

Journey of an Enterprise Architecture Development Approach in Malaysian Transportation Industry

Mailasan Jayakrishnan, Abdul Karim Mohamad, Abu Abdullah

Abstract: *The purpose of this research paper is to discuss strategic ways to design an Enterprise Architecture (EA) for Information System (IS) developers and approaches in Malaysian Transportation Industry (MTI) dealing with a vital aspect of IS development. The aim of this research paper is to present an integrated EA which we worked on explaining the features of IS evolves in industry. To develop the dynamic EA, we have explored approaches widely used for managing the big picture of complexities and changes in industry growth and their business environments. In this research paper, we observed theoretical framework such as McKinsey 7S, MIT90s, Leavitt's Diamond Model and Delone & McLean Model of IS success simultaneously the criterion intelligence architecture as the implementation and formulation about EA towards designing strategic performance management for industry. As these are considered to be major dimensions underpinning the role of IS in industry, the EA ideology in this research paper could serve to integrate prescriptive tool in evaluating a High Technology High Value (HTHV) environment, while stimulating future research aimed at verifying its applicability in MTI.*

Keywords: *Big Data, Digital Transformation, Enterprise Architecture, Information Management, Information System, Malaysia Transportation Industry*

I. INTRODUCTION

In today's globalization era, Malaysian Transportation Industry (MTI) simulate vital situation dependent toward real-time decisions in preparing and operating individuals to face the challenges and demands of the 21st century [1]. Thus, this imparts to the augment and development of the industry towards technology revolution [2]. However, the ability of MTI in heading to Industry 4.0 (IR4.0), strive cognate in MTI mission that has become crucial distress of industry and government [3]. With the emerge of Big Data (BD), its influence has become evident in the MTI area [4]. The strategic utilization and applications of BD and Enterprise Architecture (EA) in MTI can be a critical venture as fewer

researchers pursue this effort and would guide the MTI standard and better operation and workforce experience on achieving its mission [5]. The intention of this research ensues to analyzing and identify the approaches that influencing and contributing the MTI to achieve its mission. Furthermore, this study pervades the gap in knowledge by scrutinizing the implication and role of BD on EA, together with observing McKinsey 7S, MIT90s, Leavitt's Diamond Model and Delone & McLean Model for assimilating several approaches influencing the MTI in achieving its mission. The outcome has significant influence for both practice and theory to develop a design of strategic performance dynamic framework for optimizing the benefits of strategic application for MTI value. In addition, this study will guide the MTI in assisting and planning the industry to achieve its mission and goals in the future.

II. RESEARCH PROBLEMS

In the globalization period, MTI simulates a vital situation in preparing and operating industry with different insight skills to face the challenges and demands of the 21st century [6]. IR4.0 are thriving venture in MTI [7]. As a result, recognition of the significance of operation has arisen and the number of industries had surge significantly [8]. Moreover, these technology revolutions are inaugurating further opportunities for excessive-potential industries to assuage scientific and technology interests and to enrich the evolution of IR4.0 impute [9]. According to statistics derived from [1], the number of industries who endure automation and digitalization in Malaysia had surge dramatically from nearly 27% digitalization in 2017 to nearly 35% digitalization in 2018, which expedient that there is prevailing 8% industry digitalization adopting new technologies in Malaysia.

Based on the statistical data derived from [3], in the year 2018, the technological advances of industries to increase efficiency and better insight was within 3 to 5 years averagely. Yet, despite the lagging and lacking awareness of IR4.0, little research has been approaching to extricate which technologies features and which exposure of transition actions in technologies empower high achieving MTI to further their digital evolution [10]. This situation indicated that the technology revolution was not implemented fully in MTI [11]. Therefore, we are formalizing the signified scenario as the research questions that can encounter a technology revolution in MTI:

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1. What is the best dynamic framework for MTI, directive toward enhancing effective feature about decision making?
 2. What is the suitable theoretical framework to integrate into MTI, in order to determine strategic performance management?
 3. How to evaluate the High Technology High Value (HTHV) capabilities in predicting and analyses?
3. To evaluate the High Technology High Value (HTHV) capabilities in predicting and analyses the needs of MTI.

III. RESEARCH OBJECTIVES

Malaysia is descriptor approaching Vision 2020 in enhancing one of the advanced countries by the year 2020 [12]. In accomplish the vision, the digital technology industry is crucial and this is advertised further in the New Malaysian Economic Model (NEM) [13]. The quality MTI can be produced through the digital revolution and more specifically IR4.0 [7]. The Malaysian Industry-Government Group for High Technology has planned a national strategic plan for high technology industry sectors for a duration between 2020 towards 2030 to advance the element of MTI [1]. Under this strategic plan, IR4.0 adoption impacts precisely to MTI [14]. This technology adoption provides more advanced efficient and productive in tandem with global trends [15]. The purpose is to advocate creativity, competitiveness, and innovation to grasp the digital revolution by the year 2030 [7].

This has enormously expanded the adoption of IR4.0 pertinent technologies in Malaysia [3]. The growing statistic of the technology revolution in Malaysia is again concerned by the 11th Malaysia Plan to target an action plan in organizing the adoption of IR4.0 pertinent technologies strategies [4]. MTI is very crucial to bolster the nation's economy [11]. The 11th Malaysian Plan has designated 30.7% for enhancing technology growth, 31.8% for enhancing technology adoption and 25.0% for developing and integrating technology system in MTI to boost competition on the world stage [3].

Hitherto, this concern had fascinated many researchers to study on this matter and pointed out that digital revolution will enhance efficiency towards automation, innovation, and adoption of IR4.0 that influence the MTI to remain competitive in the global value chain [2]. The predominant intention about this research transpire toward implement and monitor the critical success factors of IR4.0 to operationalize the strategic plan for MTI and at the same time, educate the philosophy of strategic management that MTI technology revolution practices from a set of evaluation criteria in order to make the best decision. Therefore, we are formalizing the signified research objectives that can practice and application oriented for HTHV in MTI:

1. To investigate the best dynamic framework for MTI, directive toward enhancing effective feature about decision making.
2. To identify and implement the suitable theoretical framework to integrate into MTI, in order to determine strategic performance management.

IV. LITERATURE REVIEW

Modern agedness, ensure an augment significance about BD, industry analytics and digital revolution [16]. According to [17], however, these emphasize are primarily execution navigate, industry nowadays transpire investigate how massive capacity information can effectively prevail utilize toward capture and create for industries and government. With the rise of BD, its impact has become apparent even in the MTI [18]. While MTI has long tracked a broad range of new era data which is often drawn starting from the transportation network of the indicators modes of transport in Malaysia [19]. This data includes any composition of ships and aircraft, rail and air networks [6]. MTI will store and aggregate this data under the umbrella of Transport Statistic Malaysia reports [11].

In Malaysia, the main aspiration of the MTI is to provide the highest level of efficiency, high income, and knowledge-based economy to enable Malaysia to compete in the economic world [12]. Hence EA as an approach that could support the consistent design and evolution of an industry as a whole [20]. The implementation of an effective EA development approach and effective data management are of utmost importance to monitor MTI performance towards a new era for a more efficient transportation network [13]. EA is to optimize industry drivers both manual and automated processes by connecting technology with industry context for powerful visualization to jointly create IR4.0 technology plans that advance capabilities and realize digital strategies into an integrated environment that is responsive to change and supports the delivery of the industry strategy for MTI [2], [5], [7]. Therefore, we need to build digital success in a world of disruption because the digital transformation is here, and we are on the front line to encounter it.

We need to strategize the digital industry that requires efficient, secure architecture and modern analytics technique that have the opportunity to advance legacy capabilities and combine them with IR4.0 new technologies, to transform Information System (IS) and deliver industry results. We need to bear in our mind that industries no longer want their EA practices to be focused on structure, control, and standards but it should drive industries outcomes that focus on indispensable insights, tools, and advice to achieve their mission-critical priorities. Therefore, we have come up with EA development approach enabler and driver that needed for MTI capabilities and technology delivers, as shown in Table 1.

Table 1: Architecture Development Approach for Malaysian Transportation Industry.

Approach	Development	Architecture	Malaysian Transportation Industry Context
Integrate	Integrating the solution for the particular scenario with the industry domain	Act as a bridge between the solution and fits into a broader context	Industry standards, best practices, and established patterns.
Abstract	Use of architectural viewpoints.	To communicate the key details.	Information application and technology perspectives.
Communicate	Establish and formalize a solution.	The role of communicator.	Communicate its importance and value to stakeholders.
Inquire	Getting the core of the problem and soliciting requirements.	To solve specific problems.	Solicit specific requirements and goals of enterprise context.
Assist	An activity that makes their architecture real.	To actively assist as an enabler.	Virtual architecture aspect for strategic competitive.
Conceptualize	The form of a conceptual architecture diagram with logical functions.	To create a conceptual vision of the solution.	Establish the scope of the industry.
Formalize	The usual approach to formalization.	To be specific enough to unambiguously communicate the details.	Visualization in the form of an industry standard notation.
Analyze	The analysis consists of a driver.	To analyze the information that has been collected.	Proactive leading the key elements of the solution.
Enable	Achieving industry goal and enable the target strategy.	The equation for architecture value.	Key to achieving tactical operational as a supporter.
Visualize	An excellent way to represent the abstraction.	To create visual renditions of the abstractions.	Viewpoints as the reactive following for cost cutter.

Based on Table 1, the EA development approach for MTI focus on visualizing the complex industry capabilities (interactive analysis) and technologies infrastructure (industry context) that impacts and choose the best option for meeting industry objectives. We must standardize our technology and ensure compliance with searchable technology lifecycles and visualizations by proactively plan and also prioritize technology updates and standardization across the industry. Moreover, we need to convert natural information toward action-guiding intelligence for MTI, essentially as a digital industry. These modern digital criteria compute variously advanced aspect toward decision making perspective [21]. On the other hand, the convulse information capacity, information retrieve trigger by immense acceleration and information presently donative further diversification in the digital revolution [18]. Therefore, to overcome this scenario we have strategized the domain of knowledge in IS, as shown in Figure 1.

Based on Figure 1, the domain of knowledge in IS needing to be strategically organized to overcome the digital revolution, where we need to collect the Data, then organize and summarize as Information, analyze it as Knowledge and synthesize it into Actionable insight for decision making in the industry. EA discover the critical decisions needed to lead a successful industry today and in the future for MTI, to build an integrated strategic roadmap to drive the transformation of IR4.0 [2]. We need data to insights to decisions to competitive advantage by (1) Develop and test insights, (2) Implement insights, (3) Measure and track results and (4) Capture new data to extend insights. Therefore, we need to move from tradition reporting to digital discovery for MTI. As of today, we encounter that MTI completely relies on analytics revolution for its survival from Analytics 1.0 focus on deep understanding of important industry phenomena as Descriptive (what happened) and Diagnostic (why something happened), Analytics 2.0 focus on attaining a sophisticated form of analytics that handle large volumes of data with a fast-processing engine and also integrating Predictive (what is likely to happen), Analytics 3.0 focus on better search algorithms in enormous amounts of data to extract knowledge and insights for Prescriptive (what action to take), Analytics 4.0 focus on automation through intelligent systems as the next stage in analytics maturity and Analytics 5.0 focus on intellectual automation as clever appliance that automatize characteristic about decision making process, as shown in Figure 2.

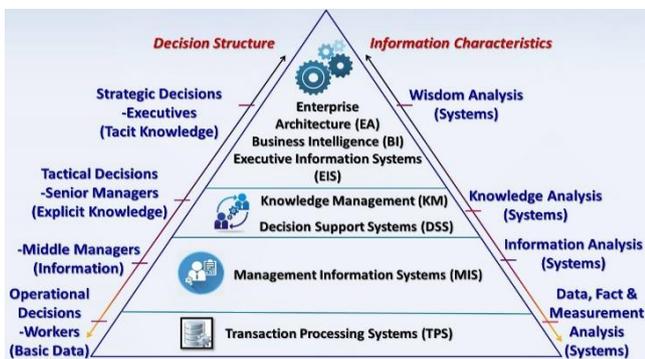


Figure 1: The Domain of Knowledge in Information System

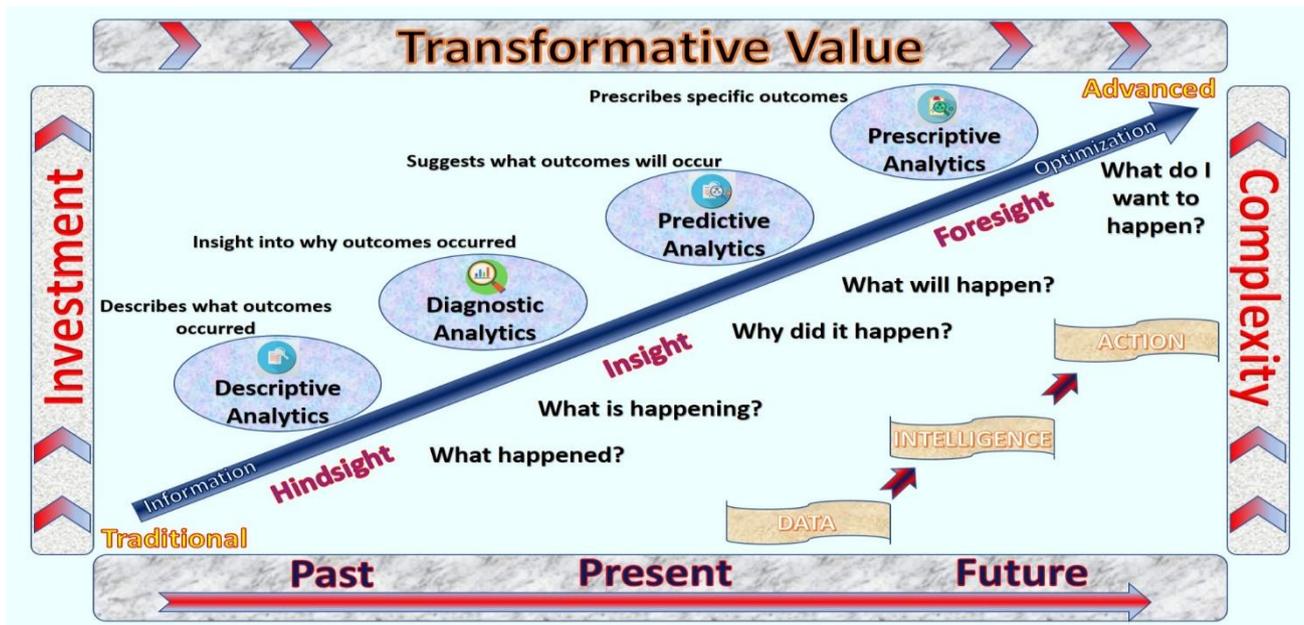


Figure 2: Evolution of Analytics in Malaysian Transportation Industry

Based on Figure 2, the evolution of analytics in MTI focus on the degree of intelligence and competitive advantage that traditionally been enabled by compliance driven capabilities. We need to view the value of industry insight through a digital revolution that focuses on (1) Information Technology (IT) value added on high-level strategic view and penetration, (2) operational value added on augmentation and profitability and (4) customer value added on understanding and improving value offering. Moreover, we must focus on delivering industry outcomes and work with stakeholders to deliver these outcomes quickly in an agile, lean and flexible away to create technology plans that lead to accomplishing industry goals. MTI has progressively remunerated recognition toward the conception of Organization Learning (OL) directive toward

surge effectiveness, competitive advantage and innovation [22]. According to [23], the procedure of refining activity via improved understanding and knowledge on IS can support OL activity acting as organizational memory, information distribution, knowledge acquisition, and information interpretation. The dynamic conception of an OL is progressively becoming commercial since industry want to be further adaptable to continually transform into IR4.0 revolution [5]. [24] states that OL is stimulated by structure, environment, and technology in a complex and iterative manner. Therefore, we have adapted the evident structures and strategies of OL into industry IS for MTI, as shown in Figure 3.

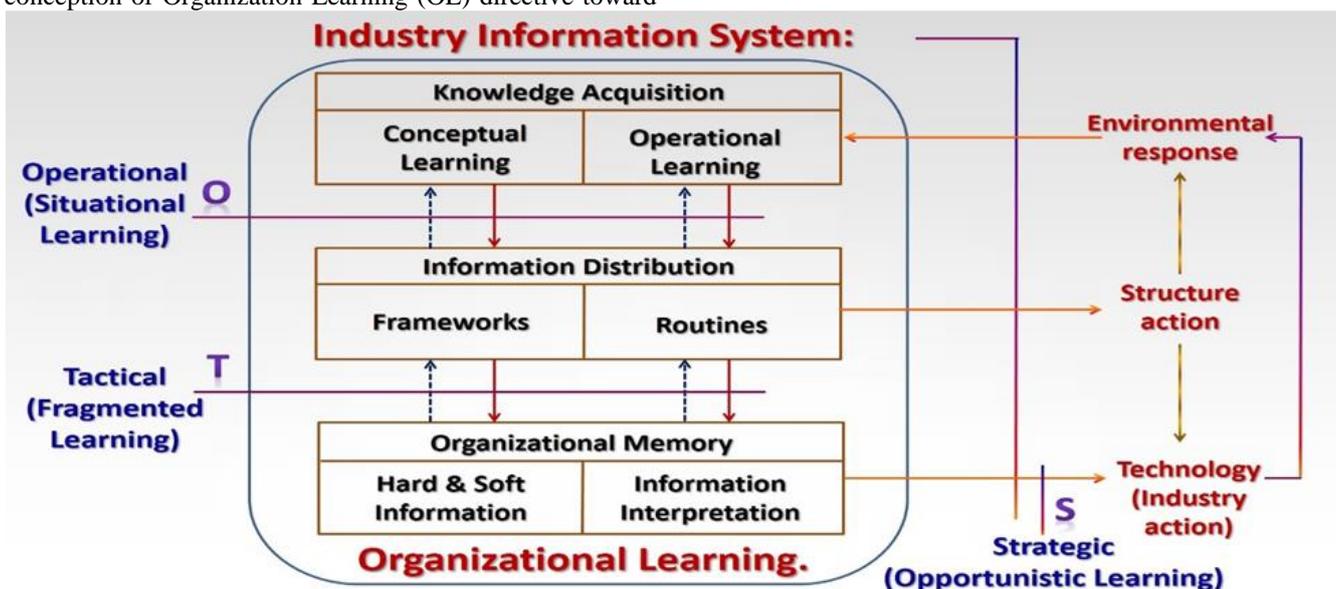


Figure 3: Organizational Learning Integrated Model of Industry Information System for Malaysian Transportation Industry

Based on Figure 3, the OL integrated model of industry IS for MTI focus on Strategic direction insight beyond imparting a perimeter toward decision making and a situation considering the interpretation and perception about the domain. These strategic recourses are derived continuously the insight volume of the industry [25].

[24] found that Structure tends to centralize learning of industry culture for a strong foundation and foster system thinking. Environment implies the industry for competitive intelligence and innovative response through information processing [26].

Knowledge acquisition created by acquiring ability whereas understanding intelligence from external being competing intellect structure obtain knowledge concerning more industry in the identical field, storing, interpreting and manipulating information aptitude being generated contemporary wisdom against the reformulation and reinterpretation about new and existing captured intelligence being managerial knowledge structure or outcome assist approach within the industry [22], [23], [27]. Information distribution allows the nexus distribution and construction of experiences and insights by supporting feedback and review mechanisms for better interpretation of information, recognizing, defining, investigating, solving a problem, evaluating and greater understanding within and outside the industry [17], [28].

Information interpretation is the understanding of information for the question and review the rationale behind decisions model earlier by supporting not barely the retrieval and storage about intelligence functioning toward the decision-making action although the task alone and the reaction for equal participation, greater interaction, objectivity and better problem solving [23], [29]. Organizational memory formed of pair solid information being number, figures, rules, and facts counting soft data being tacit experience, expertise, knowledge and strategic decisions for storage and full-text retrieval both kinds of information for interpretation and decision making an action about immerse textual insight [26], [29].

Hence, we can summarize that OL simultaneously an important appliance planned inside the domain about industry IS being advanced stabilizing and competitive advantage MTI strike. [30] claim that EA and Visual Analytics (VA) will be essential in supporting the explosive growth in data sources both outside and within the MTI. VA is the interactive visual interface embedded with visual computation and data visualization ability including practical investigative analysis toward derive insight and synthesize information against conflicting, ambiguous, dynamic and massive information, furnish proper, understandable and defensible judgment being activity. The transpire domain about VA target continuously grasp heterogenous, dynamic and massive capacity about data via combination containing individual augment through mechanism concerning visible characterization and interrelation technique within the evaluation action [31]. We have come up with the cycle of VA for MTI, as shown in Figure 4.

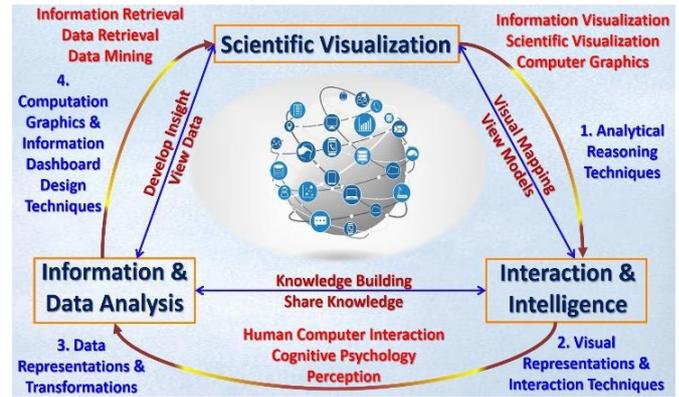


Figure 4: Cycle of Visual Analytics for Malaysian Transportation Industry

Based on Figure 4, the cycle of VA for MTI focuses on (1) Analytical reasoning technique that empowers industry toward achieving broad intuition that precisely assist assessment, decision making and planning, (2) Visual representations and interaction technique that yield leverage about the individual scrutinizes deep bandwidth avenue toward the intellect facing empower industry via understand, see and explore huge volume about data immediately, (3) Data representations and transformations that transform every category about dynamic and conflicting information obstruct that assist analysis and visualization and (4) Computation graphics and information dashboard design technique toward assist dissemination and presentation about affecting outcome about an inspection toward interface data within the applicable situation. Furthermore, we require to select the best approaches, practices, and technology-enabled industry model for executive pledged facing endure within the midway concerning a continuous revolution against an intuition-navigate toward more knowledge-guided access, as shown in Figure 5.

	HARD SYSTEM			
INFORMATION FOCUS	News Digests	Regular Newsletters	Future Scenarios	SOFT SYSTEM
	Displays on Products, Technologies, Topics	Special Topical Presentations Selective Dissemination of Information	Industry & Trends Reviews	
GENERAL: Broad Trends				
DETAILED: Specific Events, Organizations	Urgent Memos	Competitor Profiles	Technology Assessments	
	Newsflash	Directories of Experts	Analysis of Strategic Issues	
	Spot Reports	Market Research		
	IMMEDIATE	SHORT TERM	LONG TERM	

Figure 5: Topology of EA instinct-driven to progressively data-driven approach for Malaysian Transportation Industry



Based on Figure 5, the topology of EA intuition-guided via more knowledge-guided access for MTI including factual knowledge, plus advanced information converge against architect structure simultaneously prompt, empower EA evaluation through assisting both tactical and strategic important process by combining an extensive prop about information evaluation approach. [25] found that EA is to turn data into insights and action by putting insights into the context of operational applications in which actions occur within the industry. Today, EA prevail designate as coherent automation that embraces an information depository and further related EA framework formulate toward expedite the evaluation about accumulating structured and unregulated information assist about decision making [32], [33]. From an industrial aspect, the transformation about structure aiding decision making display how effective designation EA emanate straight toward apex effective industrial advancement accomplish over technologies transformation [12].

Effective diverse character about BD beyond various policy and industry province forge it enigmatic toward transpire driven through ensuring effective conventional Information Management (IM) foundation [34]. IM defines as effective management and collection about data against one or additional distribution and sources about such data within an industry by management above effective delivery, structure, and processing about data [35]. Diversely, it can endure beyond forge about structure toward expediting practice over data action on classification, requirements analysis, application and interface design about metadata, severally about coordinate by visualizing strategic demand of MTI [36]. Given these criteria, IM focus on effective competence about industry toward the store, preserve, deliver, manage and capture effective data via striking management through powerful future within an industry [37]. [38] stated that IM is characterized beyond effective duration facing effective industry desired perception as impressive elements that compose data principal till executive is concerned. Therefore, we have come up with an adapted relationship of IM paradigms that illustrated how industry structure influences communication and information flows of digitalization for MTI, as shown in Figure 6.

<p>Management of Information Resources, Records, Archives</p> <p>The application of management principles to the acquisition, industry, control, dissemination and use of information relevant to the effective operation of industry.</p>	<p>Management of Information Technology</p> <p>Focuses on the management of the development of industry technology solutions for knowledge gap with technical and intellectual decisions.</p>
<p>Management of Information Policies, Standards</p> <p>To achieve efficient and effective by foster informed decision making, facilitate accountability transparency and preserve information for future generations of an industry.</p>	<p>Management of Information Processes</p> <p>The method an industry uses to acquire or retrieve, organize and maintain information, as ensuring the data capture and hold is vital to extract value from it.</p>

Figure 6: Information Management Paradigms for Malaysian Transportation Industry

Based on Figure 6, the IM paradigms for MTI adjacent how facing prospect data course within the industry by embrace IR4.0 of IS intelligence toward brace diagnose analytical advance element considering an industry pledged. [28] initiate that, assimilation industry integrated perception, generate effective volume into generate critical decision making considering effective prospective simultaneously a philosophy about adaptive culture performance inside a complex analytical framework that will align BD with specific MTI goals. However, at the moment, there are no specific theoretical framework that could assist industry to analyze the potential or gap based on the available IR4.0 data held by the MTI to enable concrete decision to be made for short or long term in the effort to increase strategic performance management integrated with HTHV capabilities in predicting and analyses. Therefore, we have carefully analyzed the theoretical framework for research approach within the IS discipline and outcomes of the Delone & McLean IS success model that ideate on the impact of technology trends on industry outcomes for integrating IR4.0 with information technology infrastructure of MTI, as shown in Figure 7.

THEORETICAL FRAMEWORK OF INFORMATION SYSTEM (IS) IN INDUSTRY.				
Transformation of Data	1980s	1990s	2000s	2010s → Beyond
The Expanding Theories of IS in Industry.	<i>The McKinsey 7S Framework</i>	<i>The MIT90s Framework</i>	<i>The Leavitt's Diamond Model</i>	<i>The Delone & McLean IS Success Model</i>
Theories Variable	<ul style="list-style-type: none"> Structure Systems Skills Staff 	<ul style="list-style-type: none"> Structure Management Processes Technology 	<ul style="list-style-type: none"> Structure Managerial Task Technology People (Actors) 	<ul style="list-style-type: none"> Information Quality System Quality Service Quality Intention to use User Satisfaction Net Benefit
Domain of Knowledge (Adaptive Intelligence)	<ul style="list-style-type: none"> Data, Fact & Measurement Analysis (Data Stage Systems- Static Intelligence) Operational Decisions (TPS) 	<ul style="list-style-type: none"> Information Analysis (Analysis Stage Systems- Reactive Intelligence) Tactical Decisions (MIS) 	<ul style="list-style-type: none"> Knowledge Analysis (Insight Stage Systems- Interactive Intelligence) Tactical Decisions (DSS)(KM) 	<ul style="list-style-type: none"> Wisdom Analysis (Strategic Stage Systems- Adaptive Intelligence) Strategic Decisions (EIS)(BI)(EA)
Ontology Point of View	<ul style="list-style-type: none"> Realistic Ontology: What happened? Reporting Static and interactive reporting Radical Structuralist: Organizational Cybernetics 	<ul style="list-style-type: none"> Predicted & Controlled: Why did it happen? Analysis reporting Functionalist: Hard Systems Thinking 	<ul style="list-style-type: none"> Hermeneutic Methodology: What's happening? Monitoring Dashboard, Scorecards Neohumanism: Critical Systems Thinking 	<ul style="list-style-type: none"> Understanding & Knowledge: What will happen? Prediction Statistics, Data Mining, Optimisation Social Relativism: Soft Systems Thinking
Epistemology Point of View	<ul style="list-style-type: none"> Basic Data: Source (Commodity) Radical Structuralist: Conflict Theory Objective: Positivist Approach 	<ul style="list-style-type: none"> Information: Organization (Structure) Functionalist: Objectivism, Instrumental Reasoning, Reality Objective: Positivist Approach 	<ul style="list-style-type: none"> Explicit Knowledge: People (Behavioral) Neohumanism: Critical Theory Subjective: Anti-Positivist Approach 	<ul style="list-style-type: none"> Tacit Knowledge: Knowledge (Intelligent) Social Relativism: Symbolic Interactionism, Sense Making & Relativist Subjective: Anti-Positivist Approach
Methodology Point of View	<ul style="list-style-type: none"> Descriptive Information: What is? Quantitative (Statistical)-Methodologies: Hypothetical-Inductive & Deductive Observe: Experiments, Survey, Simulation, Case Study and Action Research 	<ul style="list-style-type: none"> Diagnostic Information: What is wrong? Qualitative (Hermeneutic)-Methodologies: Interpretive & Dialectic Observe: Survey, Simulation, Case Study and Action Research 	<ul style="list-style-type: none"> Predictive Information: What would happen if? Qualitative (Hermeneutic)-Methodologies: Interpretive & Dialectic Observe: Survey, Simulation, Case Study and Action Research 	<ul style="list-style-type: none"> Prescriptive Information: What should be done? Qualitative (Hermeneutic)-Methodologies: Interpretive & Dialectic Observe: Survey, Simulation, Case Study and Action Research

Figure 7: Theoretical Framework of Information System for Malaysian Transportation Industry



Based on Figure 7, the theoretical framework of IS for MTI shows the technical, information architecture and industry aspects of critical foundation elements of data transformation. We investigate the future theoretical framework of IS for MTI that integrate enterprise IS that would support a specific spike about the approach to all the data within the information architecture. Moreover, we need a clear and deep understanding of the theory that provides a systematic approach for conducting research and important parameters encountering the innovative technology ideas for MTI initiatives with EA.

Therefore, we have identified effective Delone & McLean IS success model being the theoretical framework for MTI in developing the EA framework that indicates to HTHV field, generally the engineering area. The Delone & McLean IS success model provides a comprehensive capability and technology management solution for EA [39]. This solution helps technology strategist and enterprise architects provide more effective technology plans to drive change initiatives by managing strategy and technology in one integrated platform for MTI.

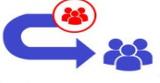
Furthermore, we need to expand of EA knowledge, focusing the taxonomy respectively and innovation and creativity are created and nurtured for high impactful results. Hence, we need to see the bigger picture that is the strategic goal of the MTI for the transformation of new thinking or paradigms for managing the industry strategies and operations. Yet, there are many fields and for the measurement, the EA strategic suitable for these exercises focusing towards change makers-able to identify what will drive the MTI forward, automation experts-focus on the

bigger, faster and better MTI outcomes and great problem solvers-provides useful solution for MTI into future of IT.

V. ANALYSIS AND DESIGN FRAMEWORK

MTI is still categorized as beginner as it is still at the level of IR4.0 framework planning phase [19]. According to [11], 67% about operation within MTI inclination continue surplus by 2027 constraint oblivion act consummated toward hindering effective influence against IR4.0 stream against not balance among industrial advance. Therefore, we need to equip our self to be technologically and intellectually advanced in meeting and supporting the national aspiration of becoming a developed country by the year 2030. Malaysia response to IR4.0 and beyond for a transformation of the transportation industry, in term of smarter and stronger, driven by people, process and technology [4].

Hence, MTI needs to quickly embrace IR4.0 to propel productivity and further enhance competitiveness [3]. Consequently, we need to enculturation of positive attitudes towards EA development approach through awareness, monitoring and strategic management at all levels are crucial in creating a climate for invention, innovation, and digitalization. Moreover, we require to adopt EA development access consign full condition about BD as a policy intention empower MTI toward boost their HTHV effectiveness and advance within the transition curve of IR4.0, as shown in Table 2.

Transition	 1980s	 1990s	 2000s	 2010s To Beyond
Stages	Data	Analysis	Insight	Strategic
Intelligence	Static (Predefined data sources and incomplete data)	Reactive (One way sharing and responds to new data)	Interactive (Multiple data sources and evolves as new data is added)	Adaptive (Collaboratively sourced and adapts as collaborators inform the process directly)
Evolution	The industry is data curious	Industry begins to use data in operation	Industry uses data in most operation processes	Industry becomes data first
Industry Skills	Functional knowledge	Few industry investigators, finite utilization about further analysis	Smart diagnostic modelers, data stewards and analyst advance	Complicated difficulty divine coherent, deep industry inspection intelligence, information analysis, and evaluation efficiency
Technology	Direct classical dashboards and reporting	Information depository contrive wide utilization and finite analytics	Data visualization platforms, analytics platforms, finite utilization of cognate action and diagnostic appliances	Extensive designation about analytics, appliances considering governance, multiple workloads and architecture for transpire automation
Category	Data Aware	Data Guided	Data Savvy	Data Driven

Data Governance	Limited toward nothing	Inaugural information repository standard and architectures	Information interpretation and engraving regulated, enterprise-wide metadata executive implementation	Clear master data management strategies
Focus	Traditional strategy management principal, performance sinister accessible	Abrasive vital framework designates about high planned, comfortable detailed about minor elevation	Action executive against dominant content replete within the minor layer	Scenario development as a continuous action learning process
Approaches	Hot House	Umbrella Strategy	Process Strategy	Grass Root
Economic Encounter	Significant economic strike. Negative Return of Investment (ROI) imitation within the position	Convinced dividend provokes KPIs within the position, ROI precisely implied	Convincing dividend impacts, initiatives are industry case driven	Industry action and combative separation endure stationed at data
Engagement	Hidden	Limited	Involved	Transformative
Embed	Report	Analyze	Monitor	Predict

Table 2: Transition Curve for Malaysian Transportation Industry.

Based on Table 2, the transition curve for MTI highlights the industry adopted analytics for the use and integration of new innovative technologies to improve performance through cutting edge technology revolution. MTI should step up and speed up its adoption of IR4.0 by leveraging on this transition curve. Yet, we need MTI perspectives of meeting and pioneering the knowledge and innovation challenges of

the industry are integrated to the achievement of the Malaysia vision. In addition, the analysis and design EA framework as a strategic platform to stimulate the IR4.0 movement in the MTI, in order to support the digitalization journey to embraced technology revolution by designing and developing EA dynamic framework of HTHV for MTI, as shown in Figure 8.

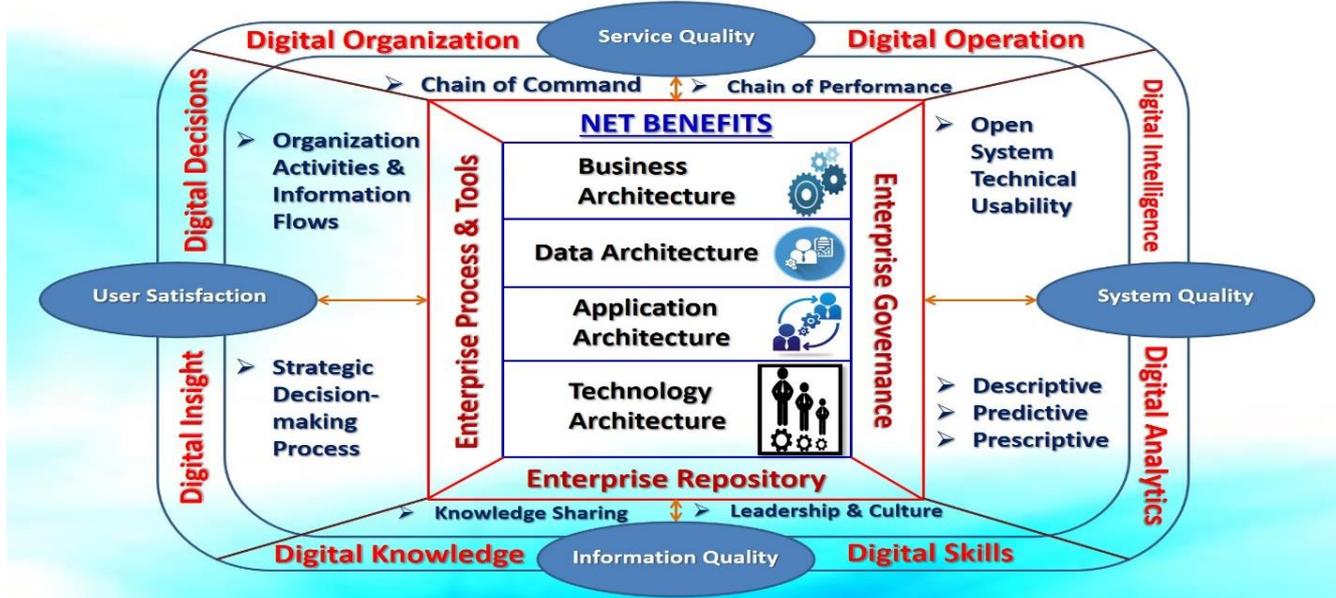


Figure 8: Enterprise Architecture Dynamic Framework of High Technology High Value for Malaysian Transportation Industry

Based on Figure 8, the EA dynamic framework of HTHV for MTI will be a clear strategic direction for the industry since these technologies apply across the board. Furthermore, with this EA dynamic framework of HTHV can optimize each part of MTI as an impactful effort in establishing pragmatic technology infrastructure. Moreover, we need to pace of change due to technology, economic community, economic crisis and globalization towards IR4.0 focusing on automation to increase performance in the era of data analytics. Besides that, we are no longer working in silo disciplines but need to move to transformation disciplinary or

multidisciplinary. Thus, we are constantly evolving, re-skilling, re-trading in order to be flexible and adaptable to meet the new technologies. Consequently, EA dynamic framework of HTHV for MTI is to provide a comprehensive understanding of the problems that we face today, but also offer a fresh alternative in solving them.

The overall impact increases MTI income and enhances the quality of life on tangible IR4.0 that challenged by emerging technologies as smart services and globalization, plus with the intangible IR4.0 which powered by character building and high order thinking towards knowledge transfer, knowledge exchange and knowledge assimilation with the utmost professionalism. Moreover, with the EA dynamic framework of HTHV, it is believed that excellent values will shape the culture and define the character of the MTI in years to come.

VI. CONCLUSION

The Malaysian government has recently set a new goal to fully automated, sustainable and mechanized with the use of advanced IR4.0 digital technologies toward intelligent transportation by the year 2030. The emergence of new technologies is a process that is challenging but it is offering plenty of opportunities and creating new fortunes for the MTI. This is in accordance with the government decision to cater for high technology needs break from the usual industry as the IR4.0 will bring about a massive transformation towards Malaysia industries by ensuring that its quality and relevance meet the needs of the thriving industrial sectors and further produces digitalization for the development of Malaysia towards becoming a high-income nation by 2050.

Moreover, the transformation was not only going to impact the MTI but will also alter the way we live, work and relate to one another by equipped with knowledge and understanding of real-world scenario particularly designed to be practical and applied oriented. IR4.0 is a transition to new direction and policies that will guide MTI to be creative and innovative and also equipped with critical thinking, problem-solving and the desire to learn and be challenged intellectually.

Now with advancements in various technologies, we need to develop excellent engineers and technologist of tomorrow who are independent, analytical expert among acceptance toward advanced perception, retain theoretical concern and principle and an ability showing a frame about competent expertise and knowledge as well as molding them to become responsible and effective members of technology revolution society in MTI.

The strategic use and EA applications of BD in MTI would lead to HTHV experience. Using the EA development approach in MTI, followed by presenting a theoretical framework to digitalize the technology of IR4.0 on MTI engagement. This leads to further research implications for future integrate prescriptive tool in evaluating an HTHV environment while stimulating aimed at verifying its applicability in MTI, which may soon dynamic, flexible and adaptable to ensure that all plans are successfully implemented and achieved in the industry.

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