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A Model-Driven IS 4.0 Development Framework for Railway Supply Chain

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ABSTRACT

Railway Industry (RI) in Malaysia possess below-average Information System (IS) skills and seldom use the IS for decision making at their operation level while they likewise discover digital transformation adaption is crucial and hence RI in Malaysia are in the slow mass of adapter classification. Perceiving the significant task of IS to RI in the economy, the government is resolved to assist and support the improvement of IS to guarantee their sustainability and competitiveness. IS framework being significant because it set up the computerized industry, lively digital, who can structure with simple to utilize and basic dynamic interaction. The present IS model utilized in Malaysia depends on the knowledge and experience of the specialist like system developers and academicians. The maximum of these IS models to identify the visual view of performance in RI are precise and are not strategized toward railway utilize and do not give prescriptive evaluation. The issue is no transition development and the absence of industry capacity to do the transition phases. This research focuses on the technology parameters influencing the adaption of IS to assist decision-makers, administrative bodies, and IS analysis to approach the advantages of its continued and expected improvement in the RI.

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1. INTRODUCTION

Throughout the years, there had been a viable interest in Information System (IS) 4.0 that merges the digitalization and industry revolution among Railway Industry (RI), where the data were managed and processed for the value chain in real-time. IS 4.0 has become the software that helps organize and analyses data for making the right decision at the right time. The industry will want to endure and develop in a profoundly vying situation on the durability of a very much planned IS 4.0. The strategic decision in an industry characterized as a game plan, are deliberately picked to accomplish business or administrative objectives [1]. Thus, the frantic pursuit has been carried out for a superior methodology and modern in IS 4.0 dynamic view. [2] found that IS 4.0 in Malaysia is confronting large difficulties due to the passive adaption of digitalization by RI. RI service in Malaysia possesses below-regular IS 4.0 abilities and hardly utilize the IS 4.0 for decision making at their operation level while they likewise discover Information Technology (IT) adaption are crucial and hence RI service in Malaysia is in the slow greater of adapter phases [3],[4],[5].

IS 4.0 is a systematic implementation of the industrial revolution and focuses on the modern system functions and production control with integrated information of the digital world. The dynamic interaction gives a basic assessment of the connection between performance and decision-making towards tending the data silos, data exchange, and sharing information between individuals [6],[7]. Early identification and development of IS 4.0 are the keys to limiting its adverse consequences and assimilating the industry on the right paradigm. Moreover, the initial improvement of IS 4.0 in the industry is a significant key to decrease complicated performing models in the future. IS 4.0 is significant because it set up the computerized industry, lively

digitalization, which can plan with the simple-to-utilize and basic dynamic cycle. RI is still cord utilizing the regular technique of performing business and managing their IS displayed clearly [7]. Perceiving the significant act of IS 4.0 to RI in the economy, the government is resolved to assist and support the advancement of IS 4.0 to guarantee their sustainability and competitiveness that contains the relevant data to facilitate real-time operation with optimizing operation plans.

The technical challenges of IS 4.0, RI organization culture must be integrated and embedded into the new business models and operation procedures. Therefore, RI must configure the process and automate their operations into the new way of situation phase of IS 4.0 adaption and use as valuable data and direction to pertinent organizations for growing further techniques of responsibility and drives in the improvement of RI in Malaysia in a coordinated and facilitated manner. IS 4.0 has introduced various initiatives through the blueprint for the efficient digital analytical which coordinates the policies and transforming the RI toward digital. Thus, IS 4.0 requires an efficient architecture that implies flexible processes and future perspectives for integrated information for real-time data. The holistic view of RI must be optimal in its visions and developments of IS 4.0 in greater utilization with supply chain process that focus on key issues in making an advanced effective RI that can contend in the global and regional and focus on the revenue of the country, which primarily increases the phases through the transition.

Initial improvement and evolution of IS 4.0 is the way to limiting its adverse consequences and to gaining the RI on the right level. Besides, the initial advancement of IS 4.0 in RI is a significant key to diminishing compound operation models in the future. IS 4.0 framework being significant because it set up the advanced industry, lively digital, who can plan with simple to utilize and transparent dynamic cycle. Recently, the validity of the current techniques of digitalization has been addressed [8]. The current IS 4.0 model utilized in Malaysia depends on the knowledge and experience of specialists like system developers and academicians. The majority of these IS 4.0 models to recognize the visual view of performance in RI are precise and are not strategized to railway utilize and don't give prescriptive evaluation. According to [9] the dynamic cycle in Supply Chain (SC) can be delegated as a transport industry- a railway industry, where a RI utilizes the data, to enhance the organizational dynamic cycle envision and conceptualize the future of their SC. Hence, this research pursues to explore the diagnostic effect of the decisional making measure on the SC as a railway case study for technology revolution into the organization through a socio-technical perspective**.**

2. METHOD

The viable interest in big data logic has provoked organizations to advance their information analytics activity. The existing growth of big data is changing the phenomena due to lack of knowledge and tradition raised hazy publicity to total phases in the organization [10]. Furthermore, it leads to a dilemma environment in the organization and creates information overload [11]. Most of the Information System (IS) 4.0 model depends on manual and rely upon ability knowledge and experience [12]. The issue is no transition development and the absence of industry capacity to do the transition phases [13]. Among the government arrangements about IS 4.0 advancement as expressed in Railway Development Planning (2012-2020) included the research to study the effectiveness of IS 4.0 supply chain performance. With the growing demand for digitalization, the global industry has become more transparent. IS 4.0 expanding abilities have urged the industry to reconsider its utilization of IS and have extended the chance for the industry to improve, applies technology to enhance business goals in more complex and vital ways. IS 4.0 must be developed incoherently and concretely concerning the business challenges in technological, management, and business perspective on failing to strategize, meeting industry needs, staying current, and integrating their technologies.

Dynamic capacities are becoming mainstream in all phases of business challenges and reaching the right and significant choices that are essential for the future prosperity and stability of the organization [14]. Strategic IS 4.0 is accepted to encourage the interaction of dynamic capacities since the industry intention and perception can advance over time for certain technology transformations [15]. RI plays a significant part and has become an impetus of economic development in Malaysia with the commitment of 50% of total business foundations in Malaysia, however, there has been almost little research done on IS 4.0 in RI. Therefore, IS 4.0 integrates the intelligent information and system ability to process big data intelligently. Yet IS 4.0 multi-stage on coordinating the decision-makers, administrative bodies, and RI analysis further approach the advantages of its continued and expected improvement in the RI. RI in most developing nations like Malaysia has been delayed to receive it despite most industries in Malaysia understand that IS 4.0 is basic to the performance and productivity of their industry [16]. Discoveries from [17], demonstrated that RI is likely to adapt to IS 4.0 in the future, government initiatives through Eleventh Malaysia Plan (2016-2020) appear to be not very successful because the IS 4.0 adoption is still low.

[18], also revealed that IS 4.0 usage and information seeking by formation become two most important digital factors on transformation while organization transition through automation and digitalization was still not popular among RI in Malaysia. IS 4.0 is the way operation adjusts the current availabilities and circumstances for recognizing the data, monitoring intelligence, and reliable source. This study directed

observational research on the phases of IS 4.0 adaption linked to the technology revolution for RI. Also included is the IS 4.0 utilization core IS factors clung to worldwide acknowledge guidelines as shown in Table 1.

Table 1. Dynamic IS 4.0 Roles of Innovations.

Dynamic Layers	IS 4.0 Roles	Innovations Perspective
Components with Sensor	Equipped with a sensor that is associated with a microcomputer for monitoring the data for a deeper insight process flow.	Addresses the requirements of data warehousing, delivering reports, monitoring dashboards, and scorecards.
Connectivity	Provides access to the microcomputer to create a data statement that transfers information for oriented processes.	Streams the compilation, monitoring, and analysis of huge volumes of rapidly changing data and providing the analytical platform, tools, and techniques.
Analysis and Evaluation	Compile total information for validity and aggregates the data for future-oriented intelligence.	Meant for one level higher ad-hoc access for exploring unforeseen business questions.
Service	Provides the digital services that are identifiable with great opportunity for business growth.	Gives business users the facility to search, access, and scrutinize unstructured data and semi-structured data.

Based on Table 1, the dynamic IS 4.0 roles of innovations determine their rate of adoption on technology revolution, which needs to be implemented and adopted for analytical methods and deal with big data as an asset in the digital world. Apart from the coherent thinking of information origins and logical analysis of the information will generate data for industry process and illustrates changes precisely. Moreover, IS 4.0 supports decision-making through automated algorithms for digital process control and improved business performance through capturing the right data in a reasonably structured manner. The automation process for IS 4.0 is more important in operating and controlling the procedures for taking the right actions. We have addressed a fundamental work based upon the ideal thinking and integrated a distinct intelligence framework that emphasis generic Strategic, Tactical, and Operational (STO) components of an organization's operation. We have adapted the computer and human side as the base template as shown in Figure 1.

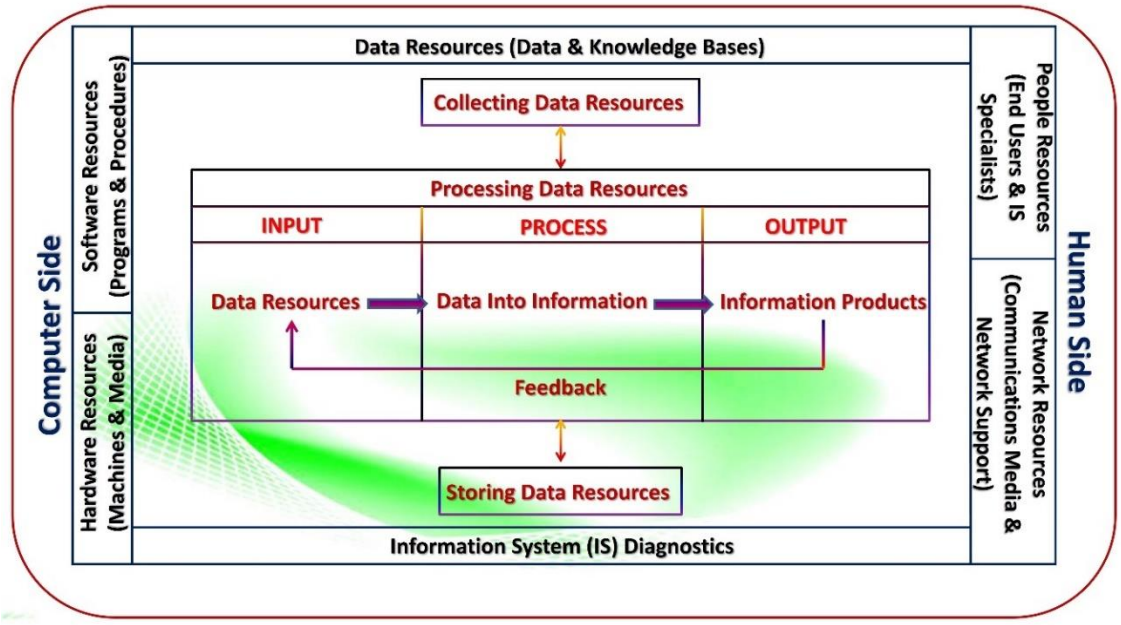

Figure 1. IS 4.0 Computer to Human Side Flow.

Based on Figure 1, IS 4.0 computer to human side flow indicates the importance point data flow and knowledge in providing information easy way for right decisions. Yet a proper model needs to be implemented for handling the modern transition and being easy to utilize the actions precisely in an inter-divisional way. The actions must emphasize on (1) process of transparent and displayed comprehensible, (2) enhance new technologies with overall process understanding, (3) supports an inter-divisional way of heuristic approach, and (4) knowledge platform that integrates the functions of IS 4.0 towards enhancing strategic processes of

decision-making within an organization's context. The proposition of IS 4.0 is the fundamental element for the organization towards exploring the integrated and analytics nature of relevant industry modeling for a real-time organizational performance measure with their analytic characteristics in designing the organizational performance measure framework.

3. RESULT AND DISCUSSION

3.1. MIT90'S THEORETICAL FRAMEWORK

The primary point of this study is to propose a relevant model-driven IS 4.0 framework for a real-time railway supply chain dashboard. The study focused on developing and extracting an integrated IS 4.0 diagnostic framework based on the scenario for generic information and strategic performance management dashboard for a railway supply chain. Yet it is the stepping stone for the industry into the prescriptive analytics of IS 4.0 elements. Also, various available theoretical excellence frameworks and IS 4.0 approaches have been reviewed and implemented in this research. The output is learning and implementing various strategies that can be applied in designing and developing an IS 4.0 excellence framework. The MIT90's framework was adapted and adopted in this study as a strategize information management tool and the fundamental components are explained in Table 2.

Table 2. Significance Factor MIT90's Adoption.

Fundamental Components	IS 4.0 Significance Factor	MIT90's Adoption	Industry Classification
Structure	Chain of command, power, and norms	Establish the organizational structure of the groups and management steering	The decision-making and coordination influence is specified by industry illustration.
	Chain of performance, legitimation, and communication	Learning design	
Management Process	Strategic and Operational Quality Management	Revise intellectual property statute and improve quality assurance	Assertive advantage, optimism, and predictability are regularly dispensed with an industry, which makes the industrial culture unique.
	Organization Process and Human Resource Management		
People	Knowledge Sharing and Enterprise	The goal-oriented community of people	Characteristic technological, relational, and conceptual competence of crucial workforce or the industry.
	Expertise and Experience		
	Leadership, Skills and Organizational Culture	Increase staff development opportunities	
	Characteristic way of acting, treating, and behavior		
Strategy	Strategic Vision and Mission	Group objectives and the way how to achieve them	The proposition of activity that expounds the industry and assigns the industry's deficient measure, overmeasure, to transform an industry from the current to the required posture.
	Decision-Making Process		
	Organization Activities and Competence	Strengthen focus on learning design, analyze and support multi-level	
	Data and Information Flows		
Technology	Open system Technical Usability, Techniques, Hardware, Software, Application, Infrastructure-Network and Databases	Methods, procedures, processes, including technical systems, IS, and technology	Internal processes are supported by numerous interconnected systems.
	Approaches: Descriptive, Predictive, and Prescriptive Analysis	Select new and integrate emerging technologies	

Based on Table 2, the significant factor of MIT90's adoption entails being situated for its success. Meanwhile, MIT90's adoption moves in a new way and unveils what will result in the organization that furnishes outcomes ultimately knowledgeable. We had started with observing and adapting the MIT90's framework of an ecosystem that consists of five distinct fundamental components that emphasized IS 4.0 intelligence. The challenge ahead is to perceive the knowledge emergence in a form of MIT90's framework that is suitable for a specific organization such as a RI supply chain performance diagnostic. We had defined the model of its reporting using MIT90's and IS 4.0 technology by creating suitable information architecture of the proposed model of performance management, as a representation of knowledge repository and data architecture in a form of a performance diagnostics dashboard. In the future, the important scientific goal in strategic decision-making design fully addresses the demands and requirements in a working environment. Without effective strategic decision-making diagnostic design, it may affect the decision-makers or stakeholders in executing their tasks efficiently. The study has identified the expected stages of the strategic management process with the MIT90's framework through the perspective on the human behavior dimension of the organizations, which is integrated with the strategized IS 4.0 of the RI.

Moreover, we need this MIT90's framework and IS 4.0 transformation due to the rapid growth of big data by using machine learning and artificial intelligence in future research studies. Machine learning is, telling

a system how to solve a problem, by showing it how it was previously solved, and the system identifies or learns on its own on all the steps that were part of the solution for the organizations [19]. Yet, artificial intelligence will treat that dataset as knowledge, use it for planning, communicate that plan with humans, or manipulate real objectives to execute that plan for organizations. The MIT90's framework originates from a variety of disciplines in management, communication, and sociology that classify specific dimensions of situations or phenomena [20]. Thus, MIT90's framework can be tested for predicting future insights through simulating the technology practice for the real-world situation and understand the predicted outcomes for the systematic view of phenomena.

3.2. INDUSTRY METHODOLOGY VIEW

The research emphasis on postpositive approach to defining the scientific method through literature analysis and developing the model-driven development IS 4.0 framework. Moreover, these strategic planning scenarios can be implemented from a philosophical view derived according to the strategic research paradigm in an organization as shown in Table 3.

Table 3. Industrial Methodology World Views Today.

Approaches	Industrial Views
The postpositive Approach (Quantitative) indicates the administration situation; mankind goes and comes.	An organization has an objective existence.
The Interpretive Approach (Qualitative) embraces that an administration situation; mankind creates and assists it.	An organization has a subjective existence.
The Critical Approach (Quantitative and Qualitative) holds the permanent power within an organization's intensity.	The formation focuses on power inside the organization that has cultural forces.
The Postmodern Approach (Mixed Mode) equally embraces the power interconnection within an organization indicate cultural discourses and larger historical, but these discourses are ever-changing and fluid.	The competence interconnection reflects within an organizational culture.

Based on Table 3, the industrial methodology world views today indicate the empirical stage where more information is needed for developing a model-driven IS 4.0 framework to the descriptive stage to describe the industry experience and knowledge. The empirical stage of the research was conducted from three (3) points of view as (1) ontology point of view is classified as the theory of being complex and to arrange data measure by determining origin pertinent concepts, relationships, and properties communicated in the field of technology and apprehend domain specialists knowledge. According to [21], to develop an adaptable and strategic technology for the derivation of acceptable ontology data need in IS 4.0 cycles by assimilation and planning basic fields of IS, (2) epistemology perspective is the theory of knowledge on its strategies, techniques, and degree by giving a profound comprehension of the essentials of IS components of IS 4.0 focal interaction. Therefore, IS 4.0 should be examined dependent on the essential setting of knowledge got from the epistemology point of knowledge, models, and insightful structures, and (3) methodology point of view can be categorized as an organization as a system development that focuses on integrating information into the strategic application that gives a broad dynamic perspective. Consequently, we have designed and organized the key philosophical viewpoint of IS 4.0 in the industry as shown in Table 4.

Table 4. Key Philosophical Perspective of IS 4.0 in Industry.

Assumption	Positivism	Interpretivism	Critical realism
Ontology: The position on the nature of reality	The target realism with the human origination of elements as a consistent combination of occasions. (Knowledge Infrastructure Building)	Realism socially built by a human through abstract meaning: multiple realism factors (Knowledge Organization)	The goal, stratified realism consisting of structures, mechanisms, and events. (Knowledge Creation and Use)
Epistemology: The view on what constitutes acceptable knowledge	Finding law-like connections that have predictive force utilizing a hypothetical-deductive methodology. (Functionality Architecture)	Information is created by deciphering the abstract implications and activities of subjects as per their frame of reference. (Systems Capabilities Framework)	Reproduction is used to make theories about the structures and systems that create the noticeable occasions, accentuating clarification over the forecast. (Data transfer technology framework)
Methodology: The model behind the research process	The inclination towards utilizing quantitative strategies dependent on enormous samples such as experiments, surveys, and analysis of archival information. (Organizational Cybernetics)	Qualitative techniques such as case studies and ethnographies. (Hard Systems Thinking)	No inclination for a specific type of research method. (Soft Systems Thinking)

Based on Table 4, the key philosophical perspective of IS 4.0 in the industry focuses on essential dynamic diagnostic instrument studies to get an outline of the dynamic elements of vital performance standards. The implements of MIT90's framework could assist the research in perceptive the central parts of industry involvement with the methodology perspective on the strategic perspective of IS 4.0 in the industry as shown in Table 5.

Table 5. Strategic Perspective of IS 4.0 in Industry.

Assumption	Positivism	Interpretivism	Critical realism	IS 4.0 Perspective
Strategic (Empirical Generalization)	Empirical speculation is lessened because it is normally likened to measurable speculation and case discoveries can't be 'summed up genuinely.	Observational speculation is conflicting with interpretivists thought that translations of truth are dynamic and may move over the long run. Naturalistic speculation is an inductive similarity, not speculation.	A delegate case can assist in distinguishing the qualities of demo normality in the community to which the case applies. This information fills as the crude phenomenal for ensuing theory building.	Strategic Monitoring System (Integrated tools for web-based prescriptive analytics system)
Tactical (Theoretical Generalization)	Theoretical speculation is anxious as a response to the typical test that contextual analysis is feeble in generalizability. Endeavors are made to legitimize theoretical speculation by contending that cases ought to be treated as innate science tests.	Some interpretivism deems that case discoveries can be summed up to theory.	Contextual studies give helpful data concerning how the proposed components work under a bunch of unforeseen conditions. Analysts work out the associated mechanistic clarification utilizing retrodiction.	Tactical Monitoring System (Information bundles of web-based predictive analytics system)
Operational (Theory Testing)	Buying to the traditional perspective of testing hypotheses dependent on factual strategies, positivists minimize the pretended played by contextual analyses in theory testing.	Theory testing isn't perceived as an element of contextual studies partly due to its relationship with the hypothetical-deductive way to logical request.	The systems uncovered by contextual studies can measure up to those proposed by the theory in question. Disconfirming outcomes, assuming any, may assist with building up new limit settings for the theory.	Operational Monitoring System (Integration of web-based descriptive and diagnostic system)

Based on Table 5, the strategic perspective of IS 4.0 in the industry focuses on the dynamic presentation norms for the industry abilities from a divergent point of view, beginning from a wide essential phase and lessening down to the most functional phase. Thus, in planning the pertinent IS 4.0 framework, the research began tending and viewing coordinated MIT90's framework and industry methodology viewpoint in adapting and embracing to wide structure, optimal reasoning of operational and tactical analytics on strategic dynamic for IS 4.0 RI supply chain.

4. CONCLUSION

Broadly, it has been commonly acknowledged that the center of IS 4.0 is valuable in aiding the RI supply chain. This research has fused the theory of MIT90's framework to determine management approach issues and the strategy of genuine observation for RI supply chain parameters where this technique has been researching independently and no complete outcome was acquired. Thus, a new conceptual model was developed and evaluated. The genuine management progress is utilized because the RI supply chain indicators are very interested in using high technological tools for decision-making. This research assists all stakeholders in special RI, particularly those modern to the dynamic of supply chain issues in Malaysia. This study urges stakeholders to direct the finding of RI supply chain factors as an initial mediation. The analysis reports can assist stakeholders to get ready for arrangement in RI. This study is very important in providing a modern development IS 4.0 framework in the RI supply chain process.

IS 4.0 framework being a model-driven framework that can assist shareholders and decision-makers in Malaysia, and this will be proven in this research. Hence the necessities of the Ministry of Transport that is eager in offering services utilizing advanced technology such as IS 4.0, this study has heeded the call to provide such model and methods of RI supply chain indicators. Based on the outcome of this research the impact can be a practical implication of the research. This study gives a significant understanding of IS 4.0 parameters in digital transformation. An industry change can't be concentrated from one point of view and presume that a specific field is sufficient to handle the change difficulties. Besides, the review of this research uncovered that digitalization is a central point in making computerized world administrations. Subsequently, a field that adjusts and coordinates technological administration into business management is fundamental. IS 4.0 should have the option to offer a service that empowers systematic decision-making and execution. Hence, IS 4.0 should be wise of the dynamic environment of the industry has, both externally and internally.

This research describes the core IS 4.0 boundaries for RI supply chain indication effectively and clearly to industry stakeholders. Making an essential relationship with industry capacities should emerge in the IS 4.0 and the key is to offer service required by industry capacities. Planning vital RI supply chain indication in the industry environment gives guidance for IS 4.0 and conveys the assumptions the industry decision-makers have towards IS 4.0. The outcomes of this research enable the RI to target the concern of the industry aspect in the digital transition. Thus, a model-driven development framework was developed and evaluated. There are some suggestions for further research based on the expected outcomes of this study. These suggestions can be carried out by scholars and researchers in the future. This study contributed to the levels of IS 4.0 adoption with core IS parameters for RI supply chain indicators for Malaysia only. Future studies may assist investigate the industry in different areas to help the improvement of the general industry revolution more completely. Future research is suggested to use the latest review of core IS parameters. Furthermore, the IS 4.0 usage is to measure in time series the industry performance to determine the effectiveness of the IS 4.0 adoption.

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