ATLANTIS PRESS
Advances in Engineering Research, volume 210
Conference on Broad Exposure to Science and Technology 2021 (BEST 2021)

The Readiness Level of Sarawak Disaster Management Agencies (SDMAS) in Managing Disaster in the Advent of Fourth Industrial Revolution (IR 4.0)

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ABSTRACT
The purpose of this research is to discuss the readiness level of Sarawak Disaster Management Agencies (SDMAs) during Fourth Industrial Revolution (IR4.0) and to examine the challenges of the IR4.0 transition for the state of Sarawak in managing the disaster. IR4.0 readiness in disaster management is described as the degree to which organisations are able to take advantage of IR4.0 technologies in managing the disaster. Therefore, conceptualisation or development of the IR4.0 readiness model is needed. It is crucial for organisations to self-assess their readiness towards IR4.0 to survive and thrive in the advent of the IR4.0. Regarding Disaster Management, there are several readiness models for IR4.0 that researchers have identified to assess the readiness of SDMAs in dealing with IR4.0 technologies. This ongoing research aims to discuss the readiness level of SDMAs in managing disaster in the advent of the IR4.0. Also, to examine the challenges of IR4.0 transition for the state of Sarawak in managing the disaster. The method used for this research is a closed ended questionnaire survey. Thirty (30) SDMAs have been selected to provide the respondent. Since this research is still ongoing, there are still no results and significant findings obtained yet. The current readiness level and IR4.0 transition challenges of SDMAs will be addressed at the end of this study. Therefore, this paper will explain the methodology used to achieve both objectives of this ongoing research.

Keywords*: SDMAs, IR 4.0, Disaster Management, Readiness level*

1. INTRODUCTION

1.1 Current Digitalization Initiatives Taken In Malaysia.

The first method of readiness assessment in Malaysia for the Fourth Industrial Revolution (IR4.0) is published by the Ministry of International Trade & Industry [1]. The assessment was made in response to the most recent industrial revolution. On 31st October 2018, 'Industry4WRD: National Policy on Industry 4.0' was launched. Malaysia's industrial and related services sectors will undergo a digital transformation through this policy. The 'National Policy on Industry 4.0 (Industry4WRD)' is a proactive action adopted by the Ministry of International Trade and Industry (MITI) to transform Malaysian manufacturing and related services into more innovative, more systematic, and resilient entities. There are five (5) specific enablers that determine the strategies, policies, and action plans for this assessment which are; (1) Funding; (2) Infrastructure; (3) Regulations; (4) Skills and Talents; and (5) Technology [1].

Previously, in the year 2017, Public Service Department has developed 'Digital Government Competency and Capability Readiness (DGCCR)'. It is one of the government initiatives to build public employers' competency and digital capabilities at all levels and their role in providing the best digital service delivery to the people. This initiative is in line with 'Dasar Wawasan Kemakmuran Negara (WKB)', 'Pelan Strategik Pendigitalan Sektor Awam (PSPSA)' by MAMPU, and Digital Economy Blueprint (DEB) by the Economic Planning Unit (EPU), which all emphasise the importance of consolidating digital competence among

public employers [2]. It also developed the maturity scale for organisational capabilities to access digital capabilities [2].

On 1st July 2021, the 'National 4IR Policy' was recently launched, which goes in tandem with the Malaysia Digital Economic Blueprint (MyDIGITAL) launched earlier in February [3]. In partnership with the Ministry of Science, Technology, and Innovation (MOSTI) and other ministries, the Prime Minister's Department's Economic Planning Unit (EPU) has launched this policy. National 4IR Policy is aligned with the National Policy on Science, Technology, and Innovation (DSTIN) 2021-2030 that aims to develop Malaysia as a high-tech nation by 2030 [3]. According to Khairy Jamaluddin (2021), previous Minister of Ministry of Science, Technology & Innovation (MOSTI), the 'National 4IR Policy' is a testament to the Government's commitment towards realising the digital revolution [4]. The policy is built on a whole-of-nation approach through people-private-public partnerships to address and optimise the challenges and opportunities that the digital age will have on our economy, society, and environmental development [3]. This policy is necessary to provide and equip the Malaysian with IR4.0 knowledge and skillsets whilst also boosting workforce productivity [4]. Therefore, our workforce needs to harness IR4.0 technology and embark on digital innovation to thrive in a fast-changing work environment [3].

Regarding current Malaysian readiness in adopting new technology, it can be said that Malaysia is not that far left behind. According to Dato' Sri Mustapa Mohamed (2021), Minister of Prime Minister's Department (Economy), the initiatives taken on technology development have managed to increase Malaysia's ranking to 33rd position out of 131 countries in the Global Innovation Index 2020 [4]. Malaysia has been ranked as the second (2nd) country after Singapore among ASEAN countries. In terms of readiness in adopting new technology, especially digital technology, Malaysia is ranked as 26th out of 63 countries in the IMD World Digital Competitiveness Ranking 2020 [4].

1.2 Research Problem

The technologies of the IR4.0 offer enormous promise to improve risk preparedness, response predictability, and transparency [5]. According to the World Economic Forum (2017), IR4.0 technologies have the potential to drive a revolution of systems throughout the environment and natural resource security agenda, including improved Disaster Risk Reduction (DRR) programme [5],[6]. In terms of disaster management, it's critical to address the IR4.0 and the societal transformations it causes to assist in the resolution of environmental challenges and redesign how we manage our shared global environment. Disasters are becoming ever-more complex, occurring at various levels, and extending throughout a prolonged period. Management of these requires an adaptable and innovative approach supported by most recent technology and generous funding, capable authorities, and adequate resources for proactive measures [7], [8]. The COVID-19 pandemic itself has further highlighted the need to cope with shocks and disruptions on a global scale [9], [10].

Most recently, IR4.0 technologies have assisted in the global fight against the COVID-19 pandemic [9]. Technologies such as drones, robotics, the Internet of Things (IoT), and Artificial Intelligence (AI) have assisted in the global fight against the COVID-19 pandemic. This pandemic has accelerated the digitalisation of the world in general as the nation transits into the new normal [9]. Thus, Malaysia needs to be better prepared for similar shocks in the future, including those stemming from disruptive technologies and climate change [9]. In addition, the emergence Delta variant has forced the state government to move fast, as it is unknown in how many ways COVID-19 could mutate, as stated by Sarawak Deputy Chief Minister Tan Sri Datuk Amar Dr James Masing [11]. It is hoped by being digitally ready, Sarawak state can curb COVID-19 faster and more efficiently.

In Sarawak, there are few agencies that have been set up for developing the digital economy of Sarawak, such as Sarawak Multimedia Authority (SMA) and Sarawak Digital Economic Strategy (SDEC); however, Sarawak still needs support to accelerate digital adoption by its citizen [12],[13]. According to Professor Datuk Dr. Madeline Berma, an economist, Sarawak needs to develop a new economic model which is more dynamic and resilient, with the capacity to cope and recover from various external shocks [13]. Sarawak should provide affordable high-speed internet to bridge the digital divide between the rural and urban, to facilitate remote access to health, education, and social care [13]. The state government is also expected to support and accelerate digital adoption by SMEs, fostering industries that are online and do not require physical contact, boost investment in high-quality connectivity and network infrastructure, and focus on green technologies [13]. Even though Sarawak has Sarawak Digital Economy Strategy (2018-2022), which was launched in December 2017, there are still certain aspects such as digital sovereignty, interoperability, ease of doing business,

Table 1. Recent Issues in Managing COVID-19 in Sarawak

No.	Title of Article	Year	Sources	Citation
(1)	Steering Sarawak's digital connectivity needs during the pandemic.	2021	The Borneo Post	[25]
(2)	*Keputusan bersesuaian diambil tangani COVID-19 di Sarawak.*	2021	Berita Harian	[24]
(3)	Battling COVID-19 in Malaysia.	2020	The Borneo Post	[26]
(4)	PSB chief: Issue of faulty ventilators being sent to the hospital a matter of 'grave concern'.	2021	The Borneo Post	[20]
(5)	COVID-19: Lack of speed, no unified coordination reason behind Malaysia's failure to fight third wave – army general.	2021	The Borneo Post	[27]
(6)	Rep challenges the ministry to address insufficient medical specialists in Sarawak's hospitals.	2021	The Borneo Post	[28]
(7)	*Kes COVID-19 meningkat: KKM akan hantar kakitangan tambahan ke Sarawak - Dr Adham.*	2021	Astro Awani	[22]
(8)	*KKM akan hantar 11 ventilator baharu ke Sarawak*.	2021	Astro Awani	[29]
(9)	*COVID-19: Hospital Sibu tangguhkan perkhidmatan klinik pakar.*	2021	Astro Awani	[30]
(10)	*Masyarakat harus diberi maklumat tepat mengenai vaksin COVID-19 - Wilson Ugak.*	2021	Astro Awani	[31]
(11)	*Fasiliti kesihatan di empat hospital utama COVID-19 di Sarawak kritikal.*	2021	Astro Awani	[32]
(12)	*Katil di ICU COVID-19 di Sarawak tidak mencukupi.*	2021	Astro Awani	[33]
(13)	*Aspirasi persoal kemampuan JPBN Sarawak tangani COVID-19.*	2021	Astro Awani	[34]
(14)	Masing: State govt should focus on dealing with COVID-19 especially with the emergence of the Delta variant.	2021	The Borneo Post	[35]
(15)	COVID-19 in Sarawak: From the first detection to vaccines.	2021	The Borneo Post	[36]

Cybersecurity, digital readiness, and supporting the digital transformation of the private sector could be further strengthened to accelerate the 'Post COVID-19 Economic Agenda' [14]. Sarawak Disaster Management Committee (SDMC) has taken IR4.0 technology initiatives which are two (2) key applications, namely 'i-Alerts' and 'enterSarawak' to curb the COVID-19 pandemic [15]. 'i-Alerts' is an official mobile application from the state government to keep Sarawakians up to date with the latest COVID-19 situation in the state

[16]. Meanwhile, 'enterSarawak' helps in creating touchless border security for Sarawak, especially during Movement Control Order (MCO) [15]. Besides, the Sarawak government has also launched two (2) contact tracing apps, namely 'COVIDTrace' and 'Qmunity' to help authorities track the movement of people for COVID-19 contact tracing in an effort to curb this pandemic [17]. Those who are entering Sarawak will be ordered to wear QR-coded wristbands following the roll-out of a digital surveillance solution by the Sarawak Multimedia Authority (SMA) to curb the spread of COVID-19 in the state [18].

However, there are still issues in managing COVID-19, such as lack of medical specialists, insufficient manpower, lack of urgent medical equipment, and resources in Sarawak hospitals [19]. According to Dato Sri Wong Soon Koh, Bawang Assan assemblyman, Sarawak hospitals, particularly those in the Rejang Basin, lack facilities, while Sibu Hospital is running low on equipment and lending from private hospitals [20]. There are also definitely not enough specialists in Sarawak [21]. Previous Health Minister of Malaysia, Datuk Seri Dr. Adham Baba said more healthcare staff is required to perform contact tracing, screening tests, as well as perform treatment and isolation processes [22]. Besides, low accessibility, high cost, and limited transportation to get the vaccine in a vaccination centre (PPV) [23]. This is supported by Datuk Patinggi (Dr) Abang Haji Abdul Rahman Zohari bin Tun Datuk Abang Haji Openg, which mentioned there are constraints in terms of resource and infrastructure in Sarawak [24]. Table 1 below shows the recent issues from renowned news that mentioned issues in managing COVID-19 in Sarawak.

In terms of disaster management, there are still many technologies in IR4.0 that can be adapted and adopted among the SDMC in dealing with these types of issues during pandemic COVID-19. There are many more IR4.0 technologies that haven't been adopted yet, such as robotics in dealing with COVID-19 [37]. For example, in overseas, robots are used to perform screening and deliver food and medications to patients' rooms [37]. Other gaps need to be fulfilled in this research area [38].

Next, there is no specific tool to measure/assess the readiness of disaster management agencies on the application of IR4.0 technologies for Sarawak Disaster Management Agencies (SDMAs). Machado et al. (2020) have discovered that it is crucial to create a proper readiness framework to ensure that its digital maturity has evolved [39]. According to Schumacher et al. (2016), readiness assessments are used before the maturing process, whereas maturity assessments are used to capture the current condition during the maturing process [40]. In order for digital transformation to be successful, an organisation's readiness for change must be demonstrated [39]. Hence, creating a roadmap for organisational readiness for digital transformation begins with an evaluation of the company's current digital situation and capabilities and a determination of where technological and organisational adjustments are required [41]. This should be applied to all SDMAs, which need a proper readiness assessment in dealing with the technology of IR4.0 for managing the disaster. Hence, this is another gap that needs to be filled in this research area.

Thus, with regards to disaster management, the IR4.0 readiness level of SDMAs will be studied and accessed through this study. This research is still ongoing, and responses will be collected from agencies through the questionnaire in Google Form. Hence, this research is important to assess the readiness of the SDMAs specifically in managing pandemic COVID-19 by using the IR4.0 technologies. Therefore, issues in managing disasters such as COVID-19 can be addressed and managed by adopting the most recent technology. Besides, challenges of the IR4.0 transition for the state of Sarawak will also be examined to develop a better preparedness plan for the state of Sarawak.

By conducting this research, it is expected that this research will contribute/produce one of the tools to measure the readiness level of every agency in the disaster management sector. Thus, the current practices of the technology of IR4.0 by the SDMAs in managing disasters can be improved. Also, by knowing and becoming aware of the challenges of IR4.0 transition for the state of Sarawak in managing the disaster, a better preparedness plan can be developed by the state of Sarawak.

1.3 Digital Readiness

According to Nasution et al. (2018), the term "digital" refers to both digital technology and digitalisation [42]. It can be defined as a digital technology device and application [42]. According to Pullen (2009), digital technology refers to any device that uses microprocessors, such as computers and their applications and digital devices.

Meanwhile, readiness is the development stage that describes the desire, willingness, and ability to undertake an action [43].

Table 2. Readiness Models for IR4.0 that has been Identified to Assess the Readiness of Disaster Management Agencies

No.	Name of Digital Readiness Model	Dimensions	Originality	Sector (Public/Private)	Year
(1)	Digital Government Competency and Capability Readiness (DGCCR)	(1)Technology; (2) People; (3)Operation; and (4) Information.	Malaysia	Public	2017
(2)	Industry4WRD Readiness Assessment (Industry4WRD-RA)	(1) People; (2)Technology; and (3) Process	Malaysia	Public & Private	2018
(3)	acatech Industry 4.0 Maturity Index 2016	(1)Resources; (2)Information Systems; (3)Culture and; (4)Organisational Structure	Germany	Public & Private	2016
(4)	Industry 4.0 Maturity Model	(1) Security; (2) Technology; (3) Data; (4) Process; (5) Organisation; and (6) Governance	United States	Private	2019
(5)	Industry 4.0 Digital Operations Self-Assessment	1) Organisation; (2) People; (3) Process; and (4) Technology	United Kingdom	Private	2016

Thus, digital readiness is defined as the desire and willingness to switch to and adopt digital technologies, as well as readiness to use the technology to create new innovative opportunities that will help an individual, organisation, industry, or country to achieve their goals faster and more effectively [42].

1.4 Digital Readiness Model

IR4.0 readiness is described as the extent to which organisations are able to use IR4.0 technologies [44]. In other words, it is about companies becoming digitally ready for it [45]. Therefore, conceptualising or developing an IR4.0 readiness model with the fundamental model dimensions is needed since it is crucial for organisations to self-assess their IR4.0 readiness to survive and thrive in the advent of the IR4.0 [46].

Due to IR4.0, many countries adapted and adopted the applications of IR4.0. Although World Economic Forum introduced it in the year 2018, not many organisations have a background in the Resilient Urban System (RUS) or apply the approach of IR4.0 in their process. Regarding Disaster Management, we can see that a lot of effort has been made to curb the pandemic COVID-19 from getting worse. Therefore, several readiness models for IR4.0 have been identified to assess the readiness of Disaster Management Agencies in dealing with the technologies. Table 2 shows Readiness Models for the IR4.0 that has been identified to assess the readiness of SDMAs.

1.5 The Element/Dimension of Digital Readiness Model

The researchers examine four (4) core dimensions to assess the readiness of Disaster Management Agencies in dealing with the technology of IR4.0. Those four (4) dimensions are; (1) People; (2) Process; (3) Technology; and (4) Strategy.

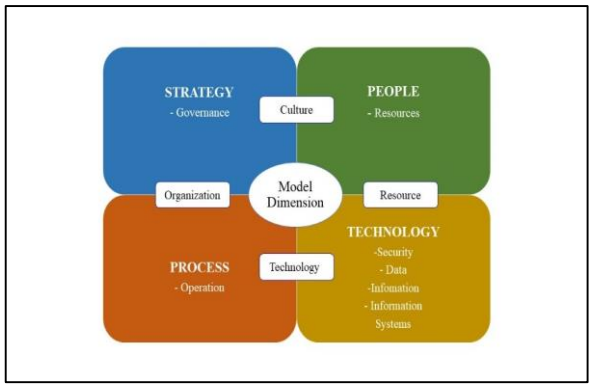

Figure 1. Summary of Readiness Models for IR4.0 that has been identified to Assess the Readiness of Disaster Management Agencies

These dimensions are classified as 'Proposed Pooled Dimension' by Hizam-Hanafiah et al. (2020)

[46]. Figure 1 below has summarised all five (5) IR4.0 Readiness Models by their core dimensions.

1.6 Organizational Readiness/Digital Transformation

Due to the digital economy's rapid growth, the business sector must move fast towards digitalisation or risk falling behind its competitors [42]. Due to which the competitive industrial landscape is evolving as a result of digitalisation and the adoption of new technology for more flexible and resource-efficient manufacturing processes [39]. Besides, companies with good digital readiness generate significantly more revenue and profit than those with a lower level of digital readiness. Hence, many businesses employ existing technology readiness models to assess their employees' digital readiness [42].

Machado et al. (2020) have discovered that it is critical to create a proper readiness framework to ensure that its digital maturity evolves [39]. Schumacher et al. (2016) also state that readiness assessments are used before beginning the maturing process, whereas maturity assessments are used to capture the current condition during the maturing process [40]. Therefore, organisational readiness for change is the ability needed to conduct digital transformation [39] successfully.

1.7 Malaysia Digital Economy Blueprint (MyDIGITAL)

On 19th February 2021, Tan Sri Dato' Haji Muhyiddin Bin Haji Mohd Yassin, Malaysian previous Prime Minister has launched 'MyDIGITAL' initiative and 'Malaysia Digital Economy Blueprint'. These innovations aim to empower all Malaysians to make their lives better in every aspect [47]. It includes, among other things, ideas and strategies to promote digital literacy, create high-paying jobs, make banking and finance more effortless and more organised, give our children virtual educational access, and bring medical facilities to remote areas [47].

'MyDIGITAL' is an initiative that symbolises the aspiration of the Government to transform Malaysia into a nation with high income driven by digitisation as a digital economy leader in the region [48]. According to YAB Tan Sri Dato' Haji Muhyiddin bin Haji Mohd. Yassin (2021), as Malaysia work towards 'Wawasan Kemakmuran Bersama 2030,' MyDIGITAL is also a key facilitator in realising Twelfth Malaysia Plan, 2021-2025 (12MP) [47]. Therefore, the Malaysian Digital Economy Blueprint outline efforts and initiatives in achieving MyDIGITAL aspirations by providing the path to fully realising the digital economy's potential for attaining inclusive, responsible, and long-term socioeconomic development [48].

1.8 National 4IR Policy

On 1st July 2021, the 'National 4IR Policy' was launched, which goes in tandem with the Malaysia Digital Economy Blueprint (MyDIGITAL) [3]. The 'National 4IR Policy' aligns with the National Policy on Science, Technology, and Innovation (DSTIN) 2021-2030, which aims to develop Malaysia as a high-tech nation by 2030 [3].

The 'National 4IR Policy' is a testament to the Government's commitment towards realising the digital revolution [9]. The policy is built to address and optimise the challenges and opportunities that the digital age will have on the Malaysian economy, society, and environmental development [9]. This policy is necessary to provide and equip the Malaysian with IR4.0 knowledge and skillsets whilst also boosting workforce productivity [9]. Therefore, the Malaysian workforce needs to harness IR4.0 technologies and embark on digital innovation to thrive in a fast-changing work environment [9].

SDMAs are agencies that come under Sarawak Disaster Management Committee in managing disasters in Sarawak. There are 47 agencies which are:

(1) Department of Irrigation and Drainage Sarawak (DID)
(2) Ministry of Welfare, Community Wellbeing, Women, Family and Childhood Development – Sarawak Social Welfare Department (JKM)
(3) Sarawak State Health Department
(4) Sarawak Public Works Department (JKR)
(5) Ministry of Infrastructure Development and Transportation Sarawak
(6) Department of Statistics, Malaysia Sarawak
(7) Fire and Rescue Department, Sarawak
(8) Royal Malaysia Police, Sarawak Branch
(9) Natural Resources and Environment Board Sarawak (NREB)
(10) Forestry Department Sarawak
(11) Sarawak Multimedia Authority (SMA)
(12) Telekom Malaysia (Sarawak Branch)
(13) Department of Agriculture, Sarawak
(14) Ministry of Education, Science and Technological Research
(15) Ministry of Utilities Sarawak
(16) Sewerage Services Department Sarawak
(17) Ministry of Urban Development and Natural Resources
(18) Acting Deputy State Secretary's Office (Rural Transformation)

(19) Acting Sarawak State Secretary
(20) National Security Council (MKN)
(21) Unit Keselamatan dan Penguatkuasaan Negeri (UKPN)
(22) Malaysian Maritime Enforcement Agency
(23) Malaysian Royal Air Force
(24) Volunteer Department of Malaysia (RELA)
(25) Department of Meteorology Malaysia
(26) Department of Broadcasting Sarawak (RTM)
(27) Department of Environment Sarawak State
(28) Sarawak Education Department
(29) Public Works Department, Sarawak State Government
(30) Sarawak Rivers Board
(31) Kuching Resident Office
(32) Kuching District Office
(33) Federal Agricultural Marketing Authority (FAMA)
(34) State Planning Unit (SPU)
(35) Sarawak Natural Resources and Environment Board
(36) Department of Information
(37) Department of Occupational Safety and Health (DOSH)
(38) Rural Water Supply Department of Sarawak
(39) Regional Corridor Authority
(40) Malaysia Civil Defence Force (Sarawak Branch)
(41) University Malaysia Sarawak
(42) Mineral & Geoscience Department of Malaysia, Sarawak
(43) Atomic Energy Licensing Board
(44) Land and Survey Department Sarawak
(45) Sarawak Federal Secretary Office
(46) Sarawak Federal Treasury
(47) National Disaster Management Agency (NADMA)

1.9 Fourth Industrial Revolution (IR4.0)

IR4.0 also known as Industry 4.0, is the age of digitalisation that has finally arrived, from the digitally connected products and services we consume in the advancement of smart cities and factories and the increasingly common automation of tasks and services in our homes and at work [49]. It's defined by a range of new technologies that integrate the physical, digital, and biological worlds, having an impact across all disciplines, economies, and businesses [50]. The Industrial Revolution 4.0 (IR4.0) is characterised by; (1) Digitisation, optimisation, and customisation of production, (2) Automation and adaptation; (3) Human-machine interaction; (4) Value-added services and businesses; and (5) Automatic data exchange and communication [51]. Figure 2, shown below, mentioned a list and description of IR4.0 technology clusters most relevant for environmental applications, which can also be employed in managing disasters in Malaysia.

1.10 Disaster Management

Disaster management is the planning, organisation, and implementation of measures to prepare for, respond to and recover from disasters [52]. Disaster management is also defined as the organization and management of resources and responsibilities for dealing with all humanitarian aspects of emergencies, particularly preparedness, response, and recovery, to mitigate the impact of disasters [53].

4IR technology clusters	Descriptions
1. 3D Printing 2. Advanced Materials (including nanomaterials) 3. Artificial Intelligence 4. Robots 5. Drones & Autonomous Vehicles 6. Biotechnologies 7. Energy Capture, Storage, and Transmission 8. Blockchain (and distributed ledger) 9. GeoEngineering 10. Internet of Things 11. Neurotechnologies 12. New Computing Technologies 13. Advanced Sensor Platforms 14. Virtual, Augmented and Mixed realities	The following high-level descriptions are provided as background – they are not intended to be exhaustive. **3D Printing** – Additive manufacturing techniques used to manufacture three dimensional objects based on 'printing' successive layers of materials. **Advanced Materials (including nanomaterials)** – Set of nanotechnologies and other material science technologies that can produce materials with significantly improved or completely new functionality, including lighter weight, stronger, more conductive materials, higher electrical storage e.g. nano-materials, biological materials or hybrids. **Artificial Intelligence** – Computer science learning algorithms that are capable of performing tasks that normally require human intelligence and beyond, e.g. visual perception, speech recognition and decision-making. **Robotics** – Electro-mechanical, biological, and hybrid machines enabled by artificial intelligence that automate, augment, or assist human activities, autonomously or according to set instructions. **Drones & Autonomous Vehicles** – Enabled by robots autonomous vehicles can operate and navigate with no, little or no human control. Drones fly or move in water without a pilot and can operate autonomously or be controlled remotely. **Biotechnologies** – Encompassing bioengineering; biomedical engineering; genomics, gene editing, and proteonomics; biomimicry; and synthetic biology; this technology set has applications in energy, material, chemical, pharmaceutical, agricultural, and medical industries to mention but some. **Energy Capture, Storage, and Transmission** – New energy technologies range from advanced battery technologies through to intelligent virtual grids, organic solar cells, spray-on solar, liquid biofuels for electricity generation and transport, and nuclear fusion. **Blockchain (and Distributed ledger)** – Distributed electronic ledger that uses cryptographic software algorithms to record and confirm immutable transactions and/or assets with reliability and anonymity without a central authority and that allows to automate contracts that relate to those assets and transactions (smart contracts). **GeoEngineering** – Large-scale, deliberate interventions in the earth's natural systems in order to, for example, shift rainfall patterns, create artificial sunshine, or alter biospheres. **Internet of Things** – Network of advanced sensors and actuators in land, in air, in oceans and in space embedded with software, network connectivity and computer capability, that can collect and exchange data over the internet and enable automated solutions to multiple problem sets. **Neurotechnologies** – Enable humans to influence consciousness and thought through decoding what we are thinking in fine levels of detail through new chemicals that influence our brains for enhanced functionality and help us interact with the world in new ways. **New Computing Technologies** – Includes technologies such as quantum computing, DNA-based solid state hard drives, and the combining of 3IR tech (big data, cloud) with the other technologies (e.g. internet of things; advanced sensor platforms). Quantum computers make direct use of quantum-mechanical phenomena such as entanglement to perform large scale computation of a particular class of currently impossible tasks by traditional computing approaches. **Advanced Sensor Platforms (including satellites)** – Advanced fixed and mobile physical, chemical and biological sensors for direct and indirect (remote sensing) of a myriad of environmental, natural resource and biological asset variables from fixed locations or in autonomous or semi-autonomous vehicles in land, in machines, in air, in oceans and in space **Virtual, Augmented and Mixed realities** – Computer-generated simulation of a three-dimensional space overlaid to the physical world (AR) or a complete environment (VR)

Figure 2. List and description of the most relevant IR4.0 technology clusters for environmental applications.

1.11 Research and Development in IR4.0 for Disaster Management in Sarawak State

Sarawak is the most advanced state integrating IR4.0 with disaster management. Recently, Sarawak state has collaborated with KANZU Research: Resilient Built Environment, Universiti Tun Hussein Onn Malaysia (UTHM) for MOBILISE and TRANSCEND research project [54], [55]. MOBILISE, 'A Collaborative Multi-Agency Platform for Building Resilient Communities' is a research project on a cool laborative digital platform to build a resilient community by providing Spatial Data Infrastructure (SDI) [54]. All risk sensitive data will be centralised and SDMAs will collaborate to plan and act accordingly in every circle of disaster management [54]. Meanwhile, TRANSCEND, 'Technology Enhanced Stakeholder Collaboration for Supporting Risk-Sensitive Sustainable Urban Development', is the continuity of MOBILISE project. TRANSCEND carry on research on adaptive

& agile governance, empowering communities, equitable resilience and climate change adaptation for urban development [55]. MOBILISE digital platform will be used as a tool/technology for TRANSCEND project.

Sarawak is very fortunate to have a great and exclusive connection with international funding agencies for these two (2) projects through KANZU Research; such as Global Challenge Research Fund (GCRF), UK and Engineering and Physical Sciences Research Council (ESPRC), UK for MOBILISE project and Global Challenge Research Fund (GCRF), UK and Economic and Social Research Council (ESRC), UK for TRANSCEND project. Sarawak has also collaborated with University of Salford, UK for both projects. There is a lab founded in University of Salford, named 'THINKLab' in 2005. THINKLab is part of University's School of the Built Environment, headed by Professor Terrence Fernando [56]. It is designed to bring university teams and external partners together in an atmosphere of collaboration and co-creation [57]. THINKlab is working with a lot of IR4.0 technologies for Disaster Risk Reduction in UK. Their experts in technical innovation use gaming technology, big data tools, and advanced visualisation techniques to create digital platforms and interactive experiences that help partners understand future scenarios and plan their solutions accordingly, using commercial and grant-funded research [57]. Along with UK, Pakistan and Sri Lanka have been involved in these projects as research partners. Hence, in the field of disaster management, Sarawak would be the most advanced state integrating IR4.0 with disaster management in Malaysia.

2. METHODS

There are two (2) objectives of this research. First, to assess the readiness level of SDMAs in managing disaster using the IR4.0 technology. Second, to examine challenges of the IR4.0 transition for the state of Sarawak in managing the disaster. To achieve these two (2) objectives, researchers have selected 30 SDMAs to provide respondents who are:

(1) Department of Irrigation and Drainage Sarawak (DID)
(2) Ministry of Welfare, Community Wellbeing, Women, Family and Childhood Development
(3) Volunteer Department of Malaysia (RELA)
(4) Sarawak State Health Department
(5) State Security and Enforcement Unit (SSEU)
(6) Sarawak Public Works Department (JKR) supported by RS & GIS Sdn Bhd
(7) Ministry of Infrastructure Development and Transportation Sarawak
(8) Fire and Rescue Department, Sarawak
(9) Royal Malaysia Police, Sarawak Branch
(10) Malaysia Civil Defence Force (Sarawak Branch)
(11) Sarawak Natural Resources and Environment Board (NREB)
(12) Sarawak Rivers Boards
(13) Forestry Department Sarawak
(14) Sarawak Multimedia Authority (SMA)
(15) Sarawak Public Works Department (JKR)
(16) Telekom Malaysia – Sarawak Branch
(17) Department of Agriculture, Sarawak
(18) Ministry of Education, Science and Technological Research
(19) Ministry of Utilities Sarawak
(20) Mineral & Geoscience Department of Malaysia, Sarawak
(21) Sewerage Services Department Sarawak
(22) Ministry of Urban Development and Natural Resources
(23) Land and Survey Department Sarawak
(24) Sarawak Federal Treasury
(25) Sarawak Federal Secretary Office
(26) Regional Corridor Authority
(27) Department of Statistics, Malaysia Sarawak
(28) Rural Water Supply Department of Sarawak
(29) Department of Occupational Safety and Health (DOSH)
(30) Department of Information Sarawak

All 30 agencies are selected out of 47 agencies since these 30 agencies are reachable through WhatsApp Group. In terms of population, 120 people have become the respondent. There are four (4) people for each selected agency, thus four people x 30 agencies: 120 people. In terms of the sample size of the population, 92 people out of the 120 people have been selected. This is referring to Krejcie and Morgan's formula. Figure 3 shows the calculation of the sample size for this research.

The methodology used for this ongoing research is purely quantitative by employing Questionnaire Survey as the method. After analysing the respondent's answer from Google form, the readiness level of the SDMAs in managing disaster by using the technology of the IR4.0 will be identified. Besides, challenges of the IR4.0 transition for the state of Sarawak in managing disaster will be examined.

Formula of Krejcie and Morgan (1970):

s = (X2NP (1-P)) / (d2 (N-1)) + (X2 P (1-P))
s: required sample size
X²: the table value of chi-square for 1 degree of freedom at the desired confidence level (3.841)
N: the population size
P: the population proportion (assumed to be 50 since this would provide the maximum sample size)
D: the degree of accuracy expressed as the proportion (0.05)

Thus, the sample size for this research:
s = (X2NP (1-P)) / (d2 (N-1)) + (X2 P (1-P))
= ((3.841)(120)(0.5)(1-0.5)) / (0.05)2(120-1)) + ((3.841)(0.5)(1-0.5))
= 115.23 / (0.0025)(119) + (0.96025)
= 115.23 / 0.2975 + 096025
= 115.23 / 1.25775
≈ 92

Figure 3. Calculation on Sample Size based on Krejcie and Morgan Formula

To achieve both Research Objectives (RO), researchers have developed a Questionnaire Survey. For RO1: To assess the readiness level of SDMAs in managing disaster by using the technology of IR4.0, researchers have developed a Section inside the Google Form which has the element of; (1) People; (2) Process; (3) Technology; and (4) Strategy. This section will determine the readiness level of SDMA for each element. How ready are they in terms of people, process, technology, and strategy?

Next, for RO2: To examine challenges of the IR4.0 transition for the state of Sarawak in managing the disaster, researchers have also developed a Section inside the Google Form which has the issues on awareness, digital readiness & connectivity, skill enhancement, cost of investment, best practices, funding & incentive, etc. By grouping all the challenges into specific issues, researchers can examine the challenges faced by the Sarawak State specific to the case.

3. RESULTS AND DISCUSSION

With regards to disaster management, the IR4.0 readiness level of SDMAs will be studied and accessed through this study. Therefore, issues in managing disasters such as COVID-19 can be addressed and managed by adopting the most recent technology. Sarawak is the most advanced state integrating IR4.0 with disaster management. There are few efforts taken in their DRR programme. Few technologies of IR4.0 has been employed to manage disaster. There are also research and development projects in disaster management area which adopting IR4.0 technology that choose Sarawak as case study, which are MOBILISE and TRANSCEND. However, it is important for every agency involved in managing disaster to self-assess their readiness towards IR4.0 technologies. By conducting Questionnaire Survey, the readiness level of SDMAs in managing disaster by using IR4.0 technologies will be assessed. Also, the challenges of the IR4.0 transition for the state in managing disaster will also be examined. Since this research is still ongoing, there are still no results or findings obtained yet. The results and findings of this ongoing research, IR4.0 readiness level of SDMAs will be investigated on the bases of this study. Also, challenges of IR4.0 transitions for the state of Sarawak in managing disasters such as COVID-19 will be published in another paper produced by researchers.

4. CONCLUSION

With regards to disaster management, the IR4.0 readiness level of SDMAs will be studied and accessed through this study. Therefore, issues in managing disasters such as COVID-19 can be addressed and managed by adopting the most recent technology. Sarawak is the most advanced state integrating IR4.0 with disaster management. There are few efforts taken in their DRR programme. Few technologies of IR4.0 has been employed to manage disaster. There are also research and development projects in disaster management area which adopting IR4.0 technology that choose Sarawak as case study, which are MOBILISE and TRANSCEND. However, it is important for every agency involved in managing disaster to self-assess their readiness towards IR4.0 technologies. By conducting Questionnaire Survey, the readiness level of SDMAs in managing disaster by using IR4.0 technologies will be assessed. Also, the challenges of the IR4.0 transition for the state in managing disaster will also be examined. Since this research is still ongoing, there are still no results or findings obtained yet. The results and findings of this ongoing research, IR4.0 readiness level of SDMAs will be investigated on the bases of this study. Also, challenges of IR4.0 transitions for the state of Sarawak in managing disasters such as COVID-19 will be published in another paper produced by researchers.

ACKNOWLEDGMENT

This work is supported by Ministry of Higher Education (MoHE), under Malaysia Technical University

Network (MTUN) grant, VOT K244: Disaster Resilience in the Advent of Fourth Industrial Revolution (RESILIENCE4FWRD). Also, I would like to thank UTHM for giving me an opportunity to be part of this grant.

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