The Institution of Engineers, Malaysia

IEM Position Paper on "Building Capacity of Railway Systems Engineering for the Future"

IEM Electrical Engineering Technical Division, Railway Systems WG

AUGUST 2019

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EXECUTIVE SUMMARY

In 2013, Suruhanjaya Pengangkutan Awam Darat SPAD [now known as Agensi Pengangkutan Awam Darat APAD] publicly attested in a media statement regarding the issue of wide skill gaps of Malaysia's rail industry workforce in Railway Systems Engineering covering signalling and train control systems, train traction power systems and operational software integration systems. Subsequently, this problem of lack of professional engineering practice in railway systems engineering was further addressed in the Board of Engineers Malaysia (BEM) quarterly publication in Vol.63 (2015) of The Ingenieur in a Paper entitled "Capacity Building of Professionals in Electrical and Railway Engineering" which provides the broad framework for primary stakeholders of the railway industry to move forward in resolving some of wide skill gaps issue in railway systems engineering.

It needs to be appreciated here, that Railway Engineering (without the *systems*) is principally concerned with civil and construction engineering for railroad alignment designs, including structures for embankment, elevated guideways and tunnels (for the rail-track works), and Stations/Builts architectural designs & associated building services facilities. In this context, Malaysia has a very well-established civil & structures engineering knowledge base which can undertake complex designs and construction engineering of civil infrastructures, including rail infrastructure civil works. As such, minimal dependency on foreign engineering expertise for undertaking such works.

This IEM Position Paper is a follow-up in addressing the shortcomings of the current state of Malaysia's railway industry in resolving some of the wide skill gaps in railway systems engineering as highlighted above.

In terms of structure, the Malaysian railway industry is **very much similar** to that of the Malaysian electricity supply industry (MESI). Both comprise six major functions, namely **1.** *Policy & Regulatory*, **2.** *Asset Management*, **3.** *Operation,* **4.** *Planning Design Implementation & Manufacturing/Assembly*, **5.** *Maintenance Repair Overhaul*, and **6.** *Education & Training.* MESI, with TNB as its anchor enterprise, is acknowledged as a successful model in terms of technical operation, customer service and business performance. It is a fact that TNB is a world-class Electricity Operator when benchmarked to performance measure of Reliability Availability Maintainability Safety (RAMS).

In addressing the wide skill gap issues/shortcomings of the current state of Malaysia's railway industry, we have used the successful MESI model to offer recommendations for the

Government/Ministry of Transport (MoT) to consider as short-term/immediate steps covering the aspects of ***Policy & Regulatory*** and ***Education & Training*** towards a better future performance in railway technical system operation, customer service and business operation of the railway industry.

The Recommendations

(i) Management & Engineering Audit of Railway Operators

Ministry of Transport (MoT) to institute within the current railway regulatory framework ***periodic*** Management & Engineering Audit (M & E Audit) of the three current Railway Operators (KTMB, Prasarana/RapidRail and ERL) covering railway systems assets and technical/business operation. MoT to kick-start this *inaugural* M & E Audit exercise as soon as possible for the railway operators. *[This periodic (once every four-year period) M & E Audit is a mandatory MESI regulatory requirement for the power producers and operators of the electricity supply industry].*

(ii) Organizational Restructuring and Renewal of Railway Operators

From the findings of this inaugural M & E Audit, MoT will be better guided to undertake Organizational Restructuring and Renewal (ORR) of the existing Railway Operators. This ORR exercise is to be strategically aligned/positioned and to be embedded and sustained at all organizational levels with that *learning and growth culture* of modern railway technical systems knowledge comprising planning, design and operation. And, for the middle and senior management staff levels, they have to be trained and developed with engineering management and business leadership skills. [*This learning and growth culture has been the sustainable strategic thrust of the national electricity power system Operator (LLN/TNB) since its inception, and thus the main contributing factor as a world-class electricity utility company in terms of planning, design, operation and RAMS].*

(iii) "Light-Touch" Railway Regulator Enabled with Decision-Making Regulatory Role

The Railway Regulator APAD is to be a *"light-touch"* independent body under MoT, but mandated with that enabling decision-making framework in minimizing levels of decision making between the Railway Operators and the GoM Cabinet (the ultimate decision-maker) when involving political and financial considerations. *[This is again the successful model that is currently employed in MESI where the "light-touch" Energy/Electricity Regulator is Suruhanjaya Tenaga (ST)].*

(iv) Harmonization and Standardization of National Acts & Regulations with International Standards

Harmonization and Standardization of existing relevant National Acts/Regulations with International Standards need to be undertaken to address the existing *"gaps"* and *"clashes"* due to the latest development in Malaysia's modern electrical railway transportation projects/systems. In particular, Malaysia's Electricity Supply Act (Act 447)/Regulations [1994] need to be updated and harmonized to include electricity supply for railway applications in terms of electrical safety and competency certification.

In this respect, it is recommended that MoT **to set up** a special Ministerial Committee to review this harmonization and standardization exercise and **to nominate** the Institution of Engineers Malaysia (IEM) as the Chairman of this Review Committee to engage and coordinate the various stakeholders involved to ensure all the necessary requirements are captured.

(v) Local Centres of Excellence to be Strengthened and Accredited & Certified

Existing collaboration between training institutes KTMB MyRA and Prasarana Rail Academy (PINTAR) and tertiary education institutions UniKL, UNITEN and UTHM conducting programs and training on railway systems should be strengthened and streamlined into focused centre of excellence (CoE). [*UniKL is currently focussing on mechanical engineering technology for railway vehicles structures & kinematics motion/propulsion and the associated rail track-works, while UNITEN is focussed on electrical power engineering for traction power system design and associated electromagnetic compatibility/interference (EMC/EMI), railway traction earthing & bonding and electrical safety. Currently, UTHM is already conducting technology degree program in rail transportation technology/railway engineering technology while UniKL is running the engineering technology degree program in railway systems].* In this respect, these engineering technology degree programs **need to be accredited** by the Board of Engineers Malaysia (BEM) and/or other relevant authorised bodies to ensure the educational and training programs are in line with current needs of the railway industry.

(vi) International Collaboration with International Centres of Excellence

To accelerate the development of railway engineering/railway systems engineering education and research, Government direction and instruction is required for these three Malaysian tertiary education institutions to enter into MoU collaboration with foreign institutions such as the University of Birmingham Centre for Railway Education & Research (BCRER) and Japan Railway Technical Research Institute (RTRI). *[In this respect, the Singapore model of postgraduate certification program for practising Singapore MRT (SMRT) engineering professionals involving the collaboration of SMRT Institute, Nanyang Technological University and BCRER is a good example to emulate\.*

Purpose

This Paper sets out the problem statement with regards to shortcomings of the current state of Malaysia's rail industry, especially in the aspects of Policy & Regulatory and Education & Training, which in turn have resulted in the lack of professional engineering expertise in **Railway Systems Engineering** with yawning skill gaps in the local industry workforce covering: *signaling and train control systems, train traction power systems, and operational software integration systems.* Consequently, Malaysia has to recruit highly-skilled foreign engineers to fill up these "**gaps"**. This issue has been recognized way back in 2013 by SPAD **[Ref.1],** but not much has been done to address those shortcomings. Recommendations are now proposed for the Government/Ministry of Transport to consider when making strategic decisions covering Policy & Regulatory as well as Education & Training in addressing those shortcomings in Railway Systems Engineering.

Background

Classification of Malaysia's Railway Systems

Malaysia's railway systems can be broadly classified as shown in Figure 1.

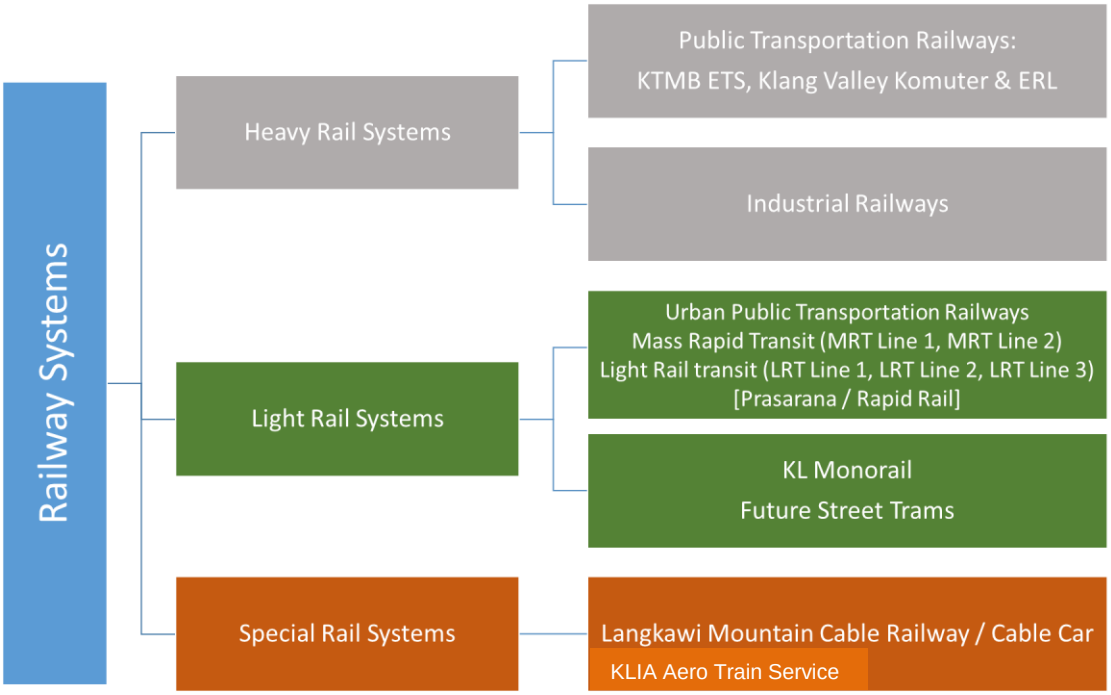

Figure 1: Classification of Malaysia's Railway Systems

Heavy Rail Systems

National public transportation railways form the nationwide KTMB railway network, including the Electrified North-South Double-Track [Padang Besar-Ipoh-KL-Gemas-Johor Bahru] which uses the Metre gauge [1000mm] running-rails and 25kV AC power/energy overhead catenary wire system (OCS) for the Intercity Express Train Service (ETS). The Klang Valley KTMB Commuter Service also falls in this heavy rail systems category.

Most industrial railways for freight/cargo [example, the cement industry] also utilize to this national KTMB public network. These railways are used to provide access for industrial facilities to the public network, but also for internal rail traffic within an industrial and/or port area. Diesel-Electric locomotives are exclusively used for freight/cargo traffic utilizing the KTMB railway network.

The KL Sentral-KLIA Express Rail Link (ERL) is a public-private rail transportation project specifically built and operated to serve the passenger traffic of the airline industry. It uses the Standard gauge [1435mm] running-rails and 25kV AC OCS power/energy supply system.

Light Rail Systems

Mass Rapid Transit (MRT)/Light Rail Transit (LRT) systems are passenger railways used for the Greater Kuala Lumpur city/urban transits. The operating Ampang/Sri Petaling LRT Line (LRT Line 1), Kelana Jaya LRT Line (LRT Line 2), KL Monorail, and Sungai Buloh-Kajang (SBK) MRT Line 1 use much lighter designs for rolling stocks and running-rails track of Standard gauge [1435mm]. The on-going LRT Line 3 (Bandar Utama-Klang Line) and the MRT Line 2 (Sg. Buloh-Serdang-Putrajaya Line) are also for urban transits. All these transit transportation systems utilize 750V DC power/energy conductor rail traction supply (the Third Rail) located next to the running-rails trackworks. All these transit systems are operated by Prasarana/RapidRail, a Government-linked company (GLC).

Special Railway Systems

Special rail systems are a third general category to cover all railways that neither meet the characteristics of heavy railways nor the characteristic of light rail system. The Langkawi mountain railway/cable car and the KLIA Aerotrain service between the main terminal building and the satellite terminal building are under this category.

Bases of Consideration: Current Rail Industry Structure & Shortcomings

In order to appreciate the current state of the rail industry in Malaysia, rail-related activities can be grouped into six major functions namely:

1. Policy & Regulatory
2. Asset Management
3. Rail Operation
4. Planning, Design, Implementation and Manufacturing/Assembly
5. Maintenance Repair & Overhaul
6. Education & Training

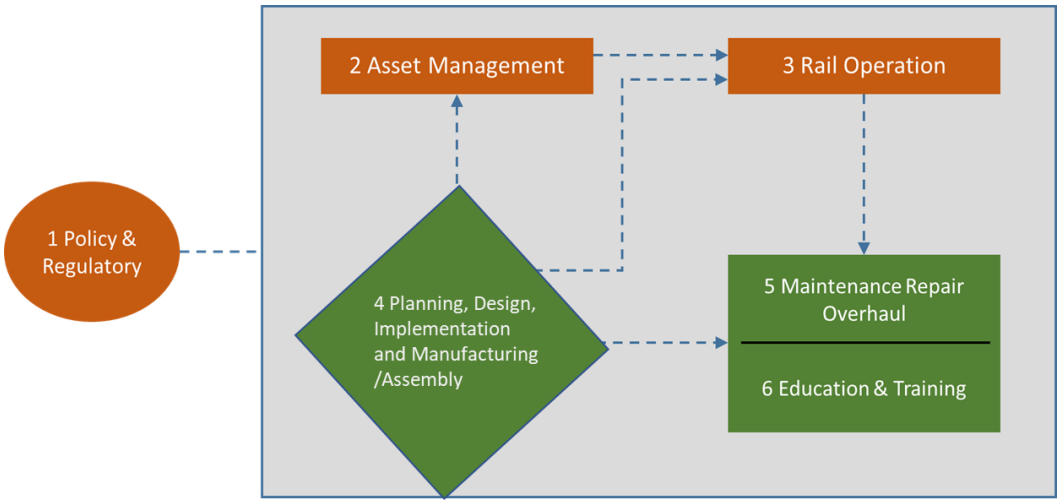

Figure 2: The Structure of Rail Industry in Malaysia

Figure 2 shows the structure of Malaysia's rail industry which is **similar** to that of the Malaysian electricity supply industry (MESI) which also comprises six major functions as above. Based on the successful proven model of the MESI structure [which has been acknowledged as world-class in terms of reliability, availability, maintainability and safety benchmarking], we have used the MESI model as the bases of consideration in highlighting the shortcomings of the current state of Malaysia's rail industry and to recommend appropriate solutions to overcome the problems besetting the rail industry, specifically in Railway Systems Engineering.

Appendix A describes the railway competency mix which covers all aspects of modern railway infrastructure projects which essentially incorporate three essential components, namely:

- **First component**: *civil engineering rail-road infrastructure* with running-rails track work, the electrical signalling & control equipment, the Stations, the high-voltage overhead catenary wire or third rail (power rail) with power/energy supply system.
- **Second component:** The *rolling stock* comprising electrical locomotives & passenger cars**.**
- **Third component:** A system of *operating rules and procedures* for a safe and efficient operation

Group 1: Policy & Regulatory

From the date of its existence, rail industry development planning and monitoring has **not** been the sole responsibility of a specific Government-related agency but it is rather fragmented and attended to by multiple agencies. There is no clear policy direction, and this leads to confusion of the roles of each individual Government agency not only with the operators but also with the public at large. As an example, the policy and regulatory affairs for rail operation fall under Agensi Pengangkutan Awam Darat (APAD), formerly known as SPAD; rail skills/vocational training (TVET) under Ministry of Human Resources (MoHR) as well as the Ministry of Education (MoE), while the trade and investment aspects requires the prerogatives of MITI. There is no single platform coordinating, planning and monitoring the development of this industry in a holistic manner. The institutional structure of the industry development is not comprehensive to bridge the gaps between prerogatives of the different domains, that is Government, the Industry and the Academia. This **overarching issue** has been long overdue and there is a need for a single platform to coordinate, develop and monitor the development of this industry. This requires an urgent attention by the Government if the development of the industry is to be comprehensively handled and accelerated.

In the context of the overarching issue pertaining to the rail industry structure as outlined above, the Malaysian electricity supply industry (MESI) offers a very successful model that the Government can refer to in order to reform, develop and improve the operating efficiency of the current rail industry in Malaysia. At the heart of this MESI model is the steady and sustainable learning and growth of the technocratic culture coupled with engineering management and business leadership of that single Government-linked agency entrusted with the planning, design, implementation and operation of the Nation's electricity supply. And, that single agency is none other than Lembaga Letrik Negara (LLN) and its successor Tenaga Nasional Berhad (TNB).

The MESI Authority/Regulator is the Energy Commission (EC) and it is answerable to the Ministry of Energy, Science Technology Environment & Climate Change (MESTECC). EC provides that ***stable enabling environment*** for this successful win-win model of Malaysia's electricity supply industry that we have today. EC is a "light-touch" Regulator but mandated with that enabling decision-making framework in minimizing levels of decision-making between the Grid System Operator (TNB) and the ultimate decision-maker (the GoM Cabinet), particularly where these levels are political.

This requirement for *technocratic leadership culture* within the business organization towards a successful performance of the Railway System Operator (RSO) is very much emphasised in **The Operator's Story Report (May 2017)** undertaken by the Railway and Transport Strategy Centre, Imperial College London **[Ref. 4].** In fact, Prasarana (Malaysia) is one of the twelve railway metro systems that participated in this survey work for the Report.

Among the **primary stakeholders** that are directly related to the development & operation of the modern railway industry are:

Ministry of Transport (MoT)	Responsible for KTMB asset development and operation for heavy railways in Peninsular Malaysia
Ministry of Finance (MoF)	Responsible for asset development of PRASARANA and MRT Corp for city/urban light rail transit systems with RapidRail as the Operator
APAD, formerly known as SPAD	The Railway Regulator since its inception in 2013 & directly under Prime Minister's Department charge, but moved to MoT since June 2018; responsible for drafting the policies & plans, regulating and enforcement of railway operation reliability/security and safety
Energy Commission	The Malaysian Electricity Supply Industry (MESI) Regulator responsible for drafting the policies & plans, regulating and enforcement of codes and regulations on electricity supply reliability/security and safety
TNB	Responsible for providing electricity grid supply of high reliability & availability to the traction power systems of modern railway industry for motive power and traction energy requirements
Ministry of International Trade and Industry (MITI)	Responsible for promotion of manufacturing and services sector through its agencies such as SME Corp, MATRADE and MIDA

In the context of Policy & Regulatory, modern rail transportation safety must necessarily address and comply to both *train movement safety* and *electrical safety* standards and regulations. These constitute the major part of Railway Systems Assurance activities and requirements before railway systems Certification and License can be granted by the Railway Regulator (APAD) to the Operators; in this respect:

a) The train movement safety are governed by international railway standards (EN Standards) on signalling & train control systems [currently, being regulated & enforced by APAD]

b) Electrification safety are governed by international railway standards (EN Standards) on electrical safety of fixed railway installations **AND** Malaysia's Electricity Supply Act (Act 447)/Regulations ,1994;

In this context, Malaysia's Energy Commission [who is the custodian of this Electricity Supply Act/Regulations] has notifed IEM Railway Systems WG and APAD that there are "gaps" between Malaysia's 25kV AC Railway OCS Specifications on clearances (both for ground and lateral clearances) which follow EN Standards and Malaysia's Electricity Supply Act 447 and hence the issue of "non-compliance" to the requirements of the said Act/Regulation.

From the foregoing "**gaps**" as highlighted above, it is now an urgent matter on the part of MoT/APAD to engage Malaysia's Energy Commission (EC) and other relevant stakeholders, including IEM, with the objective to amend/update and harmonize Malaysia's Electricity Supply Act (Act 447)/Regulations 1994 by including relevant clauses on railway applications in the Electricity Act

Group 2 & 3: Asset Management and Rail Operation

Currently, there are three major train operators that provide rail transportation services in the country. Each operator operates the rail assets owned by different business enterprises (asset owners) and correspondingly operates on different rail lines.

KTMB operates the main inter-city lines service in Peninsular Malaysia and the Klang Valley Commuter service serving both passenger and cargo transportation services. The associated rail assets are owned by the Railway Asset Corporation (RAC) which is a federal statutory body under MoT.

RapidRail core business covers the operation of LRT Line 1, LRT Line 2 and the KL Monorail Line. These assets are owned by Syarikat Prasarana Berhad, a wholly-owned Government company. RapidRail also operates the MRT Line 1 which is owned by MRT Corporation , another wholly-owned Government company.

Express Rail Link (ERL) is a private rail operator that was given the concession to finance, design, construct and operate the KLIA Express and KLIA Transit services. It provides passenger rail service from KL Sentral to KLIA.

Another successful lesson that MoT can emulate from the MESI model is to immediately institute a compliance requirement within the rail industry regulatory framework for a periodically-mandated ***independent Management & Engineering Audit (M & E Audit)*** *of the respective railway transportation services and assets of KTMB, PRASARANA and ERL , covering development planning, design, implementation, operation , maintenance and resource management functions of each business enterprise*.

Group 4: Planning, Design, Implementation and Manufacturing/Assembly

The designing, manufacturing and assembling activities can be divided into several tiers, where generally the highest tier is occupied by the final integrator who designs and produces the complete train systems such as the rolling stocks and the signalling & train control for both the heavy rail systems as well as the LRT/MRT systems. At the second tier, there are rail players who produce major sub-systems, such as the AC/DC traction power system, SCADA system, Communication system and others. The first and second tiers are supported by various equipment/product suppliers. According to the MIGHT Report **[Ref.5],** there are about 30 local players involved in the designing, manufacturing and assembling of rail-related equipment/products.

Group 5: Maintenance Repair & Overhaul (MRO)

The bulk of MRO works are conducted in-house by the respective rail operators mentioned above but with outsourcing limited to certain accredited local players such as for:

- KTMB 132kV & 25kV AC OCS equipment and Prasarana/RapidRail 33kV AC traction power supply & distribution system equipment.
- Repair and overhaul of AC and DC railway traction motors.
- Repair and reconditioning of train wheelsets & bearings and re-engineering/re-conditioning of old locomotives.

- Design, engineering and installation of trackworks.

Currently, KTMB, PRASARANA and ERL and their local repair maintenance companies continue to depend on OEMs in order to support and maintain rail operation. Although, it is inevitable to source safety-critical products from OEMs especially those related to propulsion systems, signalling and the likes which need thorough inspection and certification, other non-critical components can be sourced locally. There are several industries which have a strong base in Malaysia such as composites, electricals & electronics, automotive, chemical, telecommunication and others that can be leveraged to produce the required alternative parts. High dependency on foreign products will affect long-term sustainability of rail operation and escalate operational expenditure greatly. In this respect, localization rate is still low (10% to 30%) in rolling stocks and systems **[Ref.5].**

Group 6: Education & Training

As is typical of any public service industry (of which the railway transportation industry is one of them), the learning and growth of skilled workforce for the associated fields of the Electrical/Electronics & Mechanical (E & M) railway systems are invariably undertaken by the respective in-house training institutes of the two major rail operators, namely **KTMB MyRA** [in Batu Gajah , Perak] and **Prasarana Rail Academy** [in Subang, Selangor]; ***but*** , this is mainly concentrated on the hands-on downstream maintenance & repair activites of sub-systems and equipment/component aided by OEM standard method statements/procedures. In fact, these two training institutes have already established educational/training relationships with local tertiary universities, namely UniKL, UNITEN and UTHM.

At KTMB MyRA and Prasarana Rail Academy, the teaching curriculum offers a very basic introductory overview treatment of the principles/calculations for specifications of equipment, sub-systems and overall system integration of railway systems design, operation and control. In this context, the content of training and facilities need to be strengthened to keep up-to-date with the dynamic evolvement of the rail technology, as rail equipment and systems have evolved to be more sophisticated and embedded with high technology components which no longer exist in the mechanical form alone but combined with electronics, information technology and IEDs. These demand for the engineering workforce to be imbued with that continuous learning and growth of knowledge culture, multi-skills and competency to deal with specialized technical areas.

Referring to the success of the MESI model, ***education & training*** and the ***associated learning and growth culture*** has always been the sustainable forte and primary focus of **LLN/TNB**, the national electricity grid owner-operator since its inception before Merdeka. As a matter of fact, LLN/TNB is the first government technical agency to set up its own in-house technical training institute (Institut Latihan Sultan Ahmad Shah, ILSAS) at its sprawling campus in Bangi way back in the 1960s and then followed up with its own Research Centre subsidiary (TNB Research) and University subsidiary (UNITEN) in the 1994-1998 period at the same Bangi campus.

Notwithstanding the above, Malaysia has a very well-established civil & structures engineering knowledge-base which can undertake complex designs and construction engineering of civil infrastructures, including rail infrastructure civil works. As such, minimal dependency on foreign engineering inputs for undertaking such works.

However, this is NOT the case for the E & M railway systems component of the railway transportation industry. For those local companies involved in the manufacturing and MRO activities of E & M railway systems, they have to hire people with general qualifications either in mechanical, electrical, electronics, IT and other fields of study from local universities and polytechnics

As of 2019, two local universities are already offering ***Engineering Technology degree programs*** (under the TVET curriculum). Currently, Universiti Tun Hussein Onn Malaysia (UTHM) is offering Bachelor of Engineering Technology in Rail Transportation and Master of Science in Railway Engineering, while UniKL is offering Bachelor of Engineering Technology (Honours) in Railway Systems. However, it must be stressed here that both of these tertiary institutions do not have that synergistic link with the electricity supply utility (TNB) which is a major stakeholder for Malaysia's modern electrified railway transportation projects comprising both AC Railway schemes for intercity express and DC Railway schemes for urban transit systems.

In this context, TNB which is the operator of the electrical power/energy grid and with its own wholly-owned subsidiaries - **UNITEN** and **TNB Research** have been engaged by the local railway operators, consultants and contractors to undertake specific consultancy assignments for addressing related technical engineering designs and operational issues of the electrified railway systems. For this purpose**,** UNITEN Power Engineering Centre *and* TNB Research have been associated with a local multi-disciplinary engineering consultant in providing specialized consultancy services for the KTMB double-tracking electrification projects and

for Prasarana/RapidRail LRT projects since 2013. These services are in the area of traction power simulation design calculations, earthing & bonding and EMC studies.

The fundamental issue that is faced by the industry is that railway has been perceived by the public as less attractive and interesting compared to others such as aerospace, automotive and the maritime industry. Apart from the archaic and dull image portrayed to the younger generation, there is no rail-related course offered by local universities which could be an option to pursue their career path. Considering this situation, industry players have to employ common engineering graduates and retrain them to become familiarised with the rail environment which generally takes two years

Key Findings and Implication

i. For strengthening the Policy & Regulatory framework of Malaysia's rail industry, the Government/MoT could use the proven MESI model which has transformed the then nascent Malaysian electricity supply industry way back in the 60s/70s/80s, into what it is now today which has been acknowledged as world-class in terms of reliability, availability, maintainability and safety benchmarking.

ii. At the heart of this successful MESI model is the steady and sustainable learning and growth of the technocratic culture coupled with engineering management and business leadership of LLN/TNB [the Grid System Operator, GSO], while the Government Regulator [Energy Commission, EC] provides that stable enabling environment to the industry. EC is a "light-touch" Regulator but mandated with that enabling decision-making framework in minimizing levels of decision-making between TNB and the ultimate decision-maker (the GoM Cabinet), particularly where these levels are political and fiscal.

iii. Taking the lessons learnt from the MESI model, the Government/MoT could now actively engage and fast-track the ***organizational renewal*** of KTMB and Prasarana/RapidRail into world-class Rail Operator agencies. Currently, these two rail operators lack that robust and deep technical knowledge in the planning, design and operation of modern railway systems.

iv. For MESI, it is a regulatory requirement that independent Management & Engineering Audit (M & E Audit) be conducted periodically on TNB core functions of electricity generation, transmission and distribution covering development planning, design, implementation , operation & maintenance as well as key supporting enterprise resource management functions. This M & E Audit is also compulsory on other industry players such as independent power producers (IPPs), etc. As we know it, there is NO such regulatory requirement in the current Malaysian rail industry structure.

v. From Policy & Regulatory requirements, Malaysia's modern rail transportation safety must necessarily meet both train movement safety requirements and electrical safety requirements before railway systems certification and license is granted by the Railway Regulator to the Operator. Currently, the emphasis has always been on the traditionally-critically important railway signalling-cum-train movement safety assurance

requirements, BUT without much attention paid to the equally important electrification safety assurance requirements.

vi. From electrical safety requirements, there are **"gaps"** between existing Malaysia's 25kV OCS Specifications on clearances (both for ground and lateral clearances) which follow the relevant EN Standards *and* Malaysia's Electricity Supply Act (Act 447) /Regulations and hence the issue of "non-compliance" to the requirements of this National Act/Regulations.

vii. As of 2019, two local universities are already offering ***Engineering Technology degree programs*** (under the TVET curriculum). Currently, Universiti Tun Hussein Onn Malaysia (UTHM) is offering Bachelor of Engineering Technology in Rail Transportation and Master of Science in Railway Engineering, while UniKL is offering Bachelor of Engineering Technology (Honours) in Railway Systems.

viii. UNITEN and TNB Research have been engaged by the local railway operators, consultants and contractors to undertake specific assignments for addressing related technical engineering designs and operational issues of the electrified railway systems, namely in the area of traction power simulation design calculations, earthing & bonding and EMC studies.

ix. KTMB MyRA and Prasarana Rail Academy have already established educational/training relationships with local tertiary universities, namely UniKL, UNITEN and UTHM

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In this respect, it is recommended that MoT **to set up** a special Ministerial Committee to review this harmonization and standardization exercise and **to nominate** the Institution of Engineers Malaysia (IEM) as the Chairman of this Review Committee to engage and coordinate the various stakeholders involved to ensure all the necessary requirements are captured.

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References

[Ref.1]:*"Capacity Building of Professionals in Electrical and Railway Engineering", Ir Dr Amir Basha Ismail, The Ingenieur, Board of Engineers Malaysia,Vol. 63,July-Sept 2015*

[Ref.2]: *Merriam-Webster Dictionary* for definition of Railway Engineering

[Ref.3]: *Railway Engineering*, *Satish Chandra & M M Agarwal, Oxford University Press, 2nd Edition, 2013*

Ref. 4: *The Operator's Story, Railway and Transport Strategy Centre, Imperial College London, presented at Liepzig , May 2017*

[Ref. 5]: *Malaysian Rail Supporting Industry RoadMap 2030, MIGHT Report, 2014*

Appendix A

A1: Railway Competency Mix

The railway competency mix shown in Figure A1 below provides an illustration of the scope and range of skills and knowledge management that Malaysian engineers should be trained and competent in.

Figure A1: Railway Competency Mix

The above competency mix covers all aspect of the railway infrastructure projects incorporating three essential components:

- **First component**: civil engineering rail-road infrastructure with running-rails track work, the electrical signaling & control equipment, the Stations, the high-voltage overhead catenary wire or third rail (power rail) with power/energy supply system.
- **Second component:** The rolling stock comprising electrical locomotives, passenger cars and also freight.
- **Third component:** A system of operating rules and procedures for a safe and efficient operation.

A2: A System View of Malaysia's Electric Railways

From a Systems viewpoint, electric railways comprise two major sub-systems, that is ***traction power system*** and ***signalling & train control system***.

The objective of traction power system is to ensure uninterrupted reliable and safe operation of electric rail vehicles. Traction power system can be sub-divided into *traction power transmission/distribution*, *traction power feeding, traction power collection,* and *mobile electric rail vehicles (ERVs).* The basic structure of traction power supply system for Malaysia's railway transportation infrastructure projects is shown in **Figure A2**. As can be seen from this Figure, both the DC railway and AC railway schemes source their traction power/energy from TNB power supply system., and with the running-rails used as current return circuits for both the AC and DC railway schemes., but with fundamental difference in the configuration measures for earthing and bonding. Another fundamental point that needs to be stressed here is that TNB is one of the primary stakeholders from the perspective of reliability and safety of Malaysia's rail industry operation. *Hence**, the synergistic link** between Malaysia's electricity supply industry and the rail industry.*

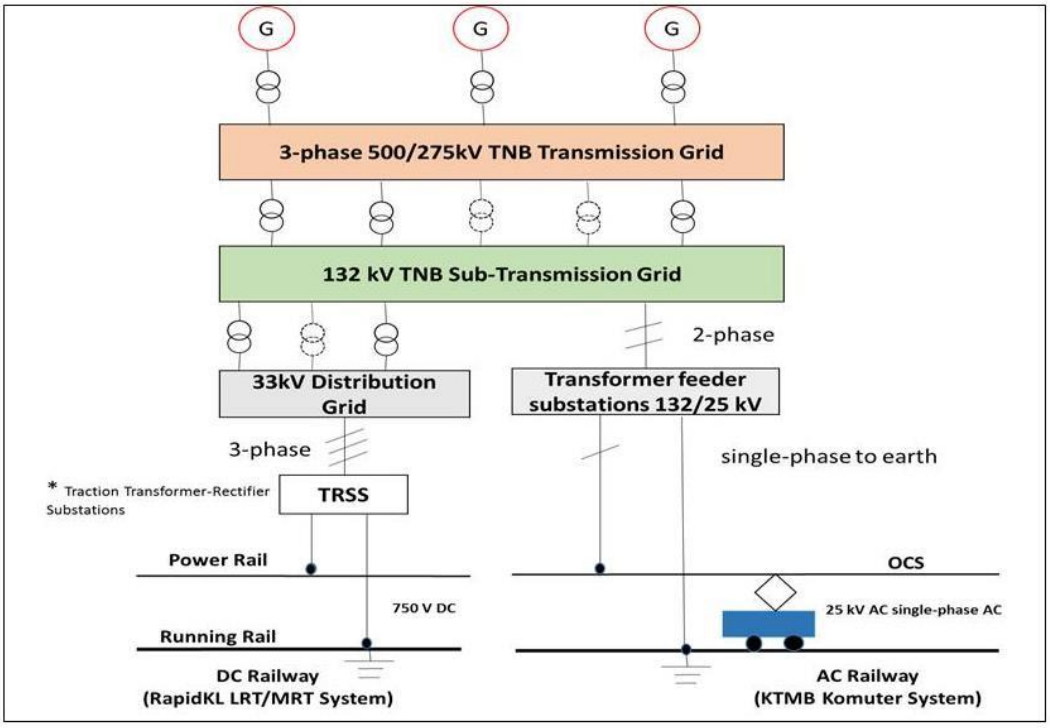

Figure A2: Structure of Traction Power Supply System for Malaysia's Electric Railways

As is widely understood in the rail industry, the railway signalling and train control system is needed for the safe control of rail traffic movements on the running-rails track-works. The objectives and tasks of the signalling and control can be defined as follows:

- **Signalling Systems:** to ensure the safe control of transport processes. The safety aspect is emphasized.

- **Operation Control Systems:** to ensure optimal control of the sequences of main and auxiliary processes in a traffic system.

Figure A3 illustrates the control loop of the processes of the railway signalling system. These processes are triggered by internal events which can occur practically at any time. However, for the operation control system, railway operation processes are triggered by external influences, such as time-related schedule, response to traffic ridership demand, and so on.

Both systems use the means and methods of *information transmission* and *information processing.* Consideration of safety reliability and availability are important in both systems, even though they serve different purposes – signalling systems involve train traffic movements regulation and accident prevention, whereas operation control systems have to prevent effective failures.

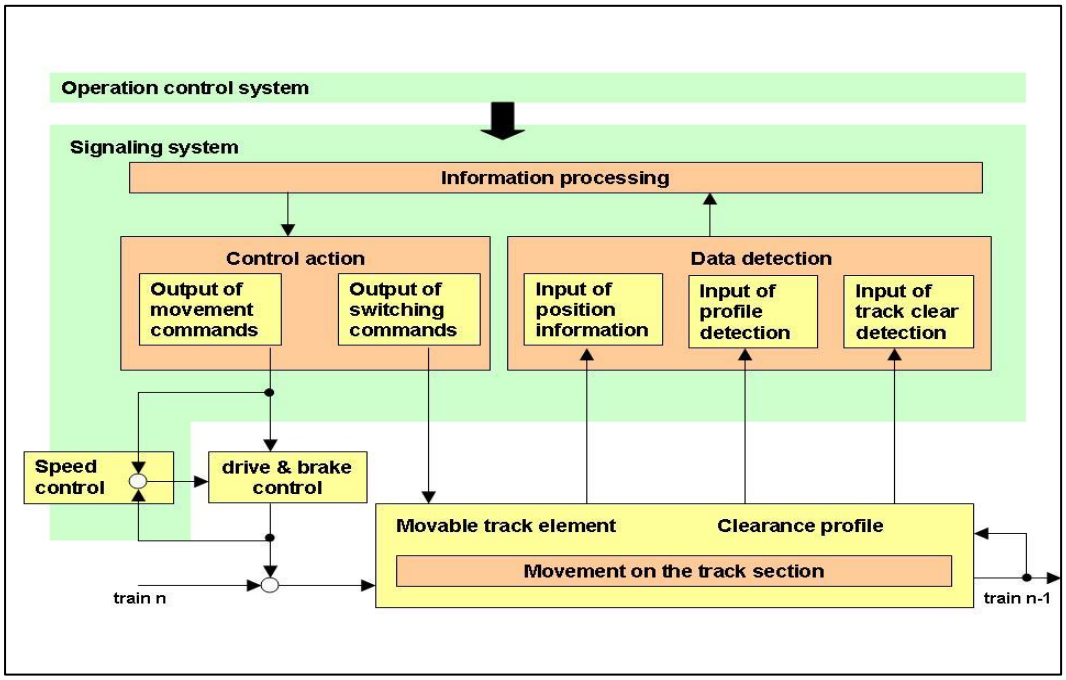

Figure A3: Processes of Railway Signalling System for Safe Control of Rail Traffic Movements

Appendix B

Position Paper Study Committee Members

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1.	Ir. Dr. Amir Basha Ismail	Chairman	IEM EETD Railway Systems WG
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