg, Germany)*, viewed 11 February 2014, <http://81.47.175.201/livingrail/index.php?option=com_content&view=article&id=697:- car-free-city-vauban-freiburg-germany&catid=28:ur- ban-developments&Itemid=103>.

S Bachok, *et al*. 2012,'The application of regression analysis on users' tolerance to prolonged -eating times: the case of KTM Komuter Services of Malaysia', *WIT Transactions on the Built Environment*, vol. 127.

Sanabra M, Castells, Santamaría JJ, Usabiaga & De Osés FX Martínez 2013, 'Manoeuvring and hoteling external costs: enough for alternative energy sources?', *Maritime Policy and Management, The Flagship Journal Of International Shipping and Port Research*, pp. 1-19.

Sarani, Rohayu *et al.* 2012, Predicting Malaysian Road Fatalities for Year 2020. Kuala Lumpur: Malaysian Institute of Road Safety Research, MIROS.

Shank bone David March 2008, *Suburban Development in Colorado Springs*, Colorado, Wikipedia.

SLTS 2013, *Shanghai Lines Up New Tram System*, <http://www.chinadaily.com.cn/chi- na/2013-09/25/content_16994688.htm>.

SPAD, 2012, *National Land Public Transport Master Plan*, SPAD.

SRFI 2011, *Strategic Rail Freight Interchange Policy Guidance*, Department for Transport, London.

ST 2014, *Shenyang Tramway*, *China*, viewed 11 February 2014, <http://www.railway-technology.com/proj- ects/shenyang-tramway/>.

Takagi, Kiyoharu March 2011,'Expansion of High-Speed Rail Services, Development of High-Speed Railways in China', *Japan Railway & Transport Review*, no. 57, pp. 36-41.

TBIM 2011,*Transportation Blueprint 2010- 2030 for Iskandar Malaysia*, Iskandar Regional Development, Malaysia.

TBIM 2011,*Transportation Blueprint 2010- 2030 for Iskandar Malaysia*, Iskandar Regional Development, Malaysia.

TCG 2014, *Travel China Guide*, viewed 11 February 2014, <http://www.travelchinaguide.com/cityguides/liaoning/dalian/getting-around.htm>.

The Star 2014, RM9 billion for LRT to Klang, viewed 12 May 2014, http://www.thestar.com.my/Business/Business-News/2014/05/12/RM9bil-LRT-to-Klang/

The Star Online 2013, in CM: 'Alternative coastal highway and railway to be built under SCORE', *The Star Online*, [online] 2nd September 2013, viewed 6 Jan 2014, <http://www.thestar.com.my/News/Community /2013/ 09/02/CM-Alternative-coastal-highway-and-railway-to-be-built-under-SCORE.aspx/>.

The Star Online 2013, in *CM: Alternative coastal highway and railway to be built under SCORE, The Star Online*, [online] 2nd September 2013, viewed 6th Jan 2014, <http://www.thestar.com.my/News/Community /2013/ 09/02/CM-Alternative-coastal-highway-and-railway-to-be-built-under-SCORE.aspx/>.

The World Bank 2002, *Cities on the Move*, The World Bank.

TLRFS 2007,'Transport for London Rail Freight Strategy', *London Rail*, *Rail Freight Strategy*, pp. 1-59.

Transport *et al*. 1991,*Towards Safer Roads in Developing Countries: a Guide for Planners and Engineers*, HM Stationery Office, place of publication.

TW, Moynihan & GW, English2007, *Rail Safety Technologies*, Research and Traffc Group.

UK Government 2014, *Getting an MOT, UK Government*, viewed 13 February 2014, <https://www.gov.uk/getting-an-mot>.

Umar, R *et al.* 1995,'Preliminary Analysis of Exclusive Motorcycle Lanes Along Federal Highway F02', *IATSS Research*, vol. 19.

UNEP 2011, *Transport: Investing in energy and resource effciency – in 'Towards a Green Economy'*, United Nations Environmental Programme, Geneva.

UNESCAP 2012, *Low Carbon Green Growth Roadmap for Asia and the Pacifc – Urban Transport: Policy recommendations for the development of eco-effcient infrastructure*, United Nations Economic and Social Commission for Asia and the Pacifc, Geneva.

UNESCAP, 2012, *Low Carbon Green Growth Roadmap for Asia and the Pacific: Urban Transport*, UNESCO.

United Nations 2011, *United Nations Decade of Action for Road Safety 2011-2020*, <http://www.un.org/en/roadsafety/>.

United Nations 2012, 'World Population Prospects: The 2012 Revision. Highlights and Advance- Tables', viewed 12 February 2014, <http://esa.un.org/ wpp/Documentation/pdf/WPP2012_HIGHLIGHTS. pdf>.

United Nations Development Programme (UNDP) 2008, *Malaysia Inland Waterway Transport System in Sarawak*, UNDP, Malaysia.

United Nations Environment Programme – Newsletter 2013, *United Nations Environment Programme*, viewed September 2010, <www.unep.org/transport/lowcarbon/newsletter/.../GER_10_Transport.pdf>.

United Nations Population Division 2009, *World population prospects — The 2008 revision*, United Nations.

US Department of Transportation December 2002, *Bureau of Transportation Statistics, Transportation Indicators*, <http://www.bts.gov/publications/transportation_indicators/december_2002/.

Vanar, Muguntan *et al.* 2011, '12 Seriously Hurt As Train Slams into Fuel Tanker', *The Star*, http://www.thestar. com.my/story.aspx/?fle=%2f2011 v2f11%2f1%2fna- tion%2f9812313&sec=nation.

Wegman, F *et al*. 1997, *Sustainable Solutions to Improve Road Safety in the Netherlands: a 'polder Model' for a Considerably Safer Road Traffic System*, n.p.

Weissenberg, P 2006, 'European Economic Clusters: the European Commission Perspective', ed Wijnolst, N, *Dynamic European Maritime Clusters*, IOS Press BV, Amsterdam.

WHO 2004, *World report on road traffc injury prevention*, WHO.

WHO 2009, *Regional Report on Status of Road Safety: the South-East Asia Region – A call for policy direction*, WHO.

WHO 2009, *Regional Report on Status of Road Safety: the South-East Asia Region – A call for policy direction*, WHO.

WHO 2013, *Global Status Report on Road Safety 2013: Supporting A Decade Of Action*, WHO.

Wikipedia 2014, *Rail Transport* [online], viewed 6 Jan 2014, <http://en.wikipedia.org/wiki/Rail_transport>.

World Commission on Environment and Development 1987, *Our Common Future*, United Nations.

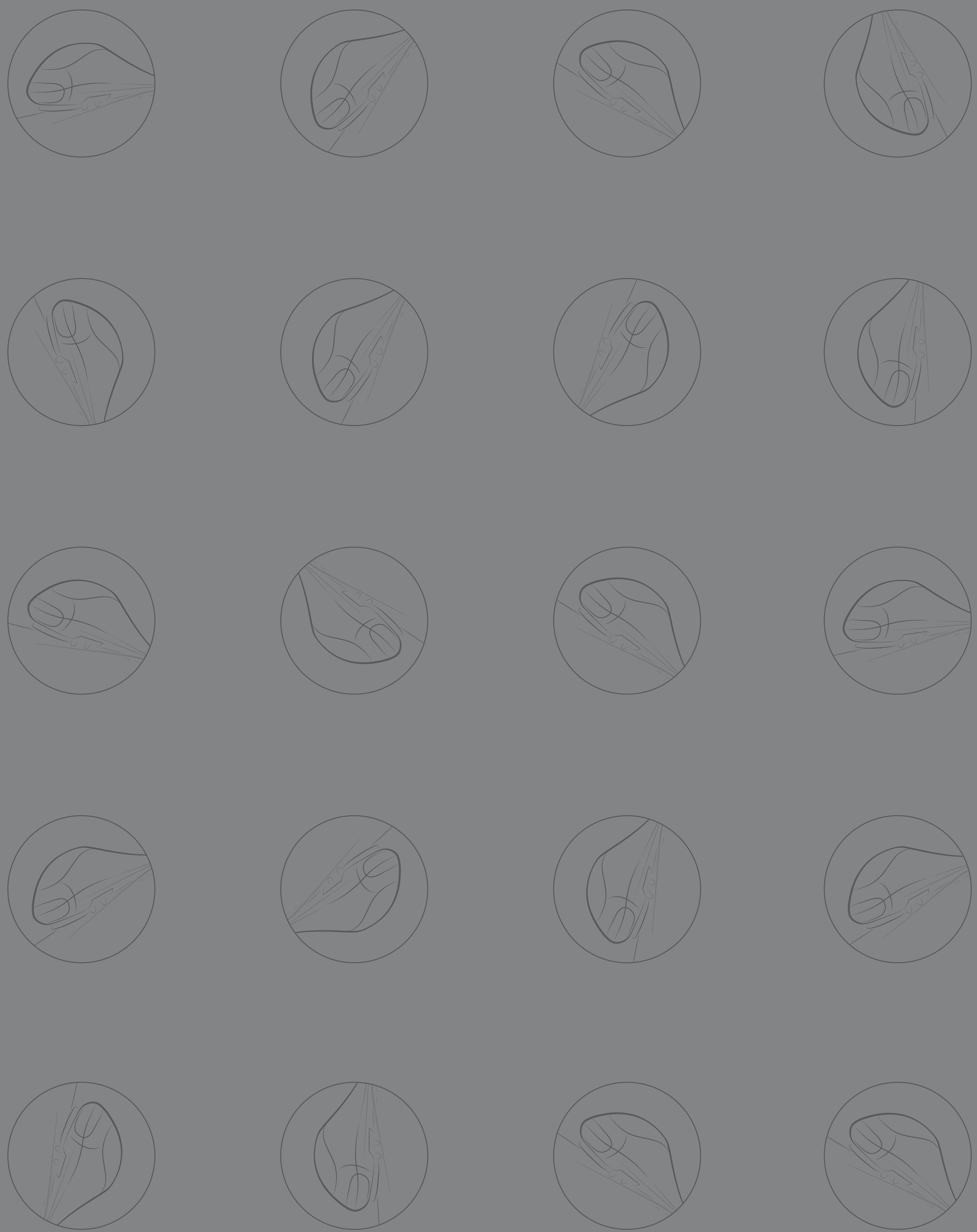
WSC, WSC 2009, *Liner Shipping and Carbon Emissions Policy*, http://www.worldshipping.org/pdf/liner_ shipping_carbon_emissions_policy_presentation.pdf.

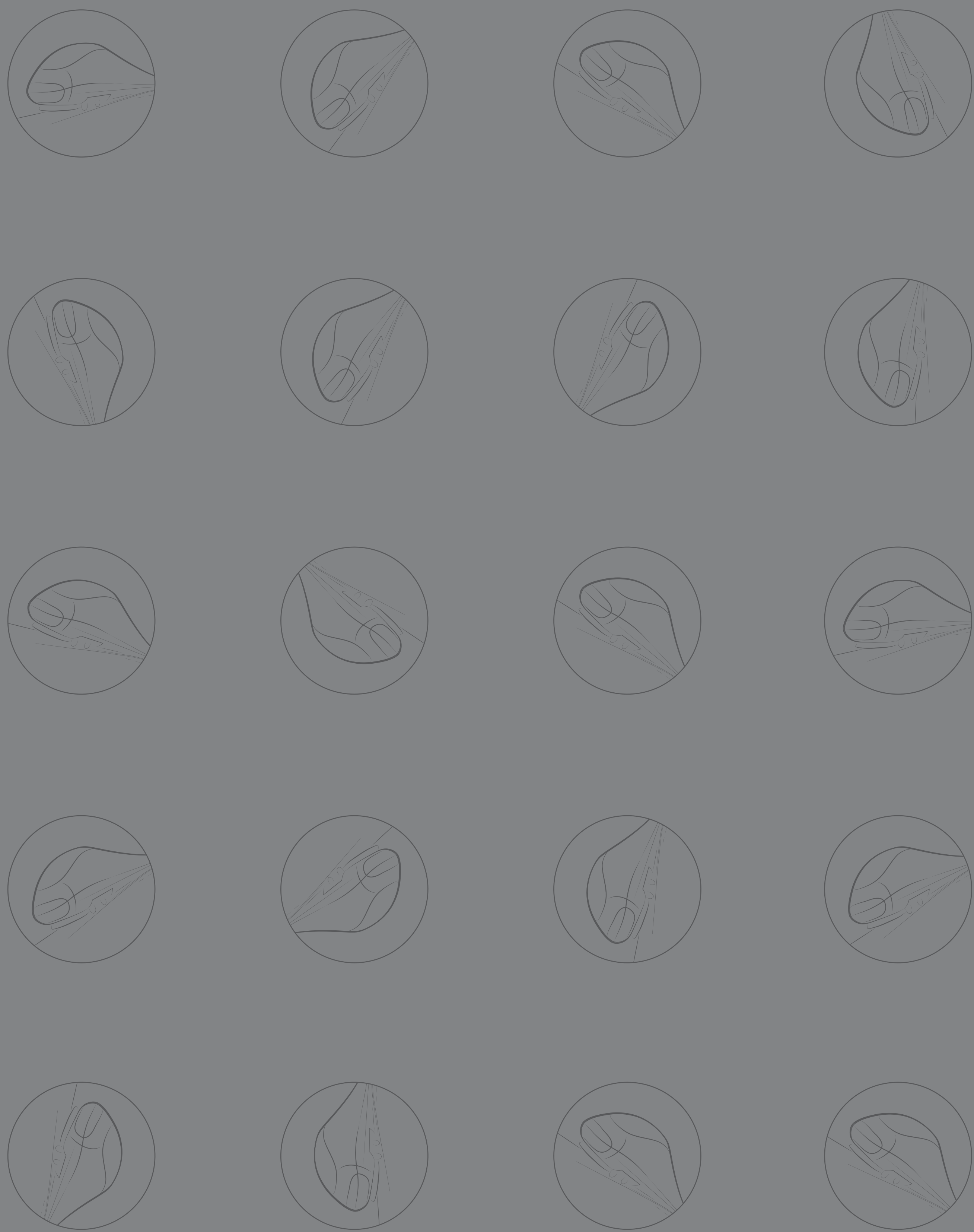
Y, Chen 2010, 'High-speed rail in Taiwan: New experience and issues for future development', *Transport Policy*, vol. 17, pp. 51-63.

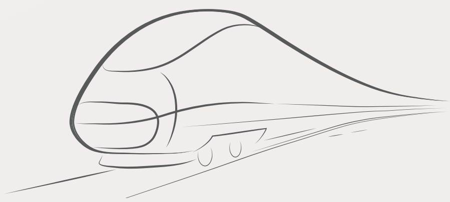
Yang, Y & Shen, K 2013, 'Comparison of the operating performance of automated and traditional container terminals', International Journal of Logistics Research, vol. 16, no. 2, pp. 158-173.

Yulin, J & Zhenyu, L May 2010, 'Practices and Policies of Green Urban Transport in China', *Journeys*, pp. 26-35.

Yulin, J & Zhenyu, L May 2010, 'Practices and Policies of Green Urban Transport in China', Journeys, pp. 26-35.







Academy of Sciences Malaysia
Level 20, West Wing, MATRADE Tower
Jalan Sultan Haji Ahmad Shah
off Jalan Tuanku Abdul Halim
50480 Kuala Lumpur, Malaysia

Phone : +6 (03) 6203 0633
Fax : +6 (03) 6203 0634

www.akademisains.gov.my