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eISBN 978-967-2298-96-0

15 JUNE, 2022
PULLMAN HOTEL, KUCHING, SARAWAK, MALAYSIA

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SOCIAL SCIENCES AND HUMANITIES RESEARCH CONFERENCE 2022 (SSHR 22), 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

PROCEEDINGS OF UNIVERSITI MALAYSIA SARAWAK SOCIAL SCIENCES & HUMANITIES RESEARCH CONFERENCE 2022

(UNIMAS-SSHR 22)

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Information Compiled by the Faculty of Social Sciences & Humanities, Faculty of Language and Communication, and the Institute of Borneo Studies, Universiti Malaysia Sarawak.

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LAYOUT AND DESIGN BY
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PRINTED IN MALAYSIA BY
Lee Ming Press Sdn. Bhd.
Lot 1050, Jalan Swasta Biawak Industrial Estate, 93450.
Kuching, Sarawak.

DETAILS OF PUBLISHER
UNIMAS Publisher,
Universiti Malaysia Sarawak,
94300 Kota Samarahan
Sarawak, Malaysia.

eISBN 978-967-2298-96-0

eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

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SOCIAL SCIENCES & HUMANITIES CONFERENCE 2022 (SSHR 22) 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

Simulations of Ammonia Release as Measures of Sustaining Port Safety Environment

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Abstract
Ammonia is being exported through the Port via pipeline and loaded to the vessel (ship) using marine loading arm. Ammonia is toxic in nature and transferred at -33 ^{o}C. Studies such as by HSE Executive, UK on loading arm had provided the probabilities of failures, and the possible size of hole such as guillotine break or 0.1 cross sectional area of pipe. This information, with ammonia operational parameters such as internal and external pressure and ammonia liquid flow rate we can thus predict the amount of ammonia release. Combining with meteorological data information, local landscape conditions and utilizing ALOHA software, we are able to simulate ammonia dispersion and thus predicting the impact of toxicity of ammonia release on the population within the area.

Keywords: Ammonia, Loading Arm, ALOHA, Failure Rate

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1. Background

Ammonia is one of the bulk liquid dangerous cargoes for export through the ports or terminals. It is loaded to vessel by loading arm, a safe and efficient way of ammonia transfer from wharf to the vessel. As loading activity takes place within the port's inner harbour, there is a chance of ammonia leakage or discharge into the atmosphere, which could impact the population.

Since the loading operation is within the inner harbour of the port, there is concern about the risk of ammonia leak or release into the atmosphere, potentially affecting the population around the port. In ensuring the sustainability of discharging ammonia onto vessels, simulations need to be conducted to ascertain the migration of ammonia in case of accidental leakage.

2. Behaviour of ammonia upon release

Ammonia is a colourless, lighter-than-air gas with a strong odour. At -33^0°C, it becomes liquid. When ammonia is released into the air, it can behave in three ways: as a superheated liquid, a pressurised liquid under boiling point, or a gas. (Che Hassan et al., 2009)

When liquid ammonia is discharged into the environment, it transforms and vaporises, generating a moving cloud. The migration is influenced by factors such as wind speed, direction, pasquill stability, temperature, and relative humidity in the environment. (Che Hassan et al., 2009)

As a result, simulations of migration from the starting condition to the expected ultimate locations are required. The inventory of releases, pipeline temperature, leak source or mechanism, surface type, roughness, internal pressure, ambient pressure, and temperature will all influence this.

3. Simulation software

Various studies and various software had been used for simulation. For this study, ALOHA is use as it is free; thus, it is widely used by experts, organizations, and departments. Lee et al. indicated that ALOHA is the best simulator for the determination of ammonia toxicity. (Lee et al., 2018).

Toxic effect of ammonia upon release

The Acute Exposure Guideline by USEPA are categorised AEGL-1, AEGL-2 and AEGL-3. The categories are shown in Table 1:

Table 1. Ammonia exposure categories

AEGL-1	**30 ppm for 60 minutes**	**Reversible upon cessation of exposure**
AEGL-2	160 ppm for 60 minutes	Adverse effect or serious bodily injury
AEGL-3	110 ppm for 60 minutes	Fatality if exposed to hazardous chemical

4. Failure mode of loading arm

Failure of the loading arm will cause the liquid to leak or release to the atmosphere. In order to determine the amount of release, thus the failure mode had to be determined. The area of hole of release will determine the flow rate and the pressure of the liquid into the atmosphere.

HSE Executive, UK has summarized and determined that the failure mode is guillotine failure, that is, the liquid release with the area of the cross-sectional area of the pipe, and 0.1 of the cross-sectional area of the pipe (HSE, 2017). This will be the basis to determine the flowrate of the liquid into the atmosphere.

The ammonia properties to be included in determining the flowrate are the operational pressure of 6 Bar, Atmospheric pressure of 1 Bar, the liquid temperature of -33°C. Specific gravity is 0.681 for ammonia.

The leak rate equation is:-

$Q = CA\{2AP/(SPw,std)\}^{-1/2}$

A = area of hole or crack

C = Discharge coefficient, need $0<C<1$

S = Liquid specific gravity

P = water sp

ΔP = Pressure drop from inside to outside of pipe (N/m^2)

Q = Flowrate of the leak in m/s

Table 2. Calculations for the specified area

Failure mode	Guillotine (total cross-sectional area)	0.1 cross-sectional area
Diameter (m)	0.0762	0.0762
Area (m^2)	0.004558055	0.00045581
Pressure (Pa)	600000	600000
External Pressure (Pa)	100000	100000
Coefficient C	0.61	1.61
Discharge Rate Q (m3/s)	**0.106545688**	**0.01789871**
Specific gravity	0.681	1.681

5. Meteorological conditions

Meteorological data was obtained from Meteorological Department Malaysia, Bintulu (2010-2019). The data are as shown in Table 3:

Table 3. Meteorological data for four scenarios

Parameters	Scenario 1	Scenario 2	Scenario 3	Scenario 4
***Wind Direction**	E	SE	NW	N
***Wind Speed**	1.5	1.5	3.0	4
***Pasquill**	6.1	6.1	6.1	6.1
Temperature	35	35	35	35
Humidity	80	80	80	80

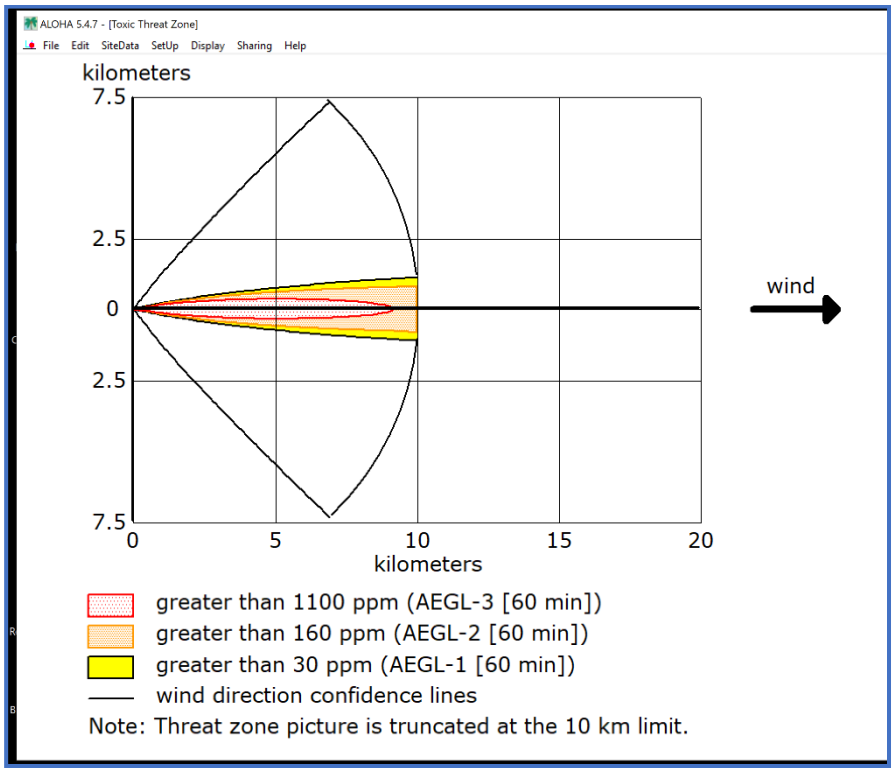
6. Simulation software

Various studies and various software had been used for simulation. For this study, ALOHA is use as it is free; thus, it is widely used by experts, organizations, and departments. Lee et al. indicated that ALOHA is the best simulator for the determination of ammonia toxicity (Lee et al., 2018). ALOHA based its simulation on Gaussian Distribution for the migration of vapour cloud.

7. Simulation Output

Examples of simulation output for guillotine failure are illustrated below.

eISBN 978-967-2298-96-0



8. Conclusion

Simulation software provides pattern of ammonia migration for typical wind direction based on 2010-2019 meteorological data. The simulation software requires meteorological data and operational data to provide simulated zones of interest. Using ALOHA which is free and acceptable to be used to simulate ammonia release gives zones in AEGL, and thus take mitigation and emergency preparedness measures. Future studies should concentrate on operational problems that are more likely to occur, such as small leakage of ammonia. As a result, more significant actions may be performed, which are more important for emergency response planning.

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eISBN 978-967-2298-96-0

Measuring Safety Behavioural Potentials: Towards the Realization of Oil and Gas Industrial Construction Workers' Sustainable Goal of Safety in Sarawak

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Abstract

Human related accidents in Sarawak's oil and gas construction sites constantly incur serious implications to safety performance, business competitiveness and financial performance. Hence, to realize and operationalize strategic thrusts of Malaysia's Occupational Safety and Health Master Plan 2021-2025 (OSHMP25) and Sustainable Development Goals (SDGs), it is imperative to develop an instrument to identify and measure potential human attributes that significantly influent workers' safe behaviour potentials to reduce risk of occupational accidents in a sustainable manner

eISBN 978-967-2298-96-0

through strengthening stakeholders' safety culture. Thus, this paper evaluates constructs' validity and reliability of the new instrument to confirms its objectivity and clarity in measuring constructs as intended. A 5-point Likert-type scale instrument consists of 98 statements was used to evaluate 51 oil and gas construction workers, randomly selected from local service providers. The outcome of analysis is discussed.

Keywords: Oil and gas construction workers, OSHMP25, SG, safe behaviour potentials

1. Introduction

Oil and gas (O&G) construction activities are prone to major accident hazards with severe consequences to safety and health of workers, environmental contamination, economic losses, and insecure energy supply (Christou and Konstantinidou, 2012; CIMAH, 1996). Some remarkable industrial accidents had occurred in the past in downstream sector of Sarawak, namely, a worker was buried alive while fitting strain sensor in a collapsed trench at an interstate gas pipeline worksite (Borneo Post, 2018); fire incident due to pipe rupture at the similar interstate gas pipeline project (Then, 2020); and lastly, an incident involving one fatality and one injury during turnaround maintenance at a local natural gas processing plant (Chong, 2020).

Occupational Safety and Health Master Plan 2021-2025 (OSHMP25) is a strategic plan jointly developed by National Council of Occupational Safety and Health (NCOSH) and Department of Occupational Safety and Health (DOSH) to address the nation's aspiration to elevate the level of occupational safety and health (OSH) in Malaysia in the face of challenges posted by rapid growth application of digital technology at work (Malay Mail, 2021; Anis, 2021). OSHMP25 aims to resolve future challenges through OSH empowerment, self-regulation, education and research, and embracing new technology, underpinned by sound organizational OSH culture and climate (NCOSH & DOSH, 2021). Meanwhile the overarching purpose of United Nations' Sustainable Development Goals (SDGs) is to ensure concurrent and balanced economic development, social advancement and environmental protection, so as to accomplish a better quality of life for all people and protect all living beings and planet by 2030 (Fonseca & Carvalho, 2019). While searching for material prosperities and quality living, the endeavor could not be sustained without due considerations of OSH performance, reduction of occupational diseases, workplace innovations including injury preventions, people's safety and controlled environment (Jilcha & Kitaw, 2017; Ma et al, 2020) as Target 8.8 of SDG8 (Decent Work and Economic Growth) has clearly demanded the protection labour rights and promote safe and secure working environments of all workers (UN, 2015).

To realize sustainable goals of safety in Sarawak's O&G construction industry as inspired by OSHMP25 and SDGs, the objectives of this study are: to determine the dimensions and features of research framework, through literature review, that could accurately express the potential empirical relationships of workers' attributes, their perception of safety climate, and safe behavior potentials at worksites; and to assess the constructs' validity and reliability of a multi-lingual survey questionnaires set, with its measured items, could accurately represent each component of research framework for future research.

2. Review of Literature

Ajzen (1991, 2020) articulated various aspects of theory of planned behavior (TPB), in which intentions to perform certain types of volitional behavior are supposedly to be predicted, quite accurately, via attitudes toward the behavior, subjective norms, and perceived behavioral control. Intention, in conjunction with perceptions of behavioral control, is poised to explain considerable change in actual behavior. TPB is widely used as a principal model to examine behavioral intentions in medical safety (Lapkin et al., 2015), coal chemical industry (Yao et al., 2020), maintenance support chain for military (Forgaty & Shaw, 2010), food safety (Lin & Roberts, 2020), vehicle repair and service industry (Abu Bakar et al., 2017), road safety (Qi et al, 2021) and consumer behavior (Ahmmadi et al., 2021). Vinodkumar and Bhasi (2009) investigated the relationship between safety climate and personal attributes by taking qualification, age, experience, and job category into account, which are mostly demographic in nature. Fang et al. (2006) and Manjula and De Silva (2014) denoted this as personal characteristic and personal factors, respectively. Dawson et al. (2011) argued that personal attributes (characteristics and values) also include the element of desire or commitment to serve, along with other attainable skills and personal qualities. This argument is partially supported by Mazur et al. (2014) stating that cognitive flexibility, itself part of personal attributes, consists of "willingness" to adapt by selecting the suitable mode of response, presumably including the commitment to comply or otherwise. Lastly, personality of a person is frequently analyzed and measured as an integral component of personal attributes in various research and studies (Fruhen et al., 2014; Wakou et al., 2003; Cheng and Hau, 2003; Flint-Taylor et al., 2014). On this account, this study hereafter examines and measures personal attributes of oil and gas construction workers through the aspects of personal characteristics, safety compliance potential (commitment to comply or otherwise) and personality. Safety climate had been empirically proven to be a valid and strong leading indicator or predictor of safety outcomes presumably included safety behavior, safety compliance and safety performance across various industries and countries (Zohar, 2010; Zohar et al, 2015; Lim et al., 2018). This assertion in principle aligns with Wu et al. (2007 & 2008) where safety climate was measured from the 5 dimensions: chief executive officer's safety commitment and action, manager's safety commitment and action, employee's safety commitment, perceived risk, and emergency response. Jusoh and Panatik (2016) adopted similar dimensions and were proven as important predictors of safety performance in a Malaysia-based electric and electronic manufacturing plant. Safety climate is also widely acknowledged to be a significant moderator between human's attributes and safety performance / behavior (Zhou & Jiang, 2015; Tholen et al, 2013). Human-related errors had contributed to some of the noteworthy industrial disasters such as the ones in Bhopal, Piper Alpha, Chernobyl, and Texaco Refinery (Jahangiri et al., 2016). Human failures can be further categorized into slips of action; lapses of memory; rule-based mistakes; knowledge-based mistakes; routine; situational violations; exceptional violations; and optimizing violations (Bates and Holroyd, 2012; HSE, 1999). Safe behavior potentials, in this study, is defined as one's tendency to act safely or otherwise at workplace. Founded upon TPB and hypothesized interrelationship between workers' personal attributes, perception of safety climate and safe behavior potentials, the following research framework (Figure 1) has been proposed as the basis of this study.

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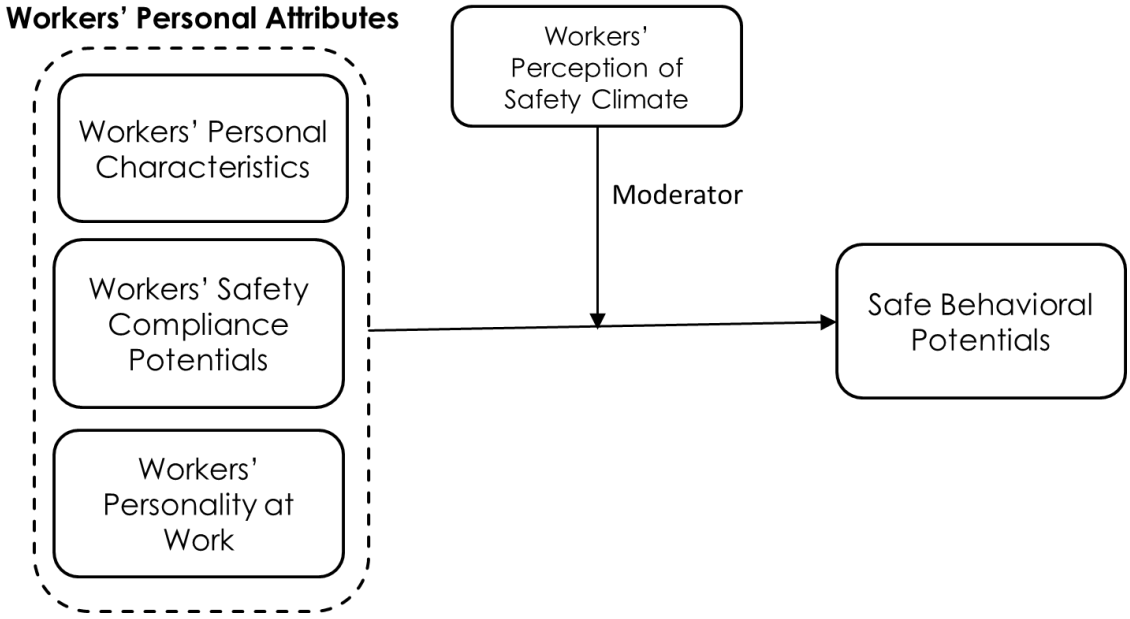
Figure 1: Proposed Research framework



Sources: Vinodkumar and Bhasi (2009), Fang et al. (2006), Manjula and De Silva (2014), Dawson et al. (2011), Mazur et al. (2014), Fruhen et al. (2014), Wakou et al.(2003), Cheng and Hau (2003), Flint-Taylor et al.(2014), Zohar (2010), Zohar et al (2015), Lim et al.(2018), Griffin and Curcuruto (2016), Wu et al. (2007 & 2008), Jusoh and Panatik (2016), Zhou & Jiang (2015), Loh et al. (2018), Zhou & Jiang (2015), Rasmussen (1982), Bates and Holroyd (2012)

3. Research Methodology

3.1 Design of Measurement Instrument

Questionnaires were developed upon reviewing previously mentioned literature and in alignment with initial model constructs. The questionnaires were initially articulated in English, followed by translation into simple Bahasa Malaysia by a professional translator. Content validation was carried out by 5 subject matter experts (SME) who are professionals with a minimum of 10 years' experience in occupational safety and health, and emergency response in oil and gas related industry. The content was then amended in accordance with SME's recommendations as required by Lawshe's Content Validity Ratio (Ayre and Scally, 2014) to reflect its suitability and relevancy to the prevailing industry's conditions. The questionnaire consists of 5 sections: Part A - Workers' personal characteristics (demographic information), Part B- workers' safety compliance potentials, Part C – workers' personality at work, Part D – workers' perception of safety climate at work, and Part E – safe behavioral potentials. All in all, there were a total of 93 questions. Part B, C, D & E are constituted by statements with five-Likert type scale response options (1 = strongly disagree, 2

= disagree, 3 = neutral, 4 = agree and 5 = strongly agree). The Part A (workers' personal characteristic) comprised of 13 demographic and personal experience related questions (PS1-PS13). Part B (workers' safety compliance potential) gathered information, via 10 focused statements (V1-V10), about their inclination to comply with safety and health related rules, particularly statutory requirement in particular. Part C (workers' personality at work) consists of 18 statements (PA1-PA9; PC1-PC9) through which information about the personality traits of a respondent is elicited. Part D (workers' perception of safety climate at worksite) obtained workers' perceived safety climate at their respective worksite includes 36 statements separated into 4 components (TMC1-TMC10; SMC1-SMC10; ER1-ER7; PR1-PR9). Part E (safety behavioral potentials) mustered information about workers' potential to commit human errors at worksite through 16 statements segregated into 2 components (BPV1-BPV8; LSM1-LSM8).

3.2 Procedure to Take Sample

The respondents were construction workers aged 18 years old or above at that material time, from various trades and designations, employed by oil and gas service contractors and vendors. A statement for consent was attached to questionnaires to ensure respondents' understanding and approval prior to their participation. The questionnaires, with both English and Bahasa Malaysia versions, in hardcopy were delivered to focal persons of each cluster (premise), i.e.3 clusters in total. The survey at sites was administered but not guided by author or focal persons. Acknowledgement of written consent from respondents had been obtained prior to their participation during briefing sessions. Sample of 50 or more is deemed adequate for pilot study (Sandvik et al., 1996; Hertzog, 2008).

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4.0 Results and Discussion

4.1 Descriptive Statistic

With reference to **Table 1**, out of 54 sets of questionnaires being distributed, 51 were complete and suitable for statistical analysis. It was revealed that 56.9 % of the respondents are aged between 25 and 38, which represents a relatively young workforce. In addition to that, 45.1 % and 27.5% of respondents worked in the oil and gas industry for less than 5 years and between 6 to 10 years respectively. The workforce in this study was predominantly male (72.5 %) as compared to female (27.5 %). 54.9 % of the respondents were married with child or children whereas 35.5 % were single, this observation is corresponding to the finding that 78.4 % of the respondents had expressed at least 1 or more family members require their support. Percentage of monthly-paid workers, both permanent and contracted staffs, from main contractors (53.0 %) and sub-contractors (45.1 %) in relation to daily-paid workers implied that the workforce was receiving stable incomes albeit the renumeration received was not within the scope of this study. The fluidity of personnel movement from one provider to another might be vindicated by the finding that 72.5 % of the respondents worked for their respective current companies for less than 5 years.

It is also suggested that the workforce was relatively well-educated as 96.1 % of the respondents received at least secondary or even tertiary education, implying that the comprehension of formal safety requirements might not be a concern. The study also revealed that a majority of the respondents under the study possessed some healthy traits as 72.5 % are nonsmoker and 52.9% are nondrinkers, with 27.5% identified themselves as occasion drinkers at best. 80.4% of the respondents indicated they had experienced occupational injuries, illnesses, or environmental pollution between 1 to 3 times, with another 13.7% between 4-6 times, either through their own encounters or from observing the others. Furthermore, 98.0% reported that they had violated established safety-related rules between 1 to 3 times. Similarly, 98.0% had identified themselves as at least having some basic knowledge and experience in safety, health, and environment (HSE), in which 25.5% had carried out occupational risk management activities such as job hazard analysis (JHA) and risk assessment (RA) before.

4.2 Reliability, Validity, and Communality

As illustrated in **Table 2**, workers' attributes were measured by 3 core components: workers' personal characteristic, workers' safety compliance potentials, and workers' personality. Workers' personal characteristic construct (PS1-PS13) indicated a KMO value of 0.517 at a significance level of $p=0.000$, with communality range of 0.314-0.898 of which PS6 (0.314) was the lowest in communality value. In addition, Workers' safety compliance potential construct (V1-V10) showed a KMO value of 0.845 at a significance level of $p=0.000$, with communality range of 0.344-0.813 of which V3 (0.593) and V6 (0.344) were the least in communality values. Finally, Workers' personality constructs were measured through *agreeableness* construct and *conscientiousness* construct. Agreeable construct (PA1-PA9) indicated a KMO value of 0.566 at a significance level of $p=0.000$, with communality range of 0.376-0.821 of which PA2 (0.493), PA4 (0.480), and PA9 (0.376) were at the lowest end of communality range. Conscientiousness construct (PC1-PC9) possessed a KMO value of 0.708 at a significance level of $p=0.000$, with communality range of 0.448-0.772 of which PC6 (0.558) and PC7 (0.448) were at the lowest segment of the range.

Workers' perception of safety climate was divided into 4 core components, namely, company top management's safety and health commitment (TMC1-TMC10), site manager's safety and health commitment (SMC1-SMC10), emergency response (ER1-ER7), and perceived risks (PR1-PR9). Firstly, company top management's safety and health commitment construct showed a KMO value of 0.815 at a significance level of *p=0.000*, with communality range of 0.586-0.838 of which TMC5 (0.586) and TMC10 (0.595) had the lowest communality values. Secondly, site manager's safety and health commitment construct indicated a KMO value of 0.793 at a significance level of *p=0.000*, with communality range of 0.591-0.879 of which SMC8 (0.591) and SMC10 (0.592) located at bottom of communality range. Thirdly, emergency response construct demonstrated a KMO value of 0.861 at a significance level of *p=0.000*, with communality range of 0.253-0.840 where both ER1 (0.253) and ER5 (0.525) were at the lowest section of communality range. Finally, perceived risk construct indicated a KMO value of 0.720 at a significance level of *p=0.000*, with communality range of 0.522-0.885 among which PR7 (0.535) and PR8 (0.522) had the lowest communality values. Workers' safe behavior potentials were measured through violations (BPV1-BPV8); and lapses, slips and mistakes (LSM1-LSM8). Violations construct possessed a KMO value of 0.697 at a significance level of *p=0.000*, with communality range of 0.146-0.837 where BPV3 (0.496), BPV4 (0.146) and BPV5 (0.549) were at the lowest spectrum of communality range. Lapses, slips, and mistakes construct showed a KMO value of 0.763 at a significance level of *p=0.000*, with communality range of 0.545-0.822 among which LSM4 (0.572), LSM5 (0.597) and LSM6 (0.545) were the items with 3 lowest communality values.

4.3 Reliability

Cronbach's Alpha is a measure of internal consistency, in other words, how closely associated a set of measured items within a group (model constructs). This test is considered to be a measure of scale reliability. SPSS analysis indicated Cronbach's Alpha of the initial model constructs is 0.926, which when above the threshold of 0.7 is considered as internally consistent.

4.4 Validity

With reference to **Table 2**, the initial model constructs, analyzed in isolation, unanimously indicate a KMO value of more than the threshold of 0.5 at a significant level of $p = 0.000$ for each construct: workers' personal characteristics (0.517); workers' safety compliance potentials (0.845); agreeableness (0.566); conscientiousness (0.708); company top management's safety and health commitment (0.815); site manager's safety and health commitment (0.793); emergency response (0.861); perceived risks (0.720); violations (0.697); lapses, slips and mistakes (0.763). The result shows that each construct possesses high internal consistency, therefore suggesting this measurement instrument might be appropriate to be deployed in subsequent research as it is likely to yield useful and representable results from factor analysis.

4.5 Communality

Extraction communalities are estimates of the variance in each variable accounted for by the constructs. High communality value (> 0.6 for sample size of less than 100) indicates that the extracted constructs represent the variables well, hence the measured items should be retained, or to be removed for subsequent analysis. A total of 20 measured items are removed as their respective communality values are less than 0.6 whereas a total of 73 items are retained for having higher communality values except 2 items (BPV3 and LSM5), refer to **Table 2** for items removed.

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Constructs with items being removed are: workers' personal characteristics (1 items - PS6); workers' safety compliance potentials (2 items - V3 and V6); agreeableness (3 items - PA2, PA4 and PA9); conscientiousness (2 items – PC6 and PC7); company top management's safety and health commitment (2 items – TMC5 and TMC10); site manager's safety and health commitment (2 items – SMC8 and SMC9); emergency response (2 items – ER1 and ER5); perceived risks (2 items – PR7 and PR8); violations (2 items – BPV4 and BPV5); lapses, slips and mistakes (2 items - LSM4 and LSM6). Items that have been retained although the respective communality values are below threshold of 0.6 are: BPV3 (0.496) and LSM5 (0.597). There are 2 critical justifications for their retention: Firstly, BPV3 and BPV4 (exceptional violations) as well as LSM5 and LSM6 (rule-based mistakes) respectively measure the same dimensions. Hence the risk of not measuring the complete dimensions of violations and mistakes in future research, if they are excluded, grossly outweighs the objections of their inclusion. Secondly, Yong and Pearce (2013) postulated that variables with communality of > 0.2 can be retained for analysis since the aim of factor analysis is to try and explain the variance through the common factors. Consequently, these arguments are particularly useful to provide justification for their inclusion, instead of other removed items with higher communality values, especially for BPV3.

5. Conclusions

Through affirming validity and reliability of the initial model constructs, and removal of measured items with low communality from initial questionnaire, a statistically valid and reliable multi-lingual questionnaire for subsequent research was therefore shaped. On that note, through content validation by local SMEs and participation of from local workers, these multi-lingual questionnaires in English and Bahasa Malaysia were tailored to reflect ethnic compositions, cultural diversities, and localized uniqueness of oil & gas workers in Sarawak. It is the ultimate aim of this research to contribute to the realization and operationalization of strategic thrusts of Malaysia's Occupational Safety and Health Master Plan 2021-2025 (OSHMP25) and Sustainable Development Goals (SDGs).

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Table 1 : Demographic Information

Parameters	Scales	Frequency	Percentage
Age (N=51)	18-24	7	13.7 %
	25-31	18	35.3 %
	32-38	11	21.6 %
	39-45	5	9.8 %
	46 & above	10	16.6 %
Gender (N=51)	Male	37	72.5 %
	Female	14	27.5 %
Marital status (N=51)	Single	18	35.5 %
	Married with no child	5	9.8 %
	Married with child / Children	28	54.9 %
No of family members to be supported (N=51)	None	11	21.6 %
	1-2	17	33.3 %
	3-4	19	37.3 %
	5-6	3	5.9 %
	7 and above	1	2.0 %
Status of employment (N=51)	Subcon daily paid	2	2.0 %
	Subcon monthly paid under contract	12	23.5 %
	Subcon permanent staff	11	21.6 %
	Main con monthly paid under contract	19	37.3 %
	Main con permanent staff	8	15.7 %
Duration of service in present company (N=51)	<1 year	6	11.8 %
	1-5 years	37	72.5 %
	6-10 years	7	13.7 %
	11-15 years	0	0.0 %
	>15 years	1	2.0 %
Duration working in oil & gas industry (N=51)	5 years or less	23	45.1 %
	6-10 years	14	27.5 %
	11-15 years	5	9.8 %
	16-20 years	5	9.8 %
	>20 years	4	7.8 %

eISBN 978-967-2298-96-0

Table 1 (continued)

Parameters	Scales	Frequency	Percentage
Smoking habit (cigarette) (N=51)	Nonsmoker	37	72.5 %
	1-5 sticks a day	3	5.9 %
	6-10 sticks a day	10	19.6 %
	11-15sticks a day	0	0.0 %
	16-20 sticks a day or more	1	2.0 %
Drinking habit (alcohol) (N=51)	Nondrinker	27	52.9 %
	Occasional drinker	14	27.5 %
	Regular drinker (weekends drinker)	10	10.0 %
	Very frequent drinker (daily drinker)	0	0.0 %
	Heavy drinker	0	0.0 %
Education level (N=51)	Below primary	1	2.0 %
	Primary	1	2.0 %
	Secondary	14	27.5 %
	Vocational certificate / certificate /diploma	20	39.2 %
	Degree or higher	15	29.4 %
Experience in occupational injuries, illnesses, and pollution at worksite through observation of others or by own encounter (N=51)	1-3 times	41	80.4 %
	4-6 times	7	13.7 %
	7-9 times	2	3.9 %
	10-12 times	0	0.0 %
	>12 times	1	2.0 %

Table 1 (continued)

Parameters	Scales	Frequency	Percentage
Experience in rule violation (N=51)	1-3 times	50	98.0 %
	4-6 times	0	0.0 %
	7-9 times	1	2.0 %
	10-12 times	0	0.0 %
	>12 times	0	0.0 %
Knowledge and experience in safety and health (N=51)	No knowledge & experience	1	2.0 %
	Basic HSE knowledge from internal safety inductions	17	33.3 %
	HSE knowledge from inductions & NIOSH approved courses	20	39.2
	Experience as safety / work supervisor, involving in JHA & risk assessment	13	25.5
	Expert in HSE management	0	0.0 %

Source: Authors' analysis using SPSS

Table 2: Validity, reliability, and communality of initial constructs

Construct Name	Question Coding	KMO	Sig.	Communality	Removed Items	Remark
Workers' personal Characteristic	PS1 – PS13	0.517	0.000	0.314 – 0.898	PS6 (0.314)	
Workers' safety compliance potential	V1 – V10	0.845	0.000	0.344 – 0.813	V3 (0.593); V6 (0.344)	
Agreeableness	PA1 – PA9	0.566	0.000	0.376 – 0.821	PA2 (0.493); PA4 (0.480); PA9 (0.376)	
Conscientiousness	PC1 – PC9	0.708	0.000	0.448 – 0.772	PC6 (0.558); PC7 (0.448)	
Company top management's safety and health commitment	TMC1 - TMC10	0.815	0.000	0.586 – 0.838	TMC5 (0.586); TMC10 (0.595)	
Site manager's safety and health commitment	SMC1 - SMC10	0.793	0.000	0.591 – 0.879	SMC8 (0.591); SMC10 (0.592)	
Emergency response	ER1 – ER7	0.861	0.000	0.253 – 0.840	ER1 (0.253); ER5 (0.525)	
Perceived risks	PR1 – PR9	0.720	0.000	0.522 – 0.885	PR7 (0.535); PR8 (0.522)	
Violations	BPV1 – BPV8	0.697	0.000	0.146 – 0.827	BPV4 (0.146); BPV5 (0.549)	*BPV3 (0.496)
Lapses, Slips and Mistakes	LSM1 – LSM8	0.763	0.000	0.545 – 0.822	LSM4 (0.572); LSM6 (0.545)	*LSM5 (0.597)

*** Note:** KMO <0.06 but yet is retained, with valid dispensation, due to risk of non-representation in future research.

Source: Authors' analysis using SPSS

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eISBN 978-967-2298-96-0

Sustainability of competencies of oil and gas on-shore contractor workers in Sarawak

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Abstract

In facing today's global challenges, oil and gas companies must define long-term priorities and opportunities in running its operation, taking into account environmental, economic, technological and social aspects, in ensuring strategic sustainability as basis for safe long-term operation. One site in Borneo, Sarawak that is heavily involved with onshore oil and gas activity is Bintulu. There is an average of 1800 contractor workers at the site with a size of 276 hectares, an average of 462 Permit-To-Work (PTW) released daily. The site recorded one fatality case in every 5 years cycle since 2009. This trend shows that serious focus needs to be addressed, especially on the contractor worker selection process. Due to this, worker's competency working in this industry needs to be strengthened as per Health, Safety, and Environment Management System (HSEMS) requirement to ensure sustainable and safe operation of the plant as it contributes to HSE performance of the organization. The objectives of this study involve assessing contractor's HSE competency and HSE attitude working in the oil and gas industry in Sarawak, develop a comprehensive assessment tool to measure worker's competency, and propose a specific syllabus for potential workers to work in the oil and gas industry as part of the journey to achieve sustainability of contractor worker HSE competencies for safe long term operation. Hence, a pilot survey has been conducted to assess 88 contractor workers' HSE competencies. A quantitative approach via a Likert scale questionnaire was applied to collect the data. The outcome from pilot survey showed that education level, experience, and competency played key important roles in HSE. Based on the pilot survey findings and literature review related to competency assessment for the workforce in oil and gas, furthering this study will be able to develop an algorithm for the assessment of contractor worker's HSE competency in the oil and gas industry in Sarawak and ultimately achieve sustainability level of HSE competency for long term safe operation.

Keywords: Sustainability, Competency, Contract Workers, Oil and Gas Industry, Assessment Tool, Sarawak.

eISBN 978-967-2298-96-0

1. Introduction

In facing today's global challenges, oil and gas companies must define long-term priorities and opportunities in running its operation, taking into account environmental, economic, technological and social aspects, in ensuring strategic sustainability as basis for long-term development. One of the active sites in Borneo Sarawak that involve in this activity is Bintulu, which is in the Tropics as shown in Figure 1. The oil and gas industry is one of the most dangerous and high-risk activities which contribute to critical economic activity for Malaysia. There is a frequent major incident happened around the world involving this industry, example loss of primary containment, explosion, and also personnel injury. Numerous fatal and major injuries occur from various activities carried out in maintaining and operating the facilities. Examples Working at height, confined space entry, working with high voltage equipment, working in H2S area, handling hazardous chemicals, exposure to radioactive material, etc. Due to the complexities of the technology, hazard, and risk exposure in oil and gas industries, specific competencies and skills are required by personnel before they are allowed to work in this industry. Study conducted before concluded that incident are often complex involving multiple causes which include the level of personnel competency (Bhusari et al., 2020).

Figure 1. Map of Borneo

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The industry are labor intensive, employing a wide variety of individuals, each having a unique experience, skills sets, and motivational pattern. Thus, the challenge for the human resource management is to manage the human capital in effective manner so that individual performance can be well-managed (George, 2008). There are several issues affecting the competency of contractor workers. One of them is a subcontracting mode that has been introduced by international major oil and gas players in their overseas operations. In the early 1980s, Alain Wisner coined – along with his team of the Conservatoire National des Arts et Métiers in France – the concept of Anthrop technological islands to refer to the way to manage safety in the branches of multinational companies located in developing countries (Wisner, 1984). After 30 years of this publication, downsizing processes took place in organizations through outsourcing. The priority in these processes was the reduction of costs. As a result, instead of the transference of risk management technologies, what took place was the transference of riskier activities to contractors.

area that needs to be paid attention to in order to ensure safe operation of the onshore oil and gas companies is HSE competencies among its contractor workers. Generally, Competencies have long been used as a framework to help focus employees' behavior on things that matter most to an organization and help drive success. They can provide a common way to harmonize, select and develop talent. The benefits are clear for worker as well as the organization. Many reports indicated that oil and gas project failures were caused by local content issues, including a high percentage of imported raw materials, lack of qualified professionals and labor with the technical skill competency for the assignment, inadequate infrastructure, and power, etc. .As new workers, adolescents are likely to be inexperienced and unfamiliar with many of the tasks required of them. The nature and organization of work are evolving, and young workers can expect to change jobs and employers many times during their working lives. These shifts will result in an increased likelihood of encountering new or different hazards or risk scenarios, suggesting the importance of an ongoing application of foundational occupational safety and health knowledge (Schulte et al., 2005).

A systematic human resource system is paramount for the sustainability of worker's HSE competency. The resource-based view suggests that human resource systems can contribute to sustained competitive advantage through facilitating the development of competencies that are firm specific, produce complex social relationships, are embedded in a firm's history and culture, and generate tacit organizational knowledge (Barney, 1992; Reed & DeFillippi, 1990; Wright & McMahan, 1992). The sustained superior performance of the most admired companies, such as Marriott, Borg-Warner, and Merck, has been attributed to unique capabilities for managing human resources to gain competitive advantage (Ulrich & Lake, 1990). Conversely, to the extent that HR systems inhibit the mobilization of new competencies and/ or destroy existing competencies, they may contribute to organizational vulnerability and competitive disadvantage. Most of Oil and gas facility in Borneo/Tropics falls under Major Hazard Installation (MHI) as per DOSH regulation, which requires the industries to have effective HSEMS as one of the element that helps organization to ensure safe operation of the facility as shown in Figure 2. Training and competency are one critical element/pillars that need to be in place to ensure people are being equipped with the right knowledge, skills, and experience to work in the oil and gas industries. Safety training emerged as a significant predictor of safety knowledge, work-related injuries, and workplace accidents. Hence, this research aims to develop an assessment tool for contractor worker's HSE competency in the oil and gas industry in Borneo/Tropics (Suxia Liu et al. 2020).

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Figure 2. On-Shore Plant Facility

1.1 Competency Factors

Various factors can be taken into competency account. The terms "21st-century skills," "work-readiness skills," "job-readiness skills," and "employability skills," have become watchwords in education, business, and government. Numerous frameworks articulate the skills, knowledge, and abilities for a skilled worker in the modern economy (Partnership for 21st Century Skills, 2009; The Conference Board, Partnership for 21st Century Skills, Corporate Voices for Working Families, & Society for Human Resource Management, 2006; U.S. Department of Labor, 2008). However, as previously noted, workplace safety and health are currently missing from many, if not most, of the current frameworks to prepare the future workforce. Oil and gas industry is facing several workforce-related challenges and overcoming these ensures sound human resource practices, provides influential talent culture, and a more robust industry (Kanason, 2018). The growth of the case sector results in increasing demand for the trained workforce as the scenario of human resources has reached a highly competitive level (Gallardo-Gallardo et al., 2013). A series of publications have shown that worker are the predominant reason for the problems (Vredenburgh, 2002; Mullen, 2004). Not only people are acknowledged as the contributing factor, but organizational factors shape the context that contributes to at-risk work behavior and human error (Gordon, 1998; Papazoglou & Aneziris, 1999).

According to the results of the correlation analysis of workers' age, the number of years of service, cognitive ability, and workability by, there was a strong correlation between workers' age and the number of years of service (Chung et al., 2015). However, there was no significant correlation between worker's age and cognitive function or workability. In addition, workability had a positive correlation with cognitive function, but there was no significant correlation between workability and age or number of years of service. Although it cannot be said that older workers with more experience always have higher workability, workability tends to increase as cognitive ability improves. According to a study conducted by Salthouse (1997), the positive effects of job experience can be directed towards basic cognitive processes or job performance. Nevertheless, it is worth noting from these previous

studies that older workers were at least as productive as younger workers; the results for the different age groups were found to be the same in jobs demanding skill and speed.

Notably, young people frequently enter the labor force lacking even the most basic workplace safety and health knowledge and skills needed to be cognizant of the safety and health challenges and hazards they may face. The inverse relationship between age and non-fatal work injuries is a consistent association found in occupational safety and health research (Breslin & Smith, 2013; Laflamme & Menckel, 1995; Salminen, 2004). Adolescent sensation seeking—the desire to pursue novel and intense experiences and sensations—and adolescent risk taking, especially when in the company of other young people, are commonly observed phenomena among developing youth (Spear, 2000; Steinberg, 2011). Moreover, when adolescents experience an absence of negative consequences when they engage in risky behavior, feelings of invulnerability may increase (Reyna & Farley, 2006). Lack of job-related knowledge, skills, and training; and lack of job control also contribute to heightened risk among younger workers, who might be less likely to recognize hazards, less likely to speak up regarding safety issues (Breslin et al. 2007; Tucker & Turner, 2013; Zakocs et al., 1998), and less aware of their legal rights as workers (NIOSH, 2003). Based on the incident in the industrial, there is a causal chain of organizational conditions and human errors indicating that human-factor causes can be attributed to 70–80% of accidents in high-hazard industries (Ruzana Ishak et al., 2017).

One critical factor in preventing accidents is the ability of workers to maintain an adequate understanding of their worksite situation. This means having a high level of awareness of task and environmental conditions and judging how these may change in the future to predict how the situation will develop. Possession and maintenance of good quality appear to be of particular importance in the offshore oil and gas industry, where the work is hazardous, time-pressured, and complex. A safety awareness campaign is one of the best methods and initiatives on how to educate the worker's knowledge toward safe working culture offshore. Low understanding of hazards towards workers is a key factor that leads to the incident offshore even though safety awareness campaigns have been conducted before mobilization. It is not only an awareness campaign but at the same time, the main objective is to transfer the knowledge as knowledge sharing to the workers to practice during performing their task. Apart from the campaign, training materials and deep knowledge are also important to ensure that all workers understand the dangers of their job. Ensure that every worker understands the hazards of their work will reduce the risk of harm that leads to injury and death. As we all know, workers that working in the oil and gas industry is highly equipped with high education and experience employees but lack knowledge of the issues pretending to hazard associated with the work. They only know how to carry out their work without knowing the potential hazards associated with their work that can cause injury.

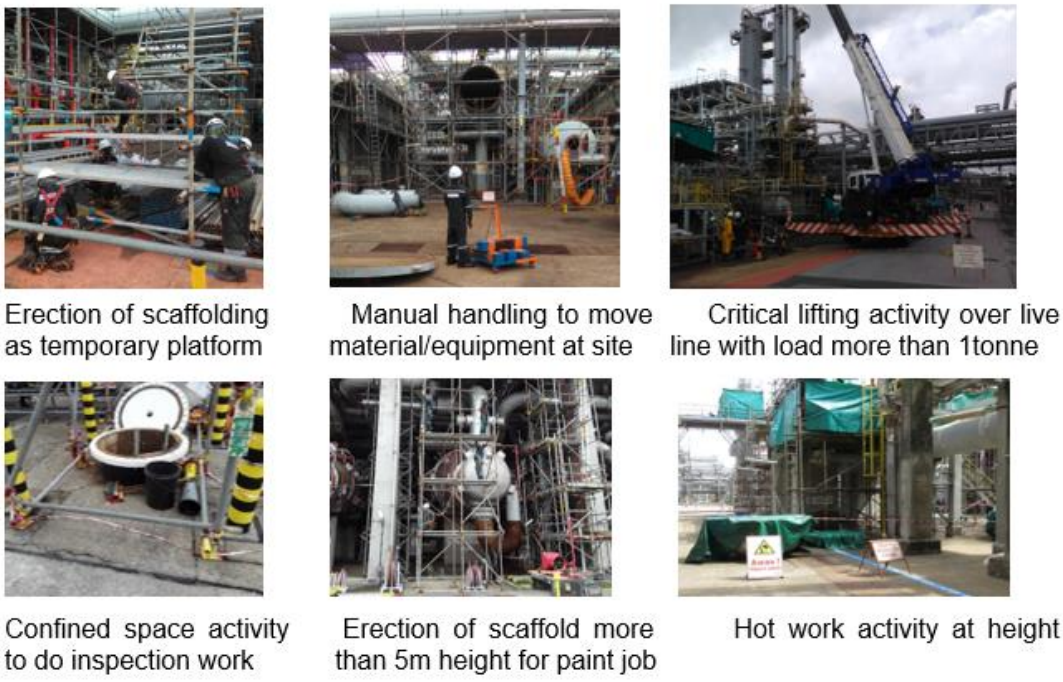
Despite the technical causes of failure, the International Atomic Energy Agency (IAEA) report (Safety Culture, 1991) on the Chernobyl disaster introduced the concept of the "safety culture" in the high consequences industry, which is a hidden factor affecting safety (Choudhry et al. 2007; Goodfellow & Jonsson, 2015; Pidgeon, 1991). Culture, by definition, is a norm shared among the people, which is evolved by internal and external influences, national and regional conditions, the educational and socioeconomic background of the people (Guldenmund et al., 2006). An organization's safety culture is a norm of its commitment to both personnel and process safety. Numerous definitions of safety culture are available in the literature. Choudhry et al. (2007) comprehensively addressed those definitions in a review article. The crux of all definitions is presented by the Advisory Committee on the Safety of Nuclear Installations as *"The Safety Culture of an organization is*

eISBN 978-967-2298-96-0

the product of individual and group values, attitudes, perceptions, competencies, and patterns of behavior that determine the commitment to, and the style and proficiency of, an organization's health and safety management" (Health and Safety Commission, 1993).

The safety culture itself is not a tangible concept and is difficult to measure (Lees, 2012). Safety culture assessment requires the selection of an appropriate model, data gathering, and techniques to obtain measurable and repeatable assessment results (Maddin & Shanks, 2016). Substantial numbers of models have been presented since the introduction of the concept of safety culture (Ahmadi et al., 2015; Maddin & Shanks, 2016). Moreover, the negative relationship between HSEMS and workplace accidents and injuries show that the existing HSEMS are either ineffective or lack the acceptable safety standards to control hazard exposures in the industry. PETRONAS has developed a technical standard to assist the contractor in identifying competency requirements to engage workers in their activity as shown in Figure 3.

Figure 3. Worker activity in the oil and gas industry



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1.2 Assessment Tools

Assessment tools are a technique used to measure potential worker's qualifications, competency, experiences, and safety aptitude related to onshore oil and gas activities. These assessment tools are required in ensuring the organization or company can determine and confirm that they are engaging the workforce with competent and right safety behavior to work in a hazardous environment. Past researchers have proposed several methods related to working competency as shown in Table 1.

Table 1: Assessment methods and tools

No.	Research	Parameters covered	Method
1	Seo et al. (2015). Analyzing safety behaviors of temporary construction workers using structural equation modeling (SEM).	1. Safety Behavior 2. Compentecy	Structural equation modeling (SEM) is used to estimate simultaneously the cause-and-effect relationship between many independents' variables and dependents variables. The author modified the Neuroticism-Extraversion- Openness Personality Inventory-Revised (NE)-PI-R; Costa and McCrae 1992), edited and standardized by Ahn and Chae (1997) for use with construction workers. A questionnaire was administered and analyzed using SEM.
2	Khan et al. (2015). Analysis of competencies, job satisfaction (JS) and organizational commitment (OC) as indicators of job performance: A conceptual framework.	1. Skill 2. Competency 3. Organization	Proposed conceptual framework (CFW) developed linking current and needed competencies with JS and OC. A survey method was employed to validate the proposed model and to test the propositions. Correlation and regression analyses were utilized to investigate the relationship and effect of current skills on JS and OC. Paired sample t-tests were applied to test the different hypotheses or to discover the significance of differences among study constructs.
3	Russo (2016). Competency Measurement Model.	1. Competency 2. Organization 3. Syllabus	A model for the competency mapping and measurement developed through literature review, analyzing the relationship between: i. staff and processes (Who does what) ii. processes and skill (What staff should know) iii. staff and competencies (What staff currently know) The model can provide identification of the competency's employees need to improve performance in their current job or to prepare for other jobs via promotion or transfer besides useful in a skill gap analysis, the comparison between available and needed competencies of individuals or organizations.

4	Ismail et al. (2020). Technical Competency among Vocational Teachers in Malaysian Public Skills Training Institutions: Measurement Model Validation Using PLS-SEM	1. Competency 2. Knowledge and skill	This study is quantitative research collected data through simple random sampling of vocational teachers from several technical programs. Measurement assessments were used to conduct a Partial Least Squares (PLS) analysis with SmartPLS 3.0 software to assess and validate the eight constructs of technical competency using a reflective model.
5	Husaina Banu Kenayathulla et al. (2019). Gaps between competence and importance of employability skills: evidence from Malaysia.	1. Competency 2. Skill 3. Interpersonal skill 4. Syllabus	Stratified sampling was used to select students in these hospitality programs from 22 vocational colleges in Malaysia. Questionnaires were distributed to 841 students in five regions in Malaysia. In general, the respondents spent 30 min to 35 min to respond to the questionnaire completely. Descriptive analysis and paired sample t-test were conducted to analyze the data.
6	Metin Bayram (2019). Safety Training and Competence, Employee Participation and Involvement, Employee Satisfaction, and Safety Performance: An Empirical Study on Occupational Health and Safety Management System Implementing Manufacturing Firms.	1. Training 2. Competency 3. HSEMS	A survey approach was used. To realize the aim of the study, 529 OHSMS certified firms operating in different industries, different sizes, and different workplace hazard classes in Turkey were found via certification firms, the authors' social network, and firm websites.
7	Mary Lehman et al. (2018). Training the Future Workforce: Social Workers in Integrated Health Care Settings.	1. Work Skill 2. Competency 3. Syllabus	This study used a phenomenological qualitative design consisting of individual interviews with social work practitioners employed on integrated health care teams. Data were collected using a survey and interview method. A total of 14 participants were invited to participate in the study.
8	Novianti et al. (2019). Pedagogical Competence Development of University Teachers with Non-Education Background: The Case of a Large University of Education in Indonesia.	1. Competency 2. Educational Background 3. Experience 4. Training	A preliminary survey of lecturer pedagogical development, and 20 of them joined our interviews and focus group discussions conducted. At the end of the study, a model of pedagogical competence development based on the results of the survey, interview, and focus-group discussion was developed. Our design was also informed by a literature review on pedagogical competence development, such as on the techniques or methods to develop a lecturer's pedagogical competence based on well-established theories and previous relevant studies.
9	Suhairom et al. (2018). Quality culinary	1. Competency 2. Interpersonal	Qualitative research design using document analysis techniques and interviews were employed

	workforce competencies for sustainable career development among culinary professionals.		skill	to obtain views within the context of Malaysian culinary settings. The integration of these two data sources allows the comparison and triangulation of rich and relevant data. The qualitative data were used to form the framework of the Star-Chef Competency Model, which consists of six identified competency constructs. The compilation of the identified competency statements was fully utilized in the development of the competency model and is believed to be very helpful guidance for culinary professionals in the Malaysian hospitality industry.
10	Ferjencik et al. (2014). Trust Managers and Respect Workmen: What does it mean to be competent in caring about safety.	1. 2. 3. 4. 5.	Competency Qualification Behavioral Safety Organization Interpersonal skill	Generic standards developed through literature review to show how competence standards for caring about safety may be created and applied to align with European Qualification Framework. The analysis procedure is divided into six steps, each of them is investigated in an individual section of this paper.
11	Dingsdag et al. (2008). Understanding and Defining OH&S Competency for Construction Site Positions: Worker Perceptions.	1. 2. 3. 4. 5.	Attitude Perception HSEMS Organization Training	A survey was administered to site-based workers via contacts with primary contractors.
12	Nykanen et al. (2018). Enhancing Safety Competencies of Young Adults: A Randomized Field Trial (RCT).	1. 2. 3. 4. 5.	Training Experience Skill Attitude Syllabus	Level of awareness and propose a guideline on areas of improvement were identified. Prior to embarking offshore, staff was exposed to a safety awareness program for four weeks. After the program, we started with the pretest to all staff. They were posted offshore for 6 weeks. Within the period, the performance awareness of each staff is monitored through observation and interview. During the final week, the posttest questionnaire was administered to all staff. Two instruments were used for the quantitative data collection, which are the Unsafe Act Unsafe Condition (UAUC) card; and Behavior Observation Tool (BOT) card. Questionnaire data were analyzed quantitatively. A Paired-sample t-test was used for analyzing pre and post result .

The most common parameter appears in articles related to the evaluation are:

1. **Competency:** (Seo et al., 2015; Khan et al., 2015; Russo 2016, Ismail et al., 2020; Husaina Banu Kenayathulla et al., 2019; Metin Bayram 2019; Mary Lehman et al., 2018; Novianti et al., 2019; Suhairom et al., 2018; Ferjencik et al., 2014).
2. **Skill**: (Khan et al., 2015; Ismail et al., 2020; Husaina Banu Kenayathulla et al., 2019; Mary Lehman et al., 2018; Nykanen et al., 2018).
3. **Training:** (Metin Bayram, 2019; Novianti et al., 2019; Dingsdag et al., 2008; Nykanen et al., 2018).
4. **Syllabus**: (Russo, 2016; Husaina Banu Kenayathulla et al., 2019; Mary Lehman et al., 2018; Nykanen et al., 2018).

Currently, there is no comprehensive tools to assess and verify potential contractor worker's competency related to HSE. In fact, the focus on the assessment and verification process must be more than one recording individual training course have been completed and the number of required jobs has been carried out. The industry has line up requirements on roles and responsibilities of contractors in providing trained and competent workers in executing their contract (PETRONAS). However, currently, the verification process is only limited to confirming paperwork requirements. It should go through systematic assessment and verification of the competency itself. Having a greater assurance in the quality, relevance, and current of the assessment and verification of the competence of the personnel undertaking safety-critical tasks will improve HSE performance and reduce potential incidence from happening.

Due to that, survey instrument was designed as per competency based assessment approach in trying to understand worker's safety competencies related to their task. Competency-based assessments are not a new innovation or trend but an overall good practice to adopt. Employee competency assessments have been around long enough to have withstood the test of time and have proven to be a very useful tool for the HR professional's toolbox. Employee competencies are a list of skills and behaviors that are specific and well defined and are used to layout an organization's performance expectations for a job or the organization's culture as a whole.

2. Method

Following the method selected above, a survey instrument has been developed in collaboration with subject matter experts from various disciplines. Eighty-eight samples were collected to confirm the reliability of the questionnaire. From the reliability statistics test conducted (refer Figure 4), the alpha coefficient for the 2 sets of questions was found to be respectively 0.881 and 0.892. This concludes that the items have relatively high internal consistency. A reliability coefficient of 0.7 or higher is considered "acceptable" in most social science research situations (Taber, 2018).

Figure 4. Value of Alpha coefficient

Case Processing Summary (Safety Behavior)			
		N	%
Cases	Valid	87	98.9
	Excluded[a]	1	1.1
	Total	88	100.0

Case Processing Summary (Safe System of Work)			
		N	%
Cases	Valid	88	100.0
	Excluded[a]	0	.0
	Total	88	100.0

Reliability Statistics (Safety Behavior)		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.881	.902	39

Reliability Statistics (Safe System of Work)		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.892	.933	34

Findings from the pilot test concluded that 11 areas have signed the findings. Three common findings that can be observed from all 11 results are discussed in the next segment. These three findings will be analyzed further upon full-scale data collection in the later stage.

3. Findings and discussion

3.1 Respondent's educational level is between SPM/SPMV and Diploma Level

Findings are aligned with studies conducted by Salminen (2004) as well as Breslin and Smith (2013) from previous studies which showed that younger age groups are at an elevated risk of accidents at work. Inexperience, short job tenure, and type of industrial establishment can all lead to a greater risk of occupational accidents among young people (Bena et al., 2013; Breslin et al., 2007). Previous studies indicate that in upper secondary-level educations, student's knowledge and awareness of occupational safety is often limited (Salminen & Palukka 2007; Andersson et al., 2015).

3.2 Their working experience is between 0~5years and 6~10 years

These findings are aligned with studies conducted by Mullen (2004), where people may adopt unsafe work practices if the perceived positive aspects of risk-taking outweigh the potential negative aspect (risk of being injured). Previous studies have shown that young worker's risk-taking orientation at work is also influenced by peer workers (Westaby & Lowe, 2005). While Breslin et al. (2007) found that young workers may see injuries as 'part of the job'. The locus of control concept refers to the degree to which an individual perceives that the outcome of the situations they experience is under their control. Studies also have found that management commitment and involvement are key elements in achieving success in safety performance at the workplace (Langford et al., 2000; Sawacha et al., 1999; Tam et al., 2004). Young people may lack skill and training in how to appropriately respond to working practices that are unsafe (Kincl et al., 2016; Mullen, 2004), for example, found that young workers may choose not to use safety equipment or may tend to work unsafely to avoid being teased by their co-workers. Tucker and Turner (2013) in turn describe how young workers' reluctance to take action to solve safety problems can be related to an underlying fear of being fired, newcomer status, and feelings of powerlessness.

3.3 The distribution between permanent and contract worker are equal

Many reports indicated that oil and gas project failures were caused by local content issues, including a high percentage of imported raw materials, lack of qualified professionals and

labor with the technical skill competency for the assignment, inadequate infrastructure, and power. These shifts will result in an increased likelihood of encountering new or different hazards or risk scenarios, suggesting the importance of an ongoing application of foundational occupational safety and health knowledge (Schulte et al., 2005).

3.4 Confidence Interval

Data will be collected through the distribution of the survey to a group of workers. Data collection through a survey is seldom done with entire populations but rather with samples drawn from a population. Even though we work with samples, our goal is to describe and draw inferences regarding the underlying population. It is possible to use a sample statistic and estimates of error in the sample to get a fair idea of the population parameter, not as a single value, but as a range of values. This range is the confidence interval (CI) which is estimated based on the desired confidence level.

Formulas for calculating CIs take the general form:

CI = Point estimate ± Margin of error Point estimate ± Critical value (z) × Standard error of point estimate

$$p \pm z\ value \times \sqrt{\left[p\frac{(1-p)}{n} \right]}$$

The CI of a statistic may be regarded as a range of values, calculated from sample observations, that is likely to contain the true population value with some degree of uncertainty. Although the CI provides an estimate of the unknown population parameter, the interval computed from a particular sample does not necessarily include the true value of the parameter. Therefore, CIs are constructed at a confidence level, say 95%, selected by the user. This implies that were the estimation process to be repeated over and over with random samples from the same population, then 95% of the calculated intervals would be expected to contain the true value. Calculation of the CI of a sample statistic takes the general form: CI = Point estimate ± Margin of error, where the margin of error is given by the product of a critical value (z) derived from the standard normal curve and the standard error of point estimate.

The factors influencing the width of the CI include the desired confidence level, the sample size, and the variability in the sample. Although the 95% CI is most often used, a CI can be calculated for any level of confidence. A 99% CI will be wider than a 95% CI for the same sample. Table 1 indicates how the required sample size for population surveys varies with an acceptable margin of error and confidence level.

Table 1. Sample sizes required for surveys

Estimated population size	**Margin of error**					
	Confidence level 95%			**Confidence level 99%**		
	5%	**2.5%**	**1%**	**5%**	**2.5%**	**1%**
100	80	94	99	87	96	99
500	217	377	475	285	421	485
1,000	278	606	906	399	727	943
10,000	370	1332	4899	622	2098	6239
100,000	383	1513	8762	659	2585	14227

500,000	384	1532	9423	663	2640	16055
1,000,000	384	1534	9512	663	2647	16317

The sample size is larger for a lower margin of error or higher level of confidence. Once the estimated population size is very large (>100,000), the sample size does not change significantly.

4. Conclusion

Following the successful outcome from a pilot project which tested 88 contractor workers, a minor adjustment was made to the questionnaire, next step of this exercise is to go for full-scale data collection to achieve a minimum of 95% data reliability to get the full picture and right data representation. The outcome from this data collection will help this research to achieve its objective in developing an assessment tool for contractor workers in the onshore oil and gas industry in Borneo/Tropics as part of its journey to achieve sustainability of contractor workers HSE competencies in ensuring safe operation in a long run. Having this assessment tool will help the organization to have a competent workforce in terms of HSE, reduce the number of incidences, and improve their HSE performance, all of which will translate into good productivity.

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SOCIAL SCIENCES & HUMANITIES CONFERENCE 2022 (SSHR 22) 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

What do effective team leaders say during resuscitation?

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Abstract
Resuscitation is a time-critical procedure, especially when it involves out-of-hospital cardiac arrest (OHCA) patients. Delays in tasks and treatments contribute strongly to mortality. It is therefore vital for resuscitation teams to be well-coordinated. Good team leadership has been identified as a key determinant of success, but communication in this critical context remains understudied, due both to the challenges of accessing relevant data and of establishing what forms of knowledge would be relevant to enhancing practical outcomes. In this study, we analyse the interactions between resuscitation team leaders and their teams to identify systematic associations of their communication patterns with the leaders' performance. We observed and transcribed the first five minutes of 26 real-life OHCA resuscitation attempts. Line-by-line dialogue annotations, based on a bespoke dialogue annotation scheme, were applied to the transcripts. Our results revealed different dialogue patterns in resuscitation teams that were led by higher performing leaders and in teams led by lower performing leaders. We posit that whilst medical leadership assessments do not typically focus on linguistic choices, high performing leaders possess the ability to optimise linguistic strategies that benefit their teams, a skill that can be integrated in medical team communication training.

Keywords: Pre-hospital resuscitation; dialogue analysis; medical team communication; team leader performance

1. Introduction

Leadership skills are a key requirement for team effectiveness. In the resuscitation setting, the crucial role that resuscitation team leaders play in ensuring their teams' success is well-documented. Prior research has established positive associations between effective leadership and desired outcomes, for instance more structured team dynamics, longer duration of uninterrupted chest compressions, better adherence to the resuscitation algorithm, and higher quality defibrillations (Cooper & Wakelam, 1999; Fernandez Castelao et al., 2013; Hunziker et al., 2010). Various elements of leadership, including experience, task participation, and training have been associated with team performance or quality of resuscitation (Cooper & Wakelam, 1999; Hunziker et al., 2010; Mann & Heyworth, 1996; Yeung et al., 2012).

In contrast, the dialogue processes that underlie leadership skills are less well explored. Most research on resuscitation leadership tends to focus on the individual leaders' psychomotor behaviour, e.g., planning the procedure, demonstrating adherence to the guidelines, and displaying a positive attitude (Cooper & Wakelam, 1999). Communication is encapsulated in many of the behaviours, but the verbalisations are seldom analysed.

Previous dialogue studies in non-medical domains have shown that team performance is related to different linguistic strategies, conveyed through various speech acts (i.e., utterances that convey a speaker's intention and affect the hearer's action). Studies that expressly compared teams with different performance levels have been conducted for commercial aviation crews (Krifka, Martens, & Schwarz, 2003) and fighter jet crews (Svensson & Andersson, 2006). Well-performing crews have been observed to verbalise intents, plans, and encouragement more frequently than lesser performing crews.

Studies in the resuscitation setting, whilst not explicitly comparing team performance, have also noted different proportions of dialogue acts that may be related to different levels of leadership execution. Pre-formed resuscitation teams (considered to be more stable in terms of leadership than ad hoc teams) have been observed to use more frequent leadership utterances that included directives or commands (Hunziker et al., 2009). Resuscitation teams that have undergone Crew Resource Management leadership training have been found to use more frequent high accuracy verbalisations (e.g., direct orders and plans) compared to teams that did not go through the same training (Fernandez Castelao et al., 2011).

It is not known whether the same patterns exist in real-life resuscitation dialogues as research is scarce in this area, particularly in the pre-hospital resuscitation setting. In fact, from a systematic review of 63 articles on resuscitation published over a period of 30 years, only 22 investigated real-life resuscitation, and none in the pre-hospital setting (Fernandez Castelao et al., 2013). The review revealed that communication (inquiries, directives for immediate actions, information-sharing statements, and repetition of verbal acts) is one of the three major elements that are strongly associated with resuscitation quality (the other two elements being planning and leadership). From the eight studies that found direct links between resuscitation performance and specific communication elements, one was conducted in the emergency room (i.e., in-hospital setting), whilst the remaining seven were simulations.

Consequently, there are unanswered questions regarding the kinds of topics, or contents, that are being talked about during different junctures of pre-hospital resuscitations, and how these contents are verbalised. It is also not known whether these verbalisation choices are associated with outcomes. Line-by-line dialogue annotation can be a useful method to target these kinds of questions.

1.1 Dialogue analysis in the medical setting

In the medical setting, the proportions of speech acts have been found to be correlated with several constructs. For instance, a high proportion of reflexive questions is associated with expertise level in oncology (Ford & Hall, 2004), whilst the use of open questions correlates with negative perceptions of doctors' competence (Gillotti, Thomson, & McNeilis, 2002). More frequent directives have also been observed in doctors' conversations with Hispanic patients compared to White patients (Laws et al., 2014). An investigation on the relationship between the linguistic choices of trainee doctors and their assessed leadership performance (Chalupnik & Atkins, 2020) revealed that for trainee doctors, indirect requests were associated with higher perceived performance compared to direct requests.

In telephone conversations between ambulance dispatchers and callers, ambulance dispatchers' choice of verbal strategies was found to have a significant impact on callers' willingness to perform cardiopulmonary resuscitation (CPR) (Riou et al., 2018). When the dispatchers structured their utterances based on future action (e.g., "I'll tell you how to do resuscitation") or obligation (e.g., "We need to do CPR, alright?"), more callers agreed to perform CPR compared to when the dispatchers structured their utterances based on the callers' willingness (e.g., "Are you willing to try CPR?").

These findings provide examples of how pragmalinguistic choices – the linguistic forms and strategies used to convey meanings – correlate with constructs such as leadership and therefore may affect outcomes. In this paper, we examine the use of linguistic strategies with the aim of better understanding what constitutes effective leadership communication in the resuscitation domain. Our study investigates whether out-of-hospital cardiac arrest (OHCA) resuscitation dialogue patterns are associated with team leaders' technical and non-technical skills performance scores. By performing fine-grained, line-by-line analysis on the kinds of communicative functions and verbalised content during the resuscitation procedure, we identify verbal features that are associated with high-performing resuscitation leaders.

2. Method

Our data consist of dialogues amongst an elite, second-tier paramedic unit responding to OHCA in Edinburgh, UK. The paramedics are specially trained to manage OHCA resuscitation alongside the primary ambulance crew and are recognised as the resuscitation team leaders when on scene. The (video) data were collected from the paramedics' body-worn cameras during OHCA calls as part of an established quality assurance programme.

Prior to this study, the team leader in each recording was assessed for both technical and non-technical skills performance by two emergency medicine experts, using a tool based on the Anaesthetists' Non-technical Skills (ANTS) assessment (Flin, Glavin, Maran, & Patey, 2003), and a technical performance grid derived from the European Resuscitation Council Adult Advanced Life Support (ALS) treatment algorithm (Resuscitation Council UK, 2015).

Given our goal of determining whether dialogue features are associated with high or low skills performance, we compare the videos representing perfect scores (N=13; Ideal Score Group, ISG) with the same number of videos with the lowest scores (N=13; Low Score Group, LSG), from an initial pool of 40 videos.

We focused on the first five minutes of dialogue after the team leaders arrived on scene as the quality of planning and task distribution in resuscitation teams depend on these early minutes (Wik et al., 2005).

2.1 Data annotation and analysis

Most medical dialogue research focuses on dyadic interactions between medical and non-medical participants (e.g., doctor-patient), typically in a less time-constrained setting. Existing annotation schemes reflect this and are suboptimal for the analysis of multi-party medical interactions under tight time constraints.

To address this, we introduced a bespoke scheme, Dialogue Annotation for Resuscitation (DARe). DARe has two main coding components: communicative function coding, used to annotate specific speech acts in dialogue; and subject matter coding, used to annotate content. The communicative function categories are based on Searle's Speech Act Theory (Searle, 1976) to allow identification of language functions and forms for pragmatic analysis. The content categories reflect tasks from the adult ALS guidelines, augmented by iterative listening, analysis, and discussion with emergency medicine experts.

To ensure accuracy, transcriptions were reviewed by a medical expert familiar with pre-hospital resuscitation. Disagreements were reviewed and errors corrected. To check reliability, 10% of the data was re-coded by an expert in English linguistics (communicative function categories: 75% agreement, Cohen's kappa=0.68, moderately substantial agreement) and a senior trainer from the Scottish Ambulance Service (contents: 80% agreement, Cohen's kappa=0.80, highly substantial agreement).

To compare the patterns of communication functions and contents in the ISG and LSG, we compute chi-square ($\chi 2$) statistics. Due to multiple datapoints from each video, we simply use the $\chi 2$ measure to identify functions/contents that are especially (in)frequent in either group.

2.2 Ethical considerations

A video audit programme using body cameras (VB-200 VideoBadge® from Edesix, a Motorola Solutions company) has been routinely used for OHCA resuscitation audits in Edinburgh since 2012. Recordings of resuscitation procedures are securely stored, reviewed, and subsequently deleted according to a pre-set deletion policy. A pre-defined audit team

reviews the videos for quality improvement purposes only. For the current project, videos were redacted for de-identification, leaving the audio intact for transcription.
Frontline Scottish Ambulance Service staff and staff partnership organisations are familiar with the audit programme. No further individual consent to recording during resuscitation is required. The South East Scotland Research Ethics Service provided written confirmation that no additional ethical approval was required. The study was also approved by the Scottish Ambulance Service Research Governance and Innovation Group and the University of Edinburgh's School of Philosophy, Psychology, and Language Sciences ethics review panel.

3. Result

3.1 Communication function analysis

The communicative functions with the highest chi-square value deviations were Affective-performatives and Alerter, both of which were more prevalent in ISG dialogue than LSG. Table 1 compares the two communicative functions.

Table 1. Comparison of the two communicative functions with the most variations in ISG and LSG dialogues

Category	Descriptive statistics	ISG (1,899 segments)	LSG (1,578 segments)
Affective-performatives **n = 123**	Total segments	96	27
	Mean per team	7	2
	Range	0 – 17	0 – 4
	Median	7	2
	% of use	5.1%	1.7%
	Standard deviation	5.09	1.50
Alerters **n = 35**	Total segments	31	4
	Mean per team	2	0
	Range	0 – 6	0 – 2
	Median	2	0
	% of use	1.6%	0.3%
	Standard deviation	2.02	0.61

The higher frequency of Affective-performatives in ISG (5.1%) suggests that apologies, compliments, and gratitude are more commonly verbalised in this group than in LSG (1.7%). Closer examination revealed that out of the 123 Affective-performatives found in the two groups, 97 (78.9%) were verbalised by the team leaders whilst the remaining 26 (21.1%) were verbalised by the team members. ISG leaders also used Affective-performative more frequently (81 out of 96 instances or 84.4%) compared to LSG leaders (16 out of 27 instances or 59.3%).

Given are two examples of Affective-performatives (an apology and a compliment) and the context in which they occurred. Apology and compliment: **bold**; Paramedic names substituted with pseudonyms; TL: Team Leader.

(1) VID411, Utterance 80-82

TL:	Okay, if we can hold his hands up	*Team members were preparing the patient for AutoPulse. TL apologised to P2, possibly because of jostling or because the patient needed repositioning.*
TL:	**Sorry, Ian**	
TL:	it's just, just need to bring him down a little bit, guys	

(2) VID289, Utterance 28

TL:	**That's good CPR**	*TL complimented the team's high-quality manual chest*

compressions.

Similar to Affective-performatives, the results showed a higher frequency of Alerters in ISG (1.6%) compared to LSG (0.3%). The disparity between the frequency of usage appeared to be due to the verbalisations by the team leaders rather than the team members. All 35 Alerters found in the two group dialogues were verbalised by team leaders.

An Alerter can take several forms. These include the hearer's name, a pronoun (e.g., "You"), a generic term (e.g., "Guys"), a combination such as a greeting plus a pronoun (e.g., "Hey you") and a pronoun with specific identification (e.g., "You there in the pink shirt"). In our data, 29/35 were name alerters. The remaining were generic alerters.

The use of Alerters was not always followed by clear verbal indications that the hearer had been successfully alerted. Only 11 Alerters were followed by immediate verbal responses. Most Alerters (n=20) were immediately followed by directive-related utterances. Examples (3) – (4) illustrate these instances. Verbal responses: **bold**; Alerters: marked*; Paramedic names substituted with pseudonyms.

(3) VID193, Utterance 193-196
TL: Ian*
P1: **Yep**
TL: Once we sit him forward could you pull all his clothes off, pal?
P1: Yep

(4) VID411, Utterance 64-66
TL: Okay, Liz*
P2: **Yes, boss**
TL: What we'll do is…sit the chap forward

3.2 Content analysis

A parallel analysis of the content patterns indicated that the largest differences between ISG and LSG concerned Compression, Patient history, and Rhythm (Table 2).

Table 2. Comparison of the three contents with the most variations in ISG and LSG dialogues

Category	Descriptive statistics	ISG (1,899 segments)	LSG (1,578 segments)
Compression **n = 198**	Total segments	142	56
	Mean per team	11	4
	Range	3 – 26	0 – 15
	Median	9	3
	% of mention	7.5%	3.5%
	Standard deviation	6.53	4.53
Patient history **n = 296**	Total segments	116	180
	Mean per team	9	14
	Range	0 – 24	0 – 55
	Median	8	13
	% of mention	6.1%	11.4%
	Standard deviation	7.00	15.20
Rhythm **n = 162**	Total segments	118	43
	Mean per team	9	3
	Range	2 – 25	0 – 13
	Median	8	2
	% of mention	6.2%	2.7%
	Standard deviation	5.97	4.05

Compression and Rhythm contents were more prevalent in ISG whilst Patient history was more prevalent in LSG. Both Compression (129/198, 65%) and Rhythm (40/162, 65%) were more frequently mentioned by leaders than team members, whilst the reverse was true for Patient history (127/296, 43%).

We examined the content distributions in one-minute intervals (Figures 1-3) to identify possible group differences regarding when contents are introduced and how they develop. Note that the numbers represent raw counts (e.g., ISG verbalised the Compression content 34 times during the first minute, whereas LSG did so 16 times).

Figure 1. Compression verbalisation per one-minute slices

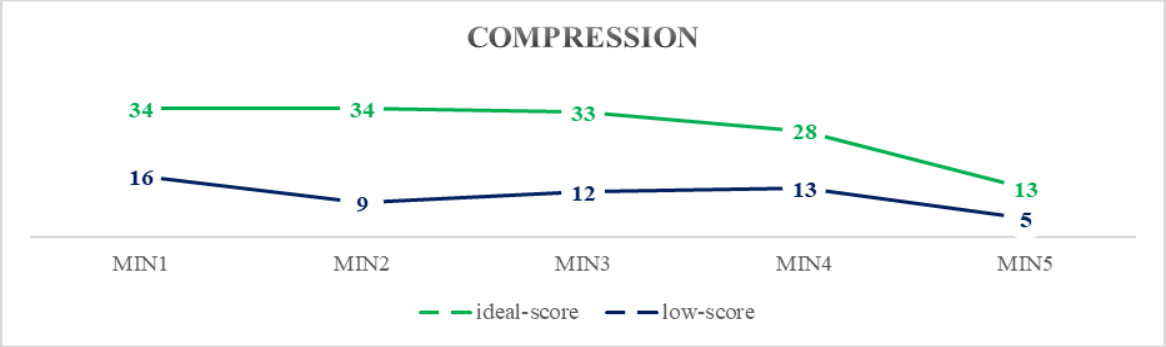


Figure 2. Patient verbalisation per one-minute slices

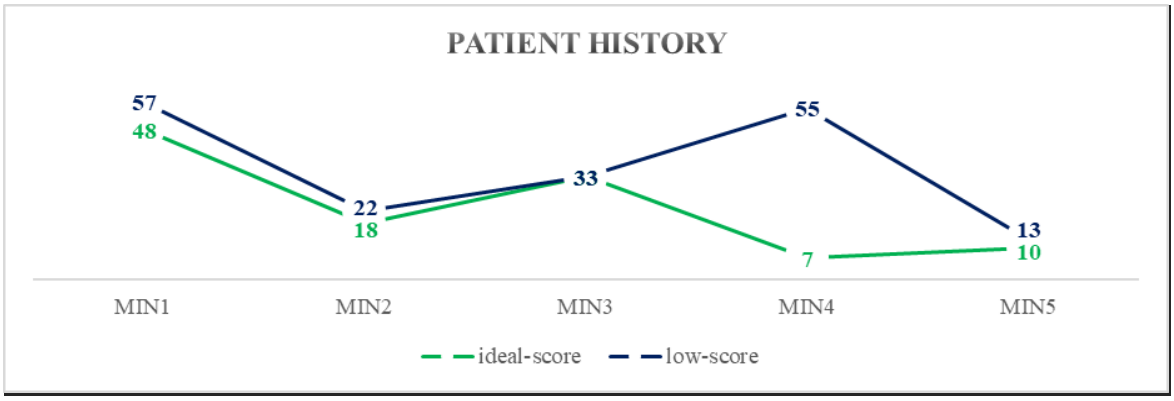
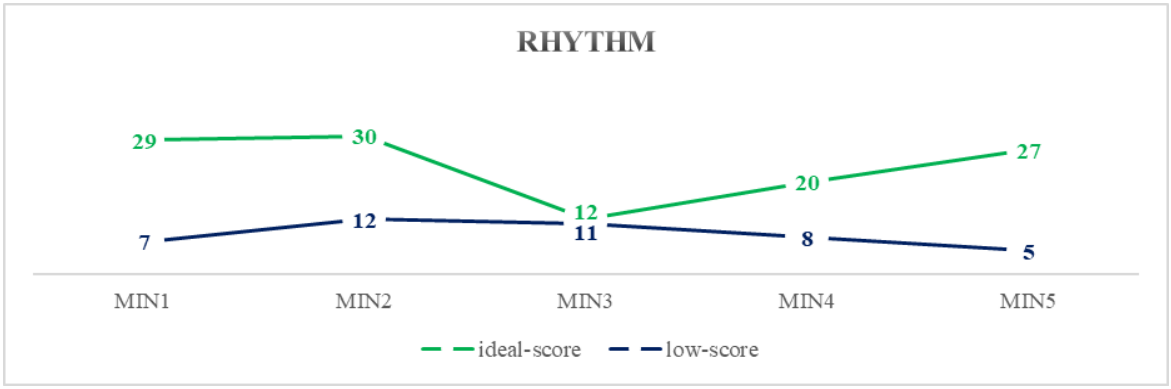


Figure 3. Rhythm verbalisation per one-minute slices



In both groups, Compression content patterns were stable in the first four minutes before declining in the fifth minute. Patient history shows more variation: the pattern in the first three minutes was similar across groups, but in the fourth minute, ISG discussion of this subject showed a sharp decline, whilst that in LSG increased. The groups then re-converged in the fifth minute. For Rhythm, ISG and LSG exhibited appreciably different frequencies at the beginning and at the end of the five minutes.

The following samples illustrate typical dialogues concerning patient rhythm in ISG (more frequent rhythm-related statements) and LSG (less frequent rhythm-related statements). TL: Team Leader; P1: Paramedic 1; P2: Paramedic 2.

Timestamp	**ISG Transcript**	
Transcription starts 11:06		
11.55	TL: Have we had any shocks in guys? P2: No P2: Eh, asystolic since our arrival TL: Okay TL: How long was it ago?	Initial information shared regarding the last type of rhythm, part of background of arrest
12:53	TL: Let's just do a wee rhythm check TL: and we'll get some pads on P1: Pads are on	Suggestion to do a rhythm check
13:03	TL: Let's just see what rhythm we've got there P2 when we get a chance	Suggestion to do a rhythm check
13:11	TL: Stop a wee second TL: Right, we've not got a rhythm	Directive to stop compressions and check rhythm, followed by

		statement about current rhythm
14:19	TL: Right, stop a wee second guys	Directive to stop compressions;
	TL: Let's just see what rhythm we've got	statement on rhythm, followed by
14:21	TL: Just asystole, okay, right	statement about current rhythm
15:58	TL: P2, what I need you to do, is look at that clock, now 11 minutes	Directive for the next rhythm check, verbalisation of plan
	TL: 12 minutes we'll go for a rhythm check okay	
16:03	TL: So, P2 going to shout out a rhythm check okay?	Reminder about team member's task regarding rhythm check
Transcription ends 16:08		

Timestamp	**LSG Transcript**	
Transcription starts 01:06		
01:21	P2: He's in some kind of agonal thing going on the now	Initial information shared regarding current rhythm, part of the background of arrest
	P2: CPR […] since he hit the floor	
	TL: Yep	
03:50	TL: Every two minutes for rhythm check there P2 yea if you can eh	Reminder to do rhythm check
04:59	TL: So, what's the time on the clock?	Reminder to do rhythm check
	P1: Eh, it's 6.40, 50	
05:01	P2: It's 6	
	TL: So, we'll do a rhythm check	
	TL: and then uh go for that tube if you can	
05:18	TL: Do a rhythm check	Directive to check rhythm, followed by statement about current rhythm
05:21	TL: Which is, agonal in nature	
	TL: Definitely agonal	
	TL: Continue	
Transcription ends 06:06		

4. Discussion

Our results indicated that there are distinct differences in OHCA resuscitation dialogue patterns between teams that are led by high-performing leaders and teams that are led by lower-performing leaders. In terms of the communicative functions, ISG dialogues contained higher occurrences of name alerters and affective utterances compared to LSG dialogues. For content verbalisation, ISG dialogues consistently contained frequent discussion of chest compressions, higher mentions of rhythm (except in the third minute of dialogue), and less discussion of patient history in the later stages compared to LSG. We now consider in turn the possible explanations for these patterns.

The high prevalence of Alerters and Affective-performatives in ISG appear to be related to both communicative and socio-affective dimensions, in that high-performing leaders use functions that are communicatively effective, and at the same time, beneficial for their teams' social cohesion.

Alerters could be linked to an awareness of the need to secure hearer's attention before communicating information. Using an alerter as an additional linguistic feature before conveying information singles out the hearer and therefore optimises the chances that the hearer is paying attention when the information is subsequently communicated. Alerting a hearer to a task minimises the possibility of a 'hanging' instruction (an instruction that is not clearly directed and has no designated recipient to take on the responsibility). In military and

aviation, the possibility of this kind of miscommunication is reduced by using closed-loop communication (CLC). Whilst CLC has been widely recommended as an effective communication strategy in the medical field (Fernandez Castelao et al., 2013), its effectiveness in real-life resuscitation has very limited studies (El-Shafy et al., 2018).

From the data, it is possible that high-performing OHCA resuscitation leaders prefer to ensure that attention has been paid prior to any requests or instructions. Nonetheless, we note that the present data simply illustrates that this is a trait associated with high-performing team leaders and not whether this specific placement of Alerters renders directives more effective. Furthermore, not all Alerters were responded to verbally; this does not, however, indicate that the hearers did not pay attention – they could, indeed, have responded with a nod.

The use of Affective-performative as social or emotion-related utterances meanwhile could provide encouragement to the team. Expressing gratitude explicitly and apologising to the team members indicate that the speaker is aware of socio-emotional conduct even in this time-constrained, high-risk setting, particularly because the resuscitation unit paramedics and the ambulance paramedics have similar power status. The use of these affective verbal utterances may indicate that the leaders are comfortable in their role, or at least comfortable enough to be able to indulge in humour.

The performance of tasks in OHCA resuscitations typically follow a routine, where certain task-related threads, for instance Patient history, Compression, and Rhythm are normally introduced in the first five minutes of the procedure, whilst other threads such as Resolution and Reversible causes are introduced later (Marzuki, Cummins, Rohde, Branigan, & Clegg, 2017). The early introduction of compression and heart rhythm threads also reflects the ALS algorithm that is used as the standard guide for adult resuscitation. Our findings, however, revealed that the ISG and LSG verbalised contents differently, especially for Compression, Patient history, and Rhythm. These illustrated potential differences in the focus of tasks that are being performed by the two OHCA resuscitation groups during the five minutes period, although notably, the verbalisation of a content does not automatically mean successful performance of a task. It could, however, indicate the focus of the teams and the verbal effort given to a particular task.

The Compression content shows similar overall trend. This was probably due to the successful deployment of the mechanical chest compression device, thus freeing team members (both from doing and talking about manual chest compressions, e.g., making sure that quality compression was maintained) to focus on other resuscitation tasks. Nonetheless, ISG appeared to consistently verbalise more about chest compressions across the first five minutes of the OHCA resuscitation procedure compared to LSG.

The Patient history content patterns revealed that the two groups clearly differed in terms of the time they took to cease discussing this subject matter. The earlier cessation of this thread in ISG indicates that teams with more proficient leaders either managed to extract sufficient information related to the patient's medical history in the first three minutes of the resuscitation or limited the discussion to the first three minutes. This shift of verbalised content is potentially useful in allowing team members' attention to be diverted to other tasks, for instance getting airway access, administering treatments, and deploying the mechanical chest compression device. Even though the act of gathering information regarding the patient's medical background or pre-arrest physical state is viewed as one of the key phases in a medical procedure (Calder et al., 2017; Gundrosen, Andenæs, Aadahl, & Thomassen, 2016), a prolonged discussion on one aspect in a time-constrained setting could distract from other equally crucial tasks.

Finally, the variation in the Rhythm content patterns suggests the different focus given to patient rhythm management in the two groups. It seems likely that a higher prevalence of verbalisations signals a continuous monitoring of the patients' heart rhythm. Although observations can be performed without any verbal comments, effective teamwork has been shown to gain benefit from shared mental knowledge or schema amongst team members (Parush et al., 2011). Proficient team leaders may be highly aware of this and therefore, make use of more frequent verbal mentions of a thread that is deemed important to the procedure to maintain their teams' awareness.

5. Conclusion

Our findings demonstrate that resuscitation dialogue patterns, with respect to prevalence of specific communicative functions and content focus, are systematically associated with OHCA team leaders' performance scores. Our communicative function analysis revealed that high-scoring leaders used more Alerters and socio-emotional utterances when communicating with their teams compared to lower-scoring leaders. We posit that the use of Alerters indicates leaders' awareness of the need for effective instructions and the use of socio-emotional utterances suggests their awareness of maintaining team morale.

Differences in the content patterns suggested that teams led by higher- vs lower-scoring leaders focused on different tasks in the first five minutes of resuscitation. Higher-scoring leaders' teams made more reference to chest compressions and exhibited different patterns as regards mentions of patient history and heart rhythm. These findings suggest there may be systematic differences in the ways the two groups time their conversations, even when dealing with the same subject matter.

These results show that dialogue patterns comprising specific communicative functions and contents are systematically associated with behavioural measures of leadership such as ANTS. We suggest that leadership assessment may reflect the leader's ability to maximise directives (i.e., by using Alerters) and verbalise socioemotional statements (i.e. through Affective-performatives), although these communicative functions are not mentioned in the scoring tool and not typically mentioned in other leadership scoring tools. Similarly, differences in the content patterns between the ISG and LSG dialogues, in terms of which subject matter is discussed and at what point, may also contribute to perceptions of leadership effectiveness.

Dialogue annotation can thus be used to identify similarities and dissimilarities in the types, frequencies, and structures of resuscitation team dialogues. We suggest that this approach may complement existing NTS scoring tools. Patterns derived from dialogue annotation analysis could be an additional index of performance and potentially have predictive value for resuscitation outcomes. Further studies into the effectiveness of specific communicative strategies would be needed to determine the value of including these in training guidelines. Our findings provide initial insight into this underexplored area, and a basis for assessing and training verbal abilities that might have potential in optimising desirable outcomes.

Acknowledgment

The authors wish to express their gratitude to the Scottish Ambulance Service, the South East Scotland Research Ethics Service, and the School of Philosophy, Psychology, and Language Sciences, University of Edinburgh.

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eISBN 978-967-2298-96-0

Impacts of Portable Recycled Hump on Ro-Ro Vehicle Carrying Vessel Operations

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Abstract
This portable recycled smart hump can increase people' well-being while also minimising traffic accidents. In addition, the non-Newtonian fluid is non-toxic and environmentally friendly. The 'liquid' speed humps relax when automobiles are driven slowly; but, when force is applied, the liquid hardens and becomes an obstacle, forcing motorists to slow down. The speed hump appears to be a standard speed hump, however there is a liquid beneath its durable plastic shell, which is "composed of rubber matt, synthetic canvas, and synthetic rubber tube.". Additionally, the non-Newtonian fluid is environmentally friendly, non-toxic and biodegradable. The speed humps have an ultra-durable plastic exterior that resists fading, wear,

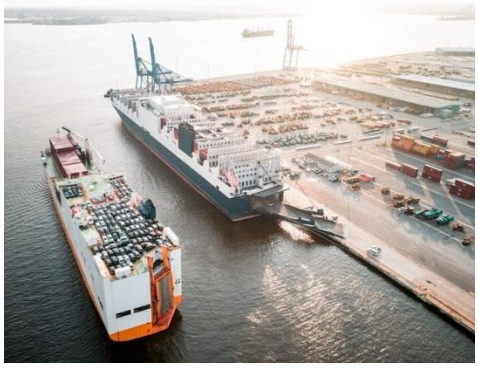
and severe weather. The entire hump is provided in one piece, requiring simply bolting to existing tarmac. The core causes of long-standing concerns with port-side activities, particularly transportation, are identified using a problem description based on collisions between Ro-Ro ships and port-side automobiles. Today, a lack of awareness in a dangerous scenario can cause substantial harm when autos and workers crash by accident. It has the potential to result in serious injury or even death. An analysis is undertaken based on the information given the information supplied above, followed by a debate and decision concerning the life duration and cost. We use recycled tyres and tubes as one of the ingredients since we want our product to be lightweighted. The non-Newtonian fluid used in the construction of the Portable Smart Recycle Hump makes it easy to handle and safe for humans. In addition, the non-Newtonian fluid is non-toxic and environmentally friendly.

Keywords: smart hump, safe environment. Ro-ro terminal, non-Newtonian fluid

1. Introduction

Speed humps can be the bane of suburban drivers. Designed to slow traffic down in high pedestrian areas, the humps can cause damage to your car's shock absorption system even when driven over at a moderate speed. However, it want to use speed humps to punish those driving too fast and not the average driver. We have developed the liquid speed hump to mitigate this problem. This is an intelligent piece of road engineering towards industrial science. The 'liquid' speed humps yield when cars are driven at a moderate speed, but when impacted with force, the liquid hardens and creates an obstacle that forces vehicles to reduce their speed. The speed hump looks like an ordinary black speed hump, where under its tough plastic exterior made by tires and synthetic rubber tube is a fluid that enters a solid-state when receiving an impact. The non-Newtonian fluid is also biodegradable and completely harmless to humans. The exterior of the speed hump is made of ultra-tough plastic designed to be highly resistant to aging, wear, vandalism, and unfavorable weather conditions. The whole hump comes as a single entity and for installation only needs to be placed at work area. The speed hump is currently only available for indoor use in parking garages, sheds, and other covered areas. Its single vision of developing a smart speed hump that would only affect vehicles driving with excessive speed. When it comes to ro-ro vehicle cargo ships, a crane is used to load the cargo, and built-in ramps are used to load and unload the cargo. These ramps are often built near the ship's stern (backside). They can be found on both the bow (front) and the sides of some ships.

Figure 1: Overview of vehicle load/unload at stern



Source: (marineinsight, May 10, 201

1.1 Problem Statement

Humps are used to position and steer vehicles in the terrestrial environment, primarily to help them reduce and maintain their speed limits while avoiding harm to the vehicles and the environment. To prevent vehicles from exceeding their speed limits, humps are essential. Crossing the hump may cause harm to oneself and other vehicles.

When vehicles collide due to speeding, they can cause significant damage to both the vehicle and the driver due to because of different aspects such as size, material used and condition. In some cases, workers who handle ship loading and unloading may collide with other cars while parking. Accidents involving Ro-Ro ships and port-side automobiles are being investigated to determine the core causes of long-standing concerns with port-side operations, particularly transportation. The goal will next be to present some qualitative indicators for analyzing how data mining technologies might be used to avoid such errors. In today's environment, a lack of awareness in a dangerous scenario can cause substantial harm when autos and workers crash by accident. As a result, both businesses and customers would suffer significant losses. It has the potential to result in serious injury or even death.

For the preceding ten years, 915 accidents involving car-carrying watercraft were registered in the study. These are dispersed around Europe on approximately 700 ships. In terms of statistics, this equates to around 0.13 accidents per vessel and year. Damage to transported cars was reported in 83 of the documented accidents; a higher number is likely. Collisions and slipping cargo due to bad weather were the most common causes of vehicle mechanical damage. Other vehicle damage happened mostly as a result of flames on the car deck. In general, all vehicle types face the same risk of damage.

Based on the article, nine people drowned when the four-wheel drive vehicle they were travelling in fell from Triso ferry into a river at Jalan Beladin Triso in Sarawak this afternoon.Local media reported that a spokesman for the Sarawak Fire and Rescue Operations Center said they received a call at 3.14 p.m afternoon and deployed members from BBP Saratok and Simunjan to the scene.The spokesman said the incident was previously spread on social media when a user recorded the live involvement.A total of eight victims were taken by the citizen with the help of ferries and bulldozers at the location according to (Utusan Malasysian by Mohd Fadhli Mohd Sulaiman,1 Januari 2022).

A pick-up truck crashed into the Batang (River) Lupar at the Triso ferry ramp, according to the article. The accident, which occurred around 3 p.m., was one of Sarawak's most tragic ferry accidents, with nine people killed. Firefighters from the Saratok and Simunjan stations were on the scene. The mishap served as a reminder to everyone about the standard operating procedures (SOP) that should be followed when using such facilities. All car occupants, save the driver, must dismount from the vehicle before it is manoeuvred along the landing ramp into the ferry, and they can only board the vehicle once it has exited the ferry at the other point of landing, according to the SOPs (malaymail., Monday, 27 Dec 2021).

1.2 Objectives

The study is an attempt to:

- To enhance a portable, environmentally friendly smart hump in a hazardous environment.
- To raise the safety margin by emphasizing the importance of loading vehicle speed control and worker safety.
- To investigate the potential for a safe working environment in the import and export transit of commodities at Ro-Ro vehicle cargo vessel terminals.

eISBN 978-967-2298-96-0

1.3 Scope of Study

The scope of the project that is implemented must comply to the objective of our study in order to ensure the effectiveness of the product in a safe working environment. In order to attach to the work, our project must achieve the stated objectives, such jobs as loading and unloading cars period. The project's scope is established goals and related. We may be able to shorten the pre-loading procedures for loading autos aboard the vessel by installing a smart hump. It can lessen the potential risk of an accident by ensuring a safe process for automobiles exiting or entering the vessel.It may cost more in terms of gasoline or time, but it can save a larger loss, such as a costly damage to vehicles

This smart hump can also be positioned as a stopper in a precise location on the ship near the parked cars to prevent them from moving. Eventhough using a strap is a good idea, the strap may become tangled and snap if the ship is under in heavy weather conditions. The smart hump can keep the automobile and the strap strain from snapping till the vessel is free of harsh weather. As a result, we may create a similar road curb using our tech tiny size road curb to ensure that it does not move from its position easily. Our PRS hump will be subjected to a skidding test as well as a vehicle impact strength test to determine the pressure and impact that the hump can withstand, as well as to ensure its longevity and efficiency. Finally, based on the overall budget needed to manufacture the product, the costing is computed and determined. Discussion and conclusion regarding the life span and cost are reached after an analysis is conducted based on the information provided above.

Figure 1: This is an example of the road that is used in the Ro-Ro to move the vehicles into the vessel. As we can see there is no any device or structure to slow car down while going into the vessel.

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Figure 2: This is the layout inside of the RoRo as we can se there is no any extra object to hold the vehicle.If the strap snap due to rough weather it can damaged other vehicle and vessel.

Figure 3: This is not a safe procedure going up the ramp since collison may occur if a brake failure happens. Hence why having a smart hump is important because it can hold the car from going backwards and colliding with other vehicle.

1.4 Significant of Study

The purpose of this research is to study a project that uses non-Newtonian fluid to create a safe working environment. Because our Portable Smart Recycle Hump ensures a safe passage from car decks to passenger accommodations. It also ensures a safe approach to the Ro-Ro ramp and avoids the procedure for abnormal loads. During the procedure,if a worker passes by the ramp by accident owing to the reduced speed, the accident will not be the worst-case situation. Non-Newtonian fluid is also a substance that is good for the environment. This research will be important in overcoming the challenge that port personnel confront, which is a lack of information and awareness of the characteristics of the Portable Smart Recycle Hump. The data collected and evaluated will, hopefully, form part of Malaysia's smart hump database. The findings of this study can be used as beneficial counsel for management when it comes to hazardous labor.

2. Litreture Review

The vessel will be able to load and discharge at most quays thanks to the quarter stern ramp at terminals.The vessel's hoistable decks allow the deck height to be adjusted in parts, allowing it to carry nearly any combination of vehicles and cargo. During the port call, the internal ramp system will provide a smooth and efficient cargo flow. In general, speed humps are well thought out as a viable and appealing technique in reducing vehicle speed since drivers are obliged to slow down their cars as they approach the speed hump at the ramps. The goal of installing speed humps, according to (Roess et. al., 2004), is to restrict vehicle speed to a bearable level at a predetermined site along the work area.

2.1 Inventory Survey On the Design Characteristic of Road Humps

Inventory surveys, also known as condition surveys, according to Bonsall & O'Flaherty in 1997 it typically conducted to assist in the identification of a suitable site for data collection, as well as to produce and update maps that will be used by researchers for data collection, (as cited by Nur Shuhadah, 2014). As a result, prior to completing the inventory survey, certain secondary data from the research region was extracted. The inventory survey was used in this study to gather information on the design characteristics of road humps. The design characteristics of road humps are utilized to identify which road humps should be used to determine the location of the spot speed survey. The dimensions of the road hump (width, height, and length) as well as the spacing between the road humps were the subject of this study.A "slow traffic" sign or a low posted speed limit can only do so much to reduce traffic, and it's simple for drivers to ignore or miss these signs entirely. Unfortunately, they're there for a reason, usually because higher speeds carry a greater danger of harm because there's less time to react.

2.2 Material

Figure 4: Non-Newtonian fluid ***(oobleck substance)***

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A non-Newtonian fluid is a fluid whose viscosity is variable based on applied stress or force. The most common everyday example of a non-Newtonian fluid is cornstarch dissolved in water. Behavior of Newtonian fluids like water can be described exclusively by temperature and pressure. However, the physical behavior of non-Newtonian fluid dependm on the forces acting on it from second to second.

Non-Newtonian fluids exhibit a number of intriguing properties. If you punch a bucket full of non-Newtonian fluid like cornstarch, for example, the incoming force causes the fluid's atoms to rearrange, leading it to act like a solid. Your hand will be turned down. However, if you gently press your palm into the liquid, it will penetrate. If you pull your hand out abruptly, it will return to its solid state, allowing you to physically pull a bucket of fluid from its container. Non-Newtonian fluids help us understand the great variety of fluids seen in nature (K. Van Canneyt, P. Verdonck ., 2014)

On the internet, a search for non-Newtonian fluid yields some intriguing findings. Non-Newtonian fluids exhibit various strange qualities when paired with an oscillating plate, such as projecting "fingers" and holes that persist after being created. An oscillating plate delivers tension to a fluid on a regular basis, rapidly changing its viscosity and placing it in a strange middle ground between a liquid and a solid. Simultaneously, there are situations when a bowl of cornstarch is placed near a vibrating speaker to witness the intriguing patterns that are generated on the mixture's surface.

Figure 5: Compression of oobleck

To put it another way, a non-Newtonian fluid is one whose flow properties are not defined by a single constant value of viscosity. Many polymer solutions and molten polymers, as well as many commonly found compounds including ketchup, starch suspensions, paint, and shampoo, are non-Newtonian fluids. The relationship between shear stress and strain rate in a Newtonian fluid is linear, with the coefficient of viscosity as the proportionality constant. The relationship between shear stress and strain rate in a non-Newtonian fluid is nonlinear and can even be time-dependent. As a result, a constant viscosity coefficient cannot be determined (L. Zheng, X. Zhang ., 2017).

2.2.1 Non – Newtonian fluid classification

Non-Newtonian fluid has been classified by Shenoy and Mashelkor[3] into two main categories: (A) Inelastic Non-Newtonian fluid and (B) viscoelastic Non-Newtonian fluid. The first one can be subdivided into two types (i) time independent and (ii) time dependent.

(A) Inelastic Non-Newtonian fluid

(i) Time independent Non-Newtonian fluid

In the Time-independent fluids properties such as viscosity does not depend on time. The non-linearity relation between the shear stress and strain rate at a given point is solely written by the following way: $\tau = f\ Y\ ()$ Where, τ and $\dot{Y}$ are the shear stress and shear rate.

(ii) Time-Dependent Fluids in these types of fluids apparent viscosity depends on the time of applied shear along with strain train rate. Such types of liquids are regarded as complex non-Newtonian fluid. It is recognized that there are two main classes of time-dependent fluids: (a) thixotropic and (b) rheopectic.

Viscoelastic fluids

Viscoelastic fluids are those that illustrate partial elastic recovery upon the removal of a deforming stress. Such materials possess properties of both fluids and elastic solids and obey Hooke's law of elasticity. For viscous fluids constitutive equation can be written as—

$r\ Y\ \tau = + \pi\ \kappa$

Where, $\dot{Y}$ and κ are the shear rate and rigidity modulus respectively.

Table 2.2: Descriptions of the materials selected

Material	Properties	Function
Non-Newtonian fluid (OOBLECK) 	Can change from liquid to solid .	Application of stress can cause them to get thicker and act like a solid

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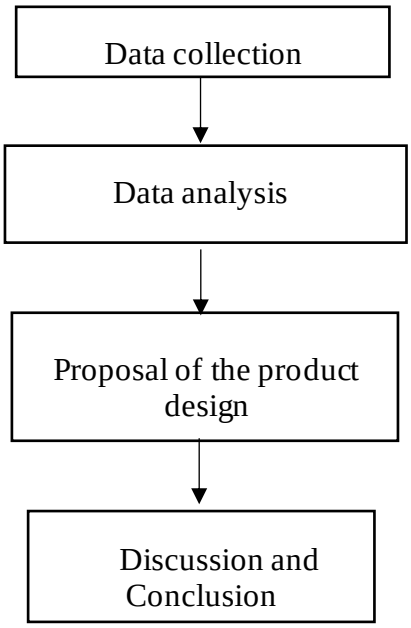
Reused Tire Tube 	Technically feasible Flexible qualities Higher elasticity	To act as a capsule that contains the liquid
Nylon canvas layer 	Excellent toughness Abrasion resistance Lightweight Strong and elastic	Thick layer that high in friction that holds the capsule in and act as the surface layer of hump
Steel plate 	High Strength Durable	Holds the upper layer and rubber matt together helps to be portable.

3.0 Methodology

Figure 6: Flowchart of The Project



3.1 Procedure of fluid mix ratio

Mix design is a process of selecting suitable ingredients and determining their relative proportions with the objective of producing Non – Newtonian fluid of having certain minimum workability, strength and durability as economically as possible. In this study, we used corn starch to replace concrete completely. Non – Newtonian fluid is prepared with the design mix of (3:1.5:1). To find out the strength of fluid we used three different replacement:

i. (85/15) % mixed of corn starch and water and (10) % mixed of coolant.
ii. (85/15) % mixed of corn starch and water and (12.5) % mixed of coolant.
iii. (85/15) % mixed of corn starch and water and (15) % mixed of coolant.

3.2 Calculation

Calculation total capacity of liquid required from the volume of semi cylindrical tyre tube.

- Volume of one capsule =120 cm x 13 cm x 0.0102 cm
  = 0.0159 m^3
- Volume for two capsules =0.0159 x 2
  = 0.0318 m^3

Table 3.3 Percentage and weigh for each portion of substance

Material	Density (kg/m^3)	Weight of each portion used (kg)			Percentage for cement and silica fume
Corn starch	625	3	3	3	(85/15)
water	1000	1.5	2.5	3	(80/20) (50/50)
coolant	1.1132	1	0.75	1.25	
Percentage for corn starch and coolant %		(60/40)	(70/30)	(80/20)	

Actual volume-based capacity.

Material	Density (kg/m^3)	Weight of each portion used (kg/litre)
Corn starch	625	8.69
water	1000	4.34
coolant	1.1132	2.89

Table 3.4 Calculation method for each portion of substance

Material	Method of calculation
Corn starch and water	Percentage of material ÷ overall ratio (3) x density x volume
Coolant and mixture	Percentage of material x ratio (2) ÷ overall ratio (3) x density x volume

3.4 Total Sample Testing

Non-Newtonian fluid is used as complete concrete replacement to produce a portable hump. The percentage of coolant will be used is 10 %, 12.5% and 15%. The total sample of liquid will be produced is 3 samples for testing liquidity strength and water absorption test.

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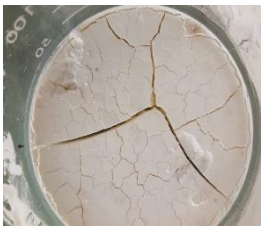
3.4.1 Testing

Test 1: 6 samples productivity test

Mixture	No	Appendix
5 Tea spoon flour 20ml water	Original	
6 Tea spoon flour 20ml water 2 Tea spoon soda	2	
5 Tea spoon flour 20ml water 2 Tea spoon yeast	3	
6 Tea spoon flour 20ml water 2 Tea spoon yeast 2 Tea spoon soda	4	

6 Tea spoon flour 20ml water 2 Tea spoon magnesium sulphate	5	
6 Tea spoon flour 20ml water 2 Tea spoon sodium hydrogen		

Test 2: Remain good but dry 'mixture continue with 2 & 6 samples'

-original , 2 , 6

All testers add on 15ml water

- No 2 add on three spoon of flour and three spoon of transparent glue
- No 6 add on 3 spoon of flour and 4ml water
  and 3spoon latex
- New no7 10spoon flour, 3spoon latex, 3spoon glue, 20ml wate

Sample 2 (Test 2)

Sample (Original)

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Sample 6

Sample 7 (New)

Method

1) First place the steel plate on ground and screws together with vaushers, the base is ready. If we take enough care to screw together seamlessly and build another body to hold it together, we can be sure to keep interconnect with each other. So, the hinge will hold connected.
2) Place the canvas@tarpauilin layer on top of the base accurately. Whereby making a frame that fits the hump with space between the rebar, canvas, the base steel in all directions. This will help the canvas not to move and ensuring no edges get loose.
3) Then, enter the nuts and bolts together and tighten tightly. Make sure all the nuts tighten well so that nothing get moved.
4) Shake liquid on top to ensure it work before its routine. Any leakage can cause damage to hump when get impact by vehicle.

3.4.2 Water Evaporation Test

The analysis of water absorption test for 10 days is shown in the table and graph as follow:

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Table 4.4 Data of Water Evaporation Test for 7 days

Sample (%)	Sample	Wet Weight (ml)	Dry Weight (ml)	Water evaporate Percentages (%)	Average Water Percentages (%)
Test 1	original	25	24.2	3.2	14.83
	2	28	24	14.3	
	3	26.5	24.3	8.3	
	4	30.2	22.4	25.8	
	5	27.3	23.5	13.9	
	6	26.9	25.1	6.69	
Test 2	Original	26.6	25	6.0	15.60
	2	32	26.3	17.8	
	6	36.4	28.2	22.52	
	7(new)	41.1	34.5	16.06	
Test 3 (Coolant)	Original	30	25	16.67	7.79 (NOT INCLUDE ORIGINAL)
	A1	30.5	28	8.19	
	A2	31	29.2	5.8	
	A3	32	29	9.38	

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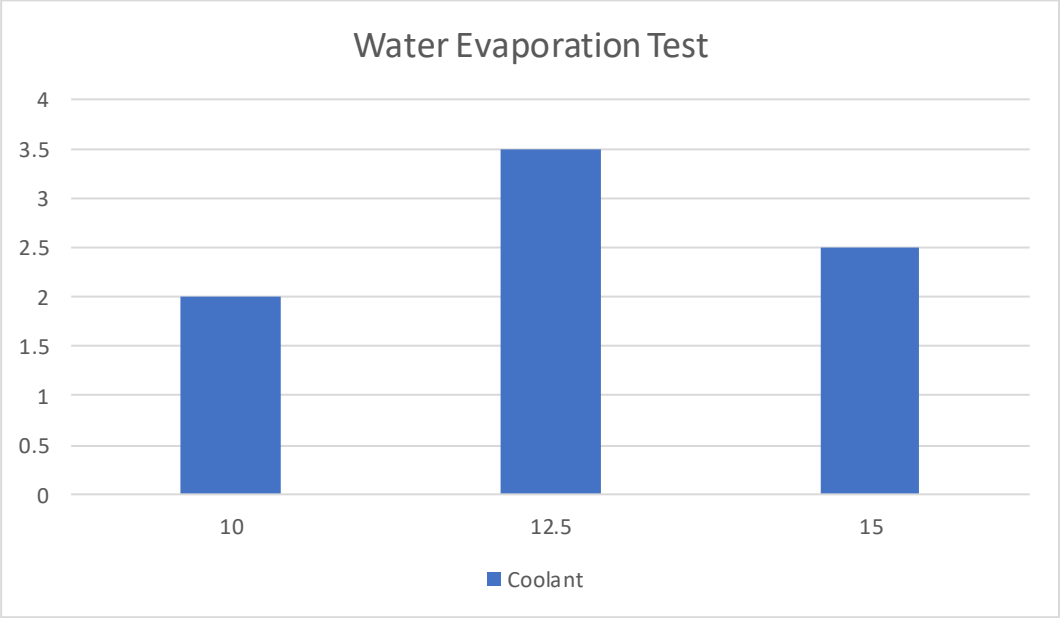
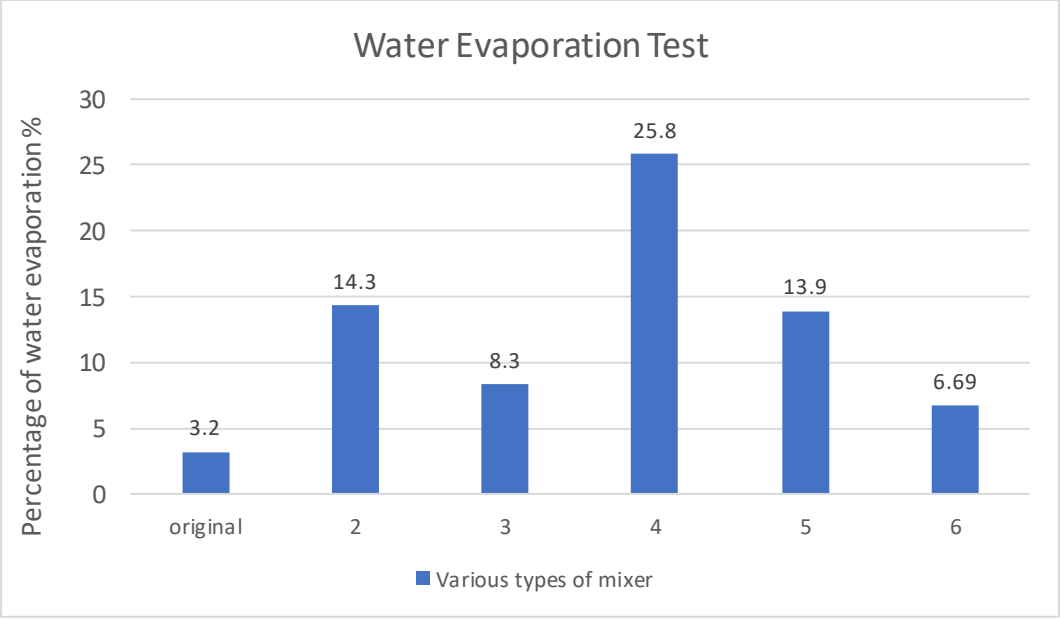


Graph 1:As we can see different type of coolant gives us different water evaporation reaction.



Graph 2: As we can see different type of mixer gives us different type of percentage of water evaporation reaction

3.5 Design

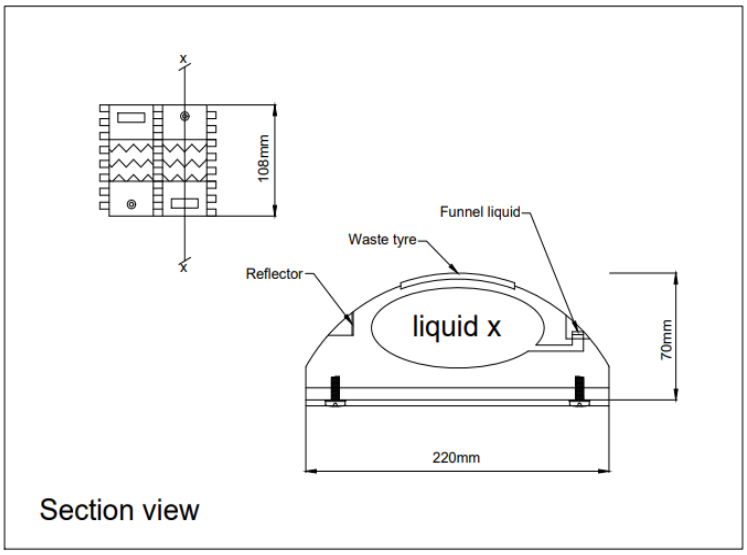


Figure 1: Section view of proposed design of ur Smart Hump.

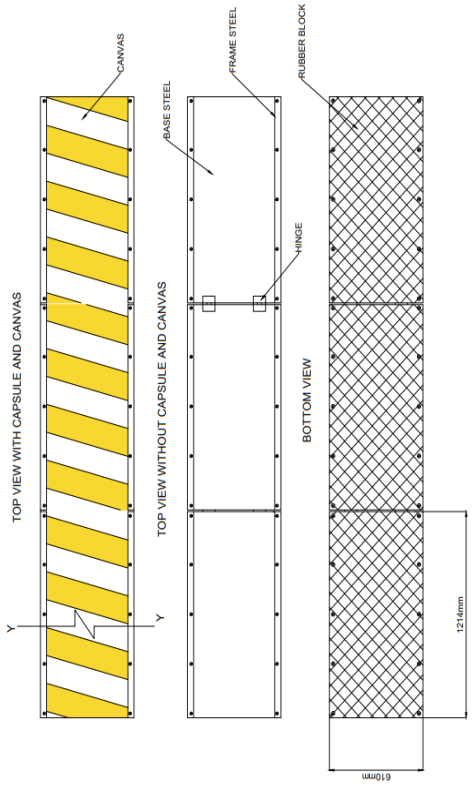


Figure 2: Layout of top view and bottom view of the smart hump.

Method

5) First place the steel plate on ground and screws together with vaushers, the base is ready. If we take enough care to screw together seamlessly and build another body to hold it together, we can be sure to keep interconnect with each other. So, the hinge will hold connected.
6) Place the canvas@tarpauilin layer on top of the base accurately. Whereby making a frame that fits the hump with space between the rebar, canvas, the base steel in all directions. This will help the canvas not to move and ensuring no edges get loose.
7) Then, enter the nuts and bolts together and tighten tightly. Make sure all the nuts tighten well so that nothing get moved.
8) Shake liquid on top to ensure it work before its routine. Any leakage can cause damage to hump when get impact by vehicle.

4. Discussion

The effects of smart humps have been examined in multiple studies which concluded that they will be quite effective towards handling traffic movement in and out of the Ro-Ro vessel. The list of negatives is not insignificant:

- Damage to vehicles
- Impediment of Emergency Vehicles
- Enforcement of speed limits.
- Clear rules controlling movement of vehicles on/off the ship.
- Clear safety procedures for using ship's cargo
- Maintain company-controlled vehicles in accordance with manufacturers guidelines.
- Increased traffic on surrounding area through evasion.
- Adequate marshalling of passenger carrying vehicles.
- Trained and competent in driving skills of workers and protocols that should follow when moving vehicles in and out.

This smart hump has been subsequently developed, either as an attempt to improve the original design or modify it for a slightly different use.The Speed hump is the most severe and earliest variant of the hump. They are usually barely a foot broad and 3-4 inches high, but they run the entire width of the road and climb sharply, requiring traffic to slow down significantly to cross over them. Suspension damage can occur when traveling at speeds beyond a certain threshold, but it is currently very uncommon. However, it is required for vessels such as Ro-Ro vessels and port area autos currently.In general, a worker's cargo handling skill and the yard area's operational manner are essential variables for enhancing service time, and they may determine port competitiveness.Our research aims to provide adaptable and flexible strategic planning for their assets, particularly multimodal roro-vessel terminals.

5. Conclusion

Advances in material technology have now found an innovative way to continue using smart humps, but modify their function to only affect those that need to be slowed down. Asphalt or concrete is typically used to form bumps as the materials are tough enough to resist the constant impact of multi-tone vehicles, but uniquely the Intelligent Smart hump is formed from a super hard-wearing plastic tube that is flexible especially in maritime field right now.

When empty, this capsule depresses under pressure and presents no obstruction to a vehicle. The capsule is filled with a non-Newtonian fluid that hardens upon sufficient impact and triggers at a set speed to form the obstacle. You may regulate the speed at which the hardening offers the resistance required to induce drivers to slow down by altering the quantity and chemistry make-up of the fluid. Any vehicle travelling below this set speed can cross over them without slowing down as the fluid stays in its liquid state, but as soon as it suffers a greater impact by a vehicle travelling at a higher speed it functions as a normal speed bump. This means that the hump will only slow down those who need to be slowed, while those who follow the rules of the road will be unaffected, reversing all of the disadvantages of traditional speed humps. The Liquid Smart Hump will alleviate traffic congestion in the Ro-Ro Vessel work area by allowing traffic to flow at a steady rate, as well as reduce repairs and extend the life of company cars by incurring less damage.It's a terrific illustration of how new technology may improve workers' control driving experience while also lowering danger and boosting the safety of the surroundings.

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SOCIAL SCIENCES & HUMANITIES CONFERENCE 2022 (SSHR 22) 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

The Pilots' Perception on the Human Causal Factor for Their Error and Risk in Malaysia and Brunei

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Abstract
Despite great improve of technologies and new rules & regulations, there are rooms to prevent occurrence of pilot accidents. Pilotage being one of the most important sectors of supply chain, port or shipping industries, the human error still constitutes about 80% of all accidents. A shift from improving technologies, design of the ships and focusing on standard of trainings or standard of operations, a more thorough studies on the human causal factors for all possible pilotage accidents could be the solution to eliminate pilot errors or risks. Four (4) Main Contributing Factors containing forty (40) sub factors were listed in the Questionnaire for the pilots to evaluate. Likert Scale is used to determine their selections. Online survey was

eISBN 978-967-2298-96-0

conducted by inviting pilots in Malaysia and Brunei. From the survey, surprised to find out that Main Factor No. 4 – Individual or Personal Challenges or Deficiency is more dominating than Main Factor of Hard Competency or Technical Skill required. CF 37 - Mental Health Status or Ability to Stand Stress scored highest. From this survey, it is neither the key competency nor soft competency for pilot that determine key safety culture for them.

Keywords: Human causal factor, Pilot perception survey, Pilot safety behaviour, Pilot error.

1. Introduction

One major concern is how to quantify the effect of human errors. Statistics shown that about 80% of collisions occur because of human error, and it is the primary cause of most transportation accidents (Li et al., 2012). Ships manoeuvring in confined and challenging waters of a harbour required to make used of the services of an experienced pilot equipped with nautical skills to prevent maritime accidents. However, there are limited formal studies on pilot risks or pilot errors based on human causal factors (HCF). A detailed study on the attributes for the Human Causal factors for pilot errors and risk was conducted by referring to the available marine journals on pilot errors and pilot risk. A refinement on the contributing factors and sub factors were tabled in the previous research on Managing the Attributes of Pilot Error and Risk (K.Tiong 2021)that was published in August 2021. From the study, the author has identified four (4) main human factors and with another forty (40) sub factors that will affect the pilot error when dealing with pilotage risks. A pilot survey was conducted to collect the perception on the human causal factors or safety behaviour for pilot based on these forty (40) subfactors. Despite the improvement of technologies, rules and regulations and tireless effort by International Maritime Organization (IMO), the possibility of pilot committed error in their daily tasks is still not on par with the aviation industry. The IMO had initiated good effort and issue a guideline on the Human Reliability Analysis (HRA) (MSC/Circ.1023, 2002) to improve the human error of seafarers or shipping industry but little effort on pilotage. The objective of this paper is to evaluate the pilots' perception on HCF of pilots' errors and safety behaviour.

A comprehensive review was carried out on available journals, reports and publications related to the Human Causal Factors (HCF) (Vinagre-Ríos & Iglesias-Baniela, 2013), (Park et al., 2019). A thorough review on the Marine Pilot Reliability Index (MPRI) (Atiyah et al., 2019) and refinement was restructured and more detailed sub factors were included. He failed to include risk identification and mitigation. Studies of maritime accidents identify human error as the primary contributing cause for up to 70% of the accidents (Galieriková, 2019). In order to provide an examples of a human factors taxonomy for the purpose of investigation, the Human Factor Analysis and Classification System (HFACS) (Galieriková, 2019), was used. The fundamental issue of the HFACS system is the proper categorisation of five main causal factors and another forty sub factors. In this paper, we are conducting a survey on pilot safety perception based on the forty sub factors. Likert scale is used to obtain the expectation and answer from those participants. The survey form was vetted by three (3) experienced experts and academicians.

For reducing the impact of human factor on shipboard safety, shipping companies are required to operation of pilots or pilotage in its member states (Oldenburg et al., 2021)

IMO still unable to come up with a recognized regulatory standard and marine pilot safety (Y. Xi et al., 2021) practices vary across countries and regions. The results reveal that a hazardous attitude has a direct negative effect, while risk tolerance has an indirect negative impact on safety behaviour. Risk perception has both direct and indirect positive effects on

safety behaviour (Y. Xi et al., 2021). One of the biggest challenges is that the pilots are reluctant to report their actual safety behaviour for avoiding the associated negative influence on his career development. Most of the near misses were not reported.

The objectives of this study are to carryout survey on the pilots' perception on human causal factor of pilot errors and pilot risks and to determine which are main contributing factor that constituted the most critical human causal factor that affect the safety behaviour of pilotage. The scope of the study is on the safety perception of the Human Causal Factors for the pilot errors and pilot risks is limiting to the active pilots and those who are closely related to pilotage within Malaysia and Brunei. However, we welcome other respondents from other countries. This paper aims to analyse on pilot perception or attitude toward the human Causal Factors for the Pilot errors or Risks. This study will have some limitations on the perception of the Malaysian and Bruneian Pilots on their hazardous attitude, risk tolerance, and risk perception influence the safety behaviour of them. The data obtained may have inherent subjectivity.

2. Literature Review

From the various literature review papers, we have found ways to improve the MPRI. This paper demonstrates shaping factors like Technologies Advancement; Continuous Professional Development and conducting Risk Assessment or using of MPRI and IMO's FSA & HRA, (2002) will derive more accurate Marine Pilot Reliability Index. The additional shaping factors ensure better result in the Pilot Reliability and to reduce or eliminate accident. The safety perception and pilot safety behaviour will affect their operational.

2.1 Pilot/Human Error

A record of 6091 major accident claims (Over USD 1,000,000/case) associated with all classes of merchant ships conducted over a period of 15 years by UK P&I Club revealed that 62% (Rothblum, 2000) of the claims are attributed by human error. Dr. Anita M. Rothblum of USA Coast Guard has concluded that about 75 – 96% of the marine casualties are caused either partly or directly by human error. Her studies shown that human error contributed:

- 84-88% of tanker accident
- 79% of the towing vessel grounding
- 89-96% of collision
- 75% of allision
- 75% of fire and explosions

A Dutch study (Wagenaar W A and Groeneweg J (1987) of 100 marine casualties found that human error contributed to 96 -100 accidents. In 93 cases of the total accidents, multiple human errors were made. Based on their studies, there are many human factors contributing directly or indirectly to the Human Errors. The human factors may include but not limited to poor communication; fatigue; poor automated design; poor general technical knowledge; poor general knowledge; poor maintenance; decision based on inadequate information; faulty policies; malpractices; wrong or poor standard; poor knowledge of one's ship systems; hazardous environment and cultural awareness.

2.2 Pilot Safety Behaviour

The majority of safety behaviour-related study is conducted from two angles—one on unsafe operational acts and the other on safety compliance and participation (Y. Xi et al., 2021).

Another study on the safety behaviour of the Thailand air force pilots, four (4) dimensions potentially construct the safety behaviours: intra-family relations, job characteristics, personal health, and self-discipline (Amornpipat, 2021).

2.3 Safety Culture

Safety culture can be defined as the informal set of values and norms that controls the way individuals and groups interact with each other and with people outside the organisation in order to improve the safety performance (Darbra et al., 2007). Surveys on pilot safety culture have been carried out by Australia and New Zealand pilots. Four (4) key aspects were included during their surveys: 1) each pilot's professional background, 2) safety culture and perception of risks, 3) navigation and pilotage hazards and 4) their perception of the pilot's role. The results exhibited that the safety behaviour on the hazardous/risk attitude has significant effect and risk perception has both direct and indirect impacts. Psychological training and safety education can improve ability of pilot skill and risk tolerance.

2.4 Pilot Risk Attitude

Pilotage is either compulsory or voluntary in all ports to ensure greater safety. Pilots are equipped with all the competencies and local knowledge and act as the expert or advisor to the Master of the ship. The safety behaviour and the risk attitude will determine the safety manoeuvring of the vessels when entering or leaving any port. The pilot risk attitude has drawn attention of experts and scholars as one of the human factors. Pilot Risk Attitude is referring to the individual motivation tendency that respond to risk related person, circumstances, or events. The pilot risk attitudes can be improved or modified through education and training. A practical method to reduce aviation accidents is to increase understanding in the contribution of human factors to these accidents (Amornpipat, 2021).

2.5 Marine Accident

The P&I Club (World Leading Insurance Underwriter) had summarized the marine claims that involved vessels under pilotage from 1999 to 2019, a total of 1,046 incidents with a total claim more than USD 1.82 billion. The types of accidents classified by Insurance companies include grounding; stranding; foundering; flooding; collision; allision; explosion; fire; reduction or loss of a vessel's power or steering capabilities; failures or occurrences, regardless of cause, which impair any aspect of a vessel's operation, components, or cargo; vessel's seaworthiness, efficiency, or fitness for service or route and any incident involving significant harm to the environment. (Mullai & Paulsson, 2011) & (Mullai & Paulsson, 2011) conducted comprehensive studies and analysis on the marine accidents have classified the main categories of marine accidents as collision; contact; grounding; fire; explosion; machinery breakdown; listing; capsizing; human effects and spill. Over the past 50 years, research in maritime accidents has undergone a series of fundamental changes (LUO & SHIN, 2019). From their studies over the past 50 years from naval architecture to human error and may continue to expand into socio-economic factors. The future research in maritime accidents will be multi-disciplinary, use multiple data sources, and adopt advanced research methods, to account for complex interactions between the natural environment, the development of naval technology, human behaviour, and shipping market conditions (LUO & SHIN, 2019).

2.6 Human error

Human error is an inevitable, happens all times and part of human nature. Within Human error in maritime domain is the commission or omission of acts by maritime personnel that causes

or contribute to merchant casualties (Nas, 1976). The finding of (Praetorius et al., 2015) shown that 67% of human and machine interface are human error. Another study on human error by (Sánchez-Beaskoetxea et al., 2021) concurred that the previous studies (Cauliemas, 1997) and (Berg et al 2013) on this topic and concluded that about 80% of the accidents are caused by human error. (Sanchez J. et al, 2021) classified and analysed the human error using types of vessels, crew error, non-crew error and combination of both errors and other people error (pilot, company, others). They identified 29 errors and divided into 10 groups.

Some authors mistakenly included navigational lights, navigational marks, navigational hazards natural environmental as part of the human error. It should be relooked at different angle from the human perspective. Therefore, the author is restructuring the human error in more correct perspective. The details of it will be exhibited in the subtopic of Human Causal Factor (HCF) and the questionnaire in the research methodology later.

A cross reference on the new hybrid approach to human error probability quantification– applications in maritime operations Human Reliability Analysis (HRA) has always been an essential research issue in safety critical systems. Cognitive Reliability Error Analysis Method (Y. T. Xi et al., 2017), as a well-known second generation HRA method is capable of conducting both retrospective and prospective analysis, thus being widely used in many sectors. However, the needs of addressing the use of a deterministic approach to configure common performance conditions (CPCs) and the assignment of the same importance to all the CPCs in a traditional CREAM method reveal a significant research gap to be fulfilled. This paper describes a modified CREAM methodology based on an Evidential Reasoning (ER) approach and a Decision-Making Trial and Evaluation Laboratory (DEMATEL) technique for making human error probability quantification in CREAM rational. An illustrative case study associated with maritime operations is presented. The proposed method is validated by sensitivity analysis and the quantitative analysis result is verified through comparing the real data collected from Shanghai coastal waters. Its main contribution lies in that it for the first time addresses the data incompleteness in HEP, given that the previous relevant studies mainly focus on the fuzziness in data. The findings will provide useful insights for quantitative assessment of seafarers' errors to reduce maritime risks due to human errors. (Xi et al., 2017).

2.7 Human Reliability or Pilot Reliability

Over the last 70 years or after the Second World War, there is a great improvement on ship design and reliability of the ship systems to reduce casualties and increasing efficiencies and productivity. We have seen great improvement on hydrodynamic hull designs, stability systems, propulsion and navigational equipment, cargo compartment or storage system, firefighting system and communication system. However, the human involvement and human error are still high. Human error costs the maritime industry USD 541 million per year as per United Kingdom Protection and Indemnity Club (UK P&I Club).

Pilotage is an indispensable part of the world shipping and port services. To select right candidate to be train as pilot is rather very important (Barca, 2019). Human reliability (Whittingham, 2020) or pilot reliability will determine the efficiency and turnaround of any port. The professionalism and competency will determine pilot reliability. The introduction of FSA and HRA by the International Maritime Organization is one the greatest positive movement to ensure Pilotage Safety Management Policy (PSM) (Hong-Bin, 2018). These FSA and HRA can be applied to determine and management the Pilotage Risk.

Human reliability is the positive orientation of human error. Human reliability assessment (HRA) is a broad name for ways to find and predict human errors in a system.

Reliability analysis of marine pilots using advanced decision-making methods developed by Atiyah, A. (2019) has listed the differences of HRA techniques fall into three generations of HRA methods.

- The first generation used the probabilities of task failure, the adjustment factors based on performance conditions, and the error factors (French et al., 2011).
- The second generation of the HRA methods attempted to incorporate contextual effects such as tiredness, stress, and organisational culture (Barriere et al., 2000).
- The third generation has sought to allow for potential variation in response and recovery actions once an error chain has begun (Mosleh and Chang, 2004).

To understand the pilot reliability (Emstsen et al., 2017) (Kobayashi, 2005) or pilot error, we must go back to the human element for the pilots. It is a complex multi-dimensional of human cognitive behavioural which affect the safety of pilotage. By reviewing on MPRI (Atiyah et al., 2019) and other related journals and publications, has found out that there is a need to improve and categorize the main shaping factors. From 11 reference factors as identified by Atiyah. A, (2019) to four (4) main causa factors and forty (40) Causal Factors for pilot errors as shown table 1.

Table 1: Human Causal Factor for Pilot Error

Main Shaping Factor	Risk/Causal Factor	Code for Causal Factor	Human factors affecting safety performance of pilotage operations
Factor 1	**Short coming of Technical Skill as Pilot (Hard Competency)**	**CF 01**	Lacking systematic training, assessments and certifications
		CF 02	Lacking ability to conduct formal Risk Assessment/Analysis and finding mitigation
		CF 03	Unable to utilize or keep pace with the functions of new technology or equipment on the bridge
		CF 04	Failure to equip all the necessary emergency response plans & crisis management
		CF 05	Failed to keep pace with the new port development and its environment especially the hydrographic and navigational aids information
		CF 06	Lacking effective communication or having language barrier
		CF 07	Failure to use the best practical and principle of ship handling
		CF 08	Wrong selection or inadequate number or power for the tugs
		CF 09	Failure to master the local knowledge
		CF 10	Failure to establish and execution of Passage Planning
		CF 11	Failure to attend periodical/refresher trainings or failed to attend simulation training for new development or new channel
		CF 12	Failure to identify the new risk, unsafe acts or failed on Risk analysis and poor situational awareness
		CF 13	Failed to perform safe transfer or transfer at wrong location or speed

		CF 14	Pilot failed to complete required Continuous Professional Development (CPD) to keep pace with the new development and requirements for Pilot
Factor 2	**Shortcoming of Non-Technical Skill**	**CF 15**	Lacking teamwork or interfacing (Bridge, Tugs, Mooring + Port Control or VTS)
		CF 16	Failure establishing of Master/Pilot Exchange or incorrect information provided
		CF 17	Failure because of external disruptions to Pilotage or towage operation
		CF 18	Failure to cross check on Pilot action by the bridge team and supporting parties
		CF 19	Lacking or unable to exhibit good leadership or as an Advisor/Specialist
		CF 20	Lacking confident level as a specialist/advisor
		CF 21	Indecisive and lacking mature decision-making skill
		CF 22	Limited or lacking networking skill as a professional pilot
Factor 3	**Non-Compliance of Rules and Regulations or Standard of Operations (SOP), Policies, Instructions and Orders**	**CF 23**	Violation of International & National Rules and Regulations
		CF 24	Violation of COLREG or Local regulations and Standards
		CF 25	Failure of complying the requirements of the Competent Authority or Pilot Organizations Policies
		CF 26	Violation of ILO or National labour Rules and Regulations
		CF 27	Failure to object or postpone the movement due to the extreme weather and sea conditions or exceeding the allowable limits
		CF 28	Failure to render or handing over the pilotage services at approved position or in safe water
		CF 29	Failure to reject the commercial or political pressure
		CF 30	Failure of Bridge Team to cross-check, to intervene or to challenge the Pilot's doubtful advice or instruction
		CF 31	Failure of Tug Master or supporting parties to comply pilot's instruction or advice
		CF 32	Failure of Tug Master or supporting parties to comply pilot's instruction or advice
Factor 4	**Challenges Personal/ Individual**	**CF 33**	Maturity or age of pilot
		CF 34	Experiences as Pilot
		CF 35	Heavy Workload or fatigue
		CF 36	Physical Health status of the Pilot
		CF 37	Mental health status or ability to stand stress
		CF 38	Ability to handle domestic issue that may affect Pilotage operation
		CF 39	Low salary or reduced job satisfaction
		CF 40	Academic/professional Qualifications

This research paper will focus on the pilots' perception associated with their risk and error. This will cover the review of the recent published literatures on marine pilot's reliability and pilot errors. This paper hoped to shine the vital roles of safe pilotage and towage services to determine the efficiency and productivity of any ports. By the end of this research, it is hope

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that it is possible to determine the highest probability on HCF. Hoping any research can be conducted and to eliminate all possible human error or pilots' risk and improve the reliability and competencies of pilots using the improved version of Marine Pilot's Reliability Index (MPRI) (Atiyah et al., 2019).

3. Methodology

A survey on the perception of the Human Causal Factors for pilot error and pilot safety has been carried out involving 50 maritime pilots around Malaysia and Brunei, representing more than the 25% of the maritime pilots in this region. The main sources of the survey samples were made available through email disseminated by the Secretary General of the Maritime Pilots Malaysia (MPM). MPM is the registered association that representing Malaysian Pilots. She is an affiliated member to the International Maritime Pilotage Association (IMPA). MPM has about 100 members up to date. Some of the respondents were directly invited by the author. For this pioneer study, the author is expecting to collect about 50 samples.

Over many years, shipping has been the world's great industries. The global economy depends on shipping due to the lowest cost and economy of scale of trading. However, the shipping industry has experienced a substantial number of accidents and studies have shown that most of the accidents are due to human error. Although the International Maritime Organization (IMO) had implemented the International Safety Management (ISM) Code in 1998, human errors still exist and could not be eliminated. This paper is the extended study on Managing the Attributes of Pilot Errors in the Process of Redevelopment of Marine Pilot Reliability Index. It is providing a review on the perception of the professional pilot toward the human causal factors of pilot errors (Figure 1).

eISBN 978-967-2298-96-0

Figure 1: The flow chart for determining the Pilot Risk Identification and Pilot Error (PRIDE)

The questionnaire contained 10 questions related to personal detail/data and another 40 questions based on the 40 subfactors in accordance with the main four (4) Main Factors of the HCF that were identified by the author. The questionnaire is designed of using the Likert Scales to obtain the feedback from the respondents. Question No. 10 allow the respondents to voice up their opinions on their reasons on why the accident/pilot error remain high whereas great improvement on technologies, infra structures, safety measures and new rules & regulations? The ultimatum is to find the recommendations for consideration in improving operational performance and safety of navigation in ports and regulated waterways. These recommendations can be used by regulators or Pilotage Organizations to improve their performance concerning pilotage matters and understand pilots' concerns. Figure 2 shows the conceptual model for pilot perception.

Figure 2: The conceptual model for pilot perception on HCF toward pilot risk or error.

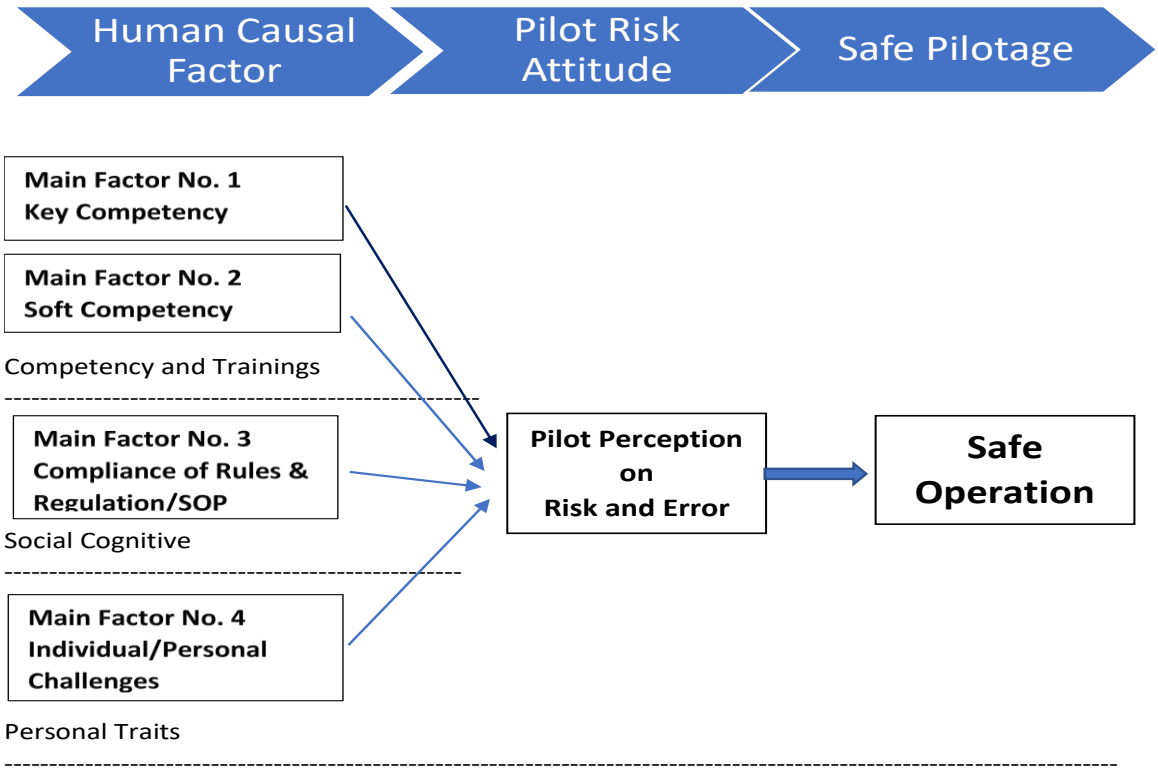

Figure 2: The conceptual model for pilot perception on HCF toward pilot risk or error.

Online survey was conducted from 18th January to 3rd March 2022 to collect the raw data on perception of the Human Causal Factors using the Google Form. Cronbach Alpha (equation 1) is being used to analyse the reliability of the data. From the analysis, we have derived the internal consistency of Cronbach Alpha is = 0.956999 which is considered very reliable and excellent.

$$\alpha = \left(\frac{K}{K-1}\right)\left(1 - \frac{\sum V_i}{V_T}\right) \quad (1)$$

4. Results and Discussion

A total of fifty (50) respondents participated in the pilot survey on their perception about the forty (40) contributing factors of the Human Causal factor. Majority of the respondents are Malaysian and Bruneian. However, one Australia and one Singaporean had participated in this survey. A wide spectrum of their experiences ranging from junior pilot to super senior pilot or advisor to the state government. 60% of the respondents have more than 10 years experiences as pilot or pilotage related occupations. A 92% of the respondents are actively involved in pilotage or marine related industries (Figure 3). Male respondent dominated in this survey. A very high 94% of the respondent agreed that a proper risk identification/assessment could prevent or reduce chances of pilot errors. Figure 4 show Age Groups of the Respondents. Whereas Figure 5 shows the years of experiences as pilot or pilotage related task.

eISBN 978-967-2298-96-0

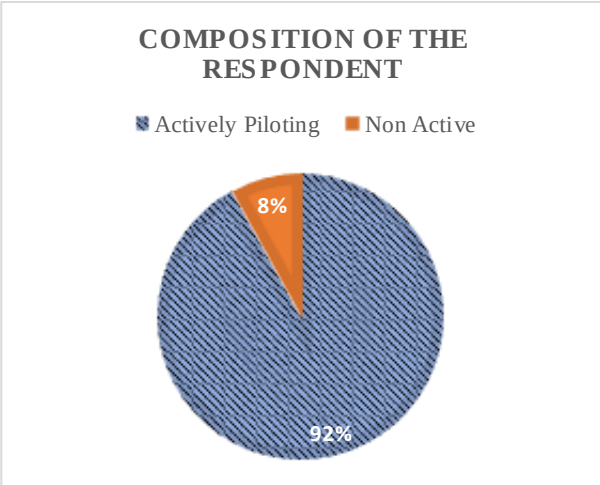

Figure 3: Composition of Respondents

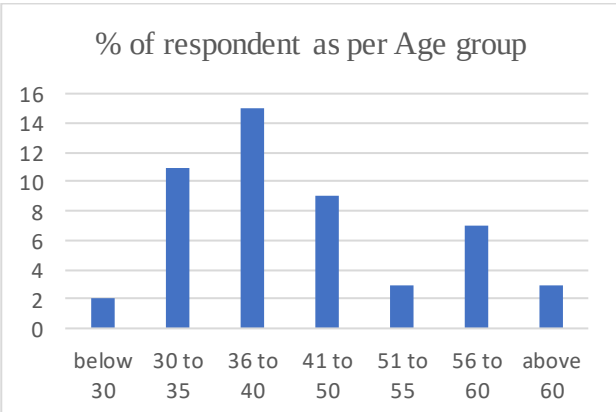

Figure 4: Age Groups of the Respondents

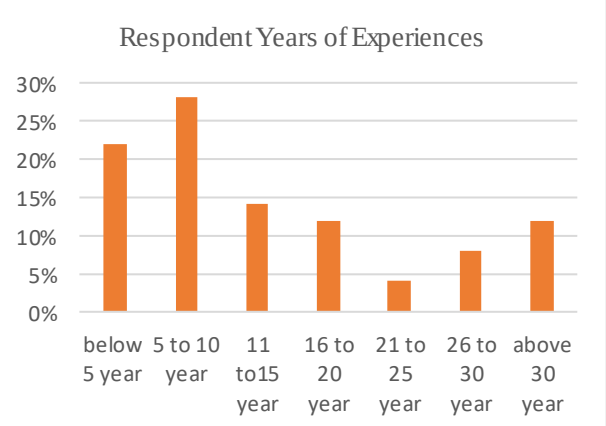

Figure 5: Year of experiences as Pilot

The following Figure 6 and table 2 shows the data collected during the survey. Figure 6 showing the distribution of the survey result using Likert Scale. It shows that majority of the respondents gave positive responses. Whereas from the table 5, it is found that the uncertainty analysis shows below 2%. Hence there is low spread between respondents for each question.

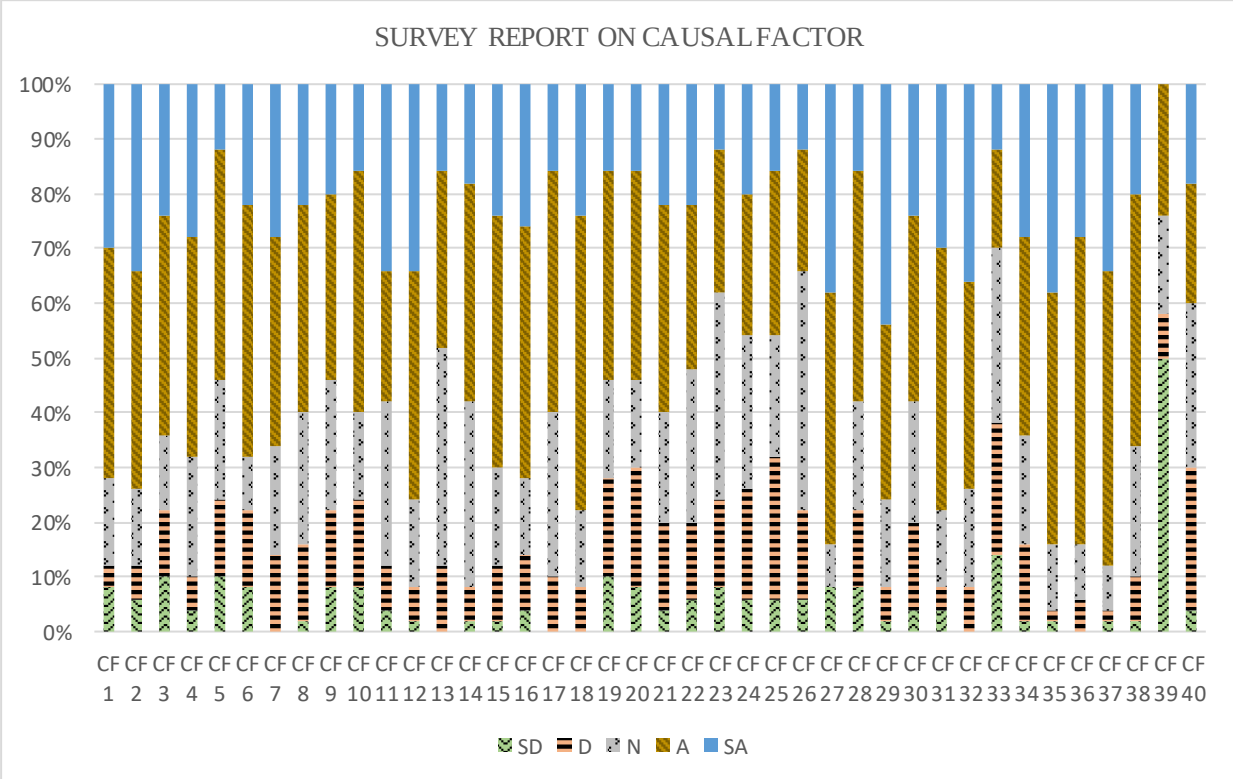

Figure 6: Overall result on the survey (SD is Strongly Disagree; D is Disagree; N is Neutral; A is Agree; SA is Strongly Agree).

Table 2: Mean and Standard Deviation for 40 Questions

HCF	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Total	Mean	Standard Deviation
CF 1	4	2	8	21	15	50	3.82	0.070
CF 2	3	3	7	20	17	50	3.9	0.071
CF 3	5	6	7	20	12	50	3.56	0.065
CF 4	2	3	11	20	14	50	3.82	0.069
CF 5	5	7	11	21	6	50	3.32	0.060
CF 6	4	7	5	23	11	50	3.6	0.066
CF 7	0	7	10	19	14	50	3.8	0.068
CF 8	1	7	12	19	11	50	3.64	0.065
CF 9	4	7	12	17	10	50	3.44	0.063
CF 10	4	8	8	22	8	50	3.44	0.062
CF 11	2	4	15	12	17	50	3.76	0.068
CF 12	1	3	8	21	17	50	4	0.072
CF 13	0	6	20	16	8	50	3.52	0.062
CF 14	1	3	17	20	9	50	3.66	0.065
CF 15	1	5	9	23	12	50	3.8	0.068
CF 16	2	5	7	23	13	50	3.8	0.069
CF 17	0	5	15	22	8	50	3.66	0.065
CF 18	0	4	7	27	12	50	3.94	0.070
CF 19	5	9	9	19	8	50	3.32	0.061

CF 20	4	11	8	19	8	50	3.32	0.061
CF 21	2	8	10	19	11	50	3.58	0.065
CF 22	3	7	14	15	11	50	3.48	0.063
CF 23	4	8	19	13	6	50	3.18	0.057
CF 24	3	10	14	13	10	50	3.34	0.061
CF 25	3	13	11	15	8	50	3.24	0.059
CF 26	3	8	22	11	6	50	3.18	0.057
CF 27	4	0	4	23	19	50	4.06	0.074
CF 28	4	7	10	21	8	50	3.44	0.062
CF 29	1	3	8	16	22	50	4.1	0.074
CF 30	2	8	11	17	12	50	3.58	0.065
CF 31	2	2	7	24	15	50	3.96	0.071
CF 32	0	4	9	19	18	50	4.02	0.072
CF 33	7	12	16	9	6	50	2.9	0.053
CF 34	1	7	10	18	14	50	3.74	0.068
CF 35	1	1	6	23	19	50	4.16	0.075
CF 36	0	3	5	28	14	50	4.06	0.072
CF 37	1	1	4	28	17	50	4.24	0.075
CF 38	1	4	12	23	10	50	3.74	0.067
CF 39	25	4	9	12	0	50	2.16	0.041
CF 40	2	13	15	11	9	50	3.24	0.059

From the Figure 5, a total 64% of the respondents had experienced some unwanted issues or past incidents whilst they carried their daily pilotage task. This finding also in agreement (Barca, 2019; Hong-Bin, 2018) mentioned that the maritime pilot is one of the most dangerous and high-risk jobs within the maritime industry. This shows that it is very significant to conduct further study to determine root causes and mitigation for the pilot risk and error.

Moreover, the survey revealed that 84% of the respondents agreed or strongly agreed that CF 27 - Failure to object or postpone the movement due to the extreme weather and sea conditions or exceeding the allowable limits could be the main root causes of those unwanted incidents or accidents. Accident could be avoided if one dare to stand firm on his professional judgement and brave enough to reject those unreasonable commercial pressure. also found this similar root causes. This is happening due to commercial pressure to the pilot. Seafarers including Pilots are pressurised to keep quiet and keep the ship moving by port operators, ship owners and shipping agents, who do not want to lose income. Economic of scales, turning blind eye to safety issues to attract and retain clients has increased commercial pressure.

Noted that 18% of the respondents did not agree that a proper structured Continuous Professional Development (CPD) system could reduce or eliminate all possible pilot errors. From the closer review, it was those senior pilots whose high egoistic and year of experiences have cultivated their comfort zone and it could because of their fear of the latest technological advancement. Another new area of study that may prosper.

From the Figure 5, CF 35 - Heavy Workload or fatigue scored 84%. A closer check on the comments given by the respective respondents have revealed that there is a need to closer look on their working schedules and conditions. Heavy workload and fatigue should bring up to their management, there should have a new formula or threshold level in term of working hours or number of ships that are to be observed closely. Whereas 84% of the respondent

strongly agreed or agreed that CF 36 Physical Health status of the Pilot is important for them to carry out their daily task safely and professionally.

Furthermore, CF 37 - Mental health status or ability to stand stress scored highest, 90% of the respondents agreed or strongly agreed as key contributing factor for pilot errors. The findings are different from the studies conducted by (Oldenburg et al., 2021), the reasons could have to be but not confined to the working rotation system, alcoholic behaviour, sleeping disorder and lifestyle. Finally, a very high of 94% of the respondent agreed or strongly agreed that a proper risk identification/assessment could prevent or reduce chances of pilot errors. The risks and uncertainties in pilotage operations have yet to be fully explored (Oraith, 2020; Amornpipat, 2021).

5. Conclusion

This paper presents a novel way of identifying the pilot's perception toward their errors and risk. From this study, the Pilot Organization or Authority should focus more on the attributes from the 4 main human causal factor - Individual or Personal Challenges or Deficiencies instead of Technical or Non-technical Competencies for eliminating of pilot errors or risk.

The approach is to ensure more personal touch and pay more attention to individual or personal deficiencies. Reducing of stress and workload will help. To conduct a regular risk assessment and provide mitigations for any pilot risk. This study provides empirical evidence on how the perception on the HCF of the pilot risk and error including their hazardous attitude, risk tolerance, and risk perception influence the safety behaviour of pilots. Further study on HCF in relation to pilot risk and error is highly recommended.

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eISBN 978-967-2298-96-0

Emergency Response Time and Sustainable Safety Goals for an Integrated Oil and Gas Facility

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Abstract

Safety goals of oil and gas industry are in line with current global SDGs. In an emergency incident time is of the crucial factor, and the basic philosophy of an emergency response agency is to respond as quickly as possible to minimize the loss of life and property damage. Emergency response operations are very important activities in the oil and gas industrial areas. As an incident in an integrated facility at oil and gas industrial area can have considerable major economic and social impact, response to such an incident has to be provided in a very short time. The use of parameters plays an important role in the successful implementation of emergency response. The decisions for such emergency responses to integrated facility should consider the available emergency resources, and other factors such as emergency responders competency, fire protection and fire detection system, and the characteristics of surrounding affected industrial facilities. Exploring potential options can be risky and costly to implement; improving the response time provides a means of overcoming these obstacles. This case study considered configuration emergency response time parameters at an integrated facility. Therefore in order to predict the response time consideration must be given to the characteristics of emergency response parameters, it effectiveness and efficiency. This study

aims to identify parameters considered to reduce response time for crisis management through literature review. Having this process will enable the company to improve emergency preparedness and response management and aligned with crisis management protocol by government authority.

Keywords: Sustaining safety response time, integrated facility, emergency responders.

1. Introduction

Integrating emergency response time into sustainable development strategies, by identifying the emergency response parameters, strengthening risk assessment and disaster/emergency prevention, will be critical to protecting the gains of development. The Sustainable Development Goals (SDGs) are the blueprint to achieve a better and more sustainable future for all. The ultimate purpose of emergency management is to save lives, preserve the environment and protect property and the economy. The protection of life is of paramount importance. In the broadest sense, emergency management raises the understanding of risks and contributes to a safer, prosperous, sustainable, disaster resilient society. This research is to understand how the operational effectiveness of the emergency response time can be improved by applying applicable configurable parameters. Emergency response time is controlled by different characteristics/factors; this study will identify, analyze and determine the degree of their consequence and effect on the overall response time and how it related to sustainable safety goals.

This research begins with a case study involving an oil and gas facility located in Bintulu, Sarawak, Malaysia.

The research objective is achieved by answering two questions:

1. *What are the parameters required to reduce emergency response time for an Integrated Facility and the direct effect on response time improvement?*
2. *Could an integrated and centralized emergency fire services interventions be identified, modeled and implemented that can significantly and effectively improve response time and how it relates to sustainable developments goals (SDG)?*

2. Problem Statement

NFPA 1710 section 4.1.2.1 states that a fire department shall arrive within four minutes after receiving the fire alarm 90% of the response times. The National Fire Protection Agency (NFPA) recommends a two-minute turnout time. NFPA defined the term “response time” is measured as being the total amount of travel time between the fire units leave the station and arrive to the scene (NFPA 1710, 2004). When benchmarking the response time of a fire & rescue services, it is usually compared to a standard response time. The current the plant fire brigade response performance can provide a minimum of five responders to this fire area in full turnout gear within 5 to 10 minutes. The public fire department response time is approximately 20 to 25 minutes. A delayed response can have life threatening, reputation and economic consequences that may otherwise have been avoided. studied and found that responses delayed by as little as five minutes can allow overall damage to increase by 97-percent for tightly coupled events such as structural fires, road accidents, or drowning cases (Mattsson et al.,1997).

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3. Literature review

Suraj Mal et al (2018) in in Climate Change, Extreme Events and Disaster Risk Reduction Book defined the Emergency response during disasters: -

The main actions during the disaster emergency include emergency information dissemination, evacuation, self-help and cooperation, rescue, emergency resources reserve, and deployment. The agencies of emergency response should follow the allocation of responsibilities and the requirements of the emergency plan, dispatch of emergency rescue experts, materials and equipment in time and give feedback to the city emergency response center in time. Considering the importance of communication during a disaster, information dissemination should be timely, accurate, and objective. And the rescue should be comprehensive and efficient.

A disaster can encompass a more general period in which there is a clear and marked deterioration in the coping abilities of a group or community. Unusual initiatives by groups, communities and external intervention are also evident during this period. defined an emergency might be regarded as a particular type (or sub-set) of a disaster. "Emergency" suggests an intense time period and level of urgency . An emergency is bound by a specific period in which lives and essential property are immediately at risk. (Department of Humanitarian Affairs/United Nations Disaster Relief Office - United Nations Development Programme, 1992). The context emergency management functions are increasingly connected to issues such as environmental stewardship, community planning and sustainable development. (Britton, 2019). Emergency management is being relocated within a wider framework, or so it seems. Recent efforts have suggested that it is, for example, an integral part of community decision making.

The adoption of *'Transforming Our World: The 2030 Agenda for Sustainable Development'* represents the culmination of efforts to develop a successor to the Millennium Development Goals. The 2030 Agenda for Sustainable Development is being hailed as a positive and ambitious milestone for all regions and stakeholders. The UN Secretary-General describes the outcome as a "universal, transformative and integrated development agenda". The 17 Sustainable Development Goals (SDGs) and 169 global targets sets out areas to advance sustainable development. United Nations Office for Disaster Risk Reduction (UNISDR) and examines the links between disaster risk reduction and development in the context of 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction 2015-2030. The paper gives perspectives on how disaster risk reduction and resilience is reflected in the outcome document and outlines what disaster risk reduction means for the SDGs. It also highlights the opportunities to reduce disaster risk, build a resilient future and achieve the goals and targets through the implementation of both the 2030 Agenda for Sustainable Development and the Sendai Framework.

Goal 3: Ensure healthy lives and promote well-being for all at all ages

People"s health and wellbeing are often affected as a result of disasters and other emergencies. Major risks to public health are raised by diseases, injuries, psychosocial effects and disabilities linked to extreme weather and climate-related hazardous events.

Target 3.d, which relates to strengthening early warning and risk reduction of national and global health risks presents an opportunity to further actions to promote resilient health systems. This target in particular is complemented by the outcome of Sendai Framework which has placed strong emphasis on the resilience of health

systems and integration of disaster risk reduction into health care provision at all levels.

The response time norms implemented in various countries. These included North America which adopted the 8:59 benchmark in urban areas, 15 minutes in rural areas and 30 minutes in wilderness areas. It was indicated that these should be achieved for 90% of the life-threatening emergency cases. The United Kingdom has had an established national standard since 2001 for both urban and rural areas for life threatening cases. This standard includes achieving a response time of eight minutes with 75% compliance, of which 95% must be within 14 minutes in urban areas and within 19 minutes in rural areas. Response times in Australia are measured at five, 10 and 15 minute intervals. It was reported that 50% of the cases are responded to within 10 minutes for both rural and urban areas. (Fitch, 2005). On August 5, 2004, NFPA-1710 has established specific response time objectives for fire suppression services. (Ahmed Jarallah, 2015). According to the NFPA, the term "response time" is measured as being the total amount of travel time between the fire units leave the station and arrive to the scene. NFPA-1710 section 4.1.2.1 states that a fire department shall arrive within four minutes after receiving the fire alarm 90% of the response times.
Delayed of emergency response by as little as five minutes can allow overall damage to increase by 97-percent for tightly coupled events such as structural fires, road accidents, or drowning cases. (Mattsson et al.,1997).

Similarly, the arrival of emergency responders in five minutes instead of seven can nearly double the probability of survival in heart attack victims. Hong Kong adopted what is known as a performance pledge which involves arriving within 12 minutes for 92% of all cases. The same response commitment has been made to both emergency and non-emergency cases. In Monterrey, Mexico, the average response time achieved was 10 minutes while in Hanoi, Viet Nam the recorded average response was 30 minutes. (Kobusingye et al., 2005). A descriptive study conducted in Nordic countries, reported a response time average of less than five minutes to cases categorised as immediately life threatening in Copenhagen in Denmark. The Norwegian government required response time for patients in remote areas was 45 minutes and using predominantly service, rotor-wing ambulances manned by physicians. (Langhelle et al., 2004).

London recently reported a deterioration in response times of up to 12% over a period of 12 months as compared to the target of eight minutes and with late arrivals to 42% of critically ill patients (DailyMail, 2016). This is a clear indication that, as predicted by Blackwell and Kaufman (2002) and Pons and Markovchick (2002), the sustainability of the eight minute target is unrealistic.

South African national response time standard for urban areas is less than 15 minutes and less than 40 minutes for rural areas. (Finlayson, 2017). The The KZN public EMS uses this benchmark to measure their responses to priority one (red code) cases in both urban and rural areas (KwaZulu-Natal Department of Health 2004). One important component of emergency response is the time taken to respond, which has been identified as a measure of emergency performance Al-Ghamdi (2002), and Pons et al (2002). A few scholars have asserted that performance measurement is recognized as an index of output or production. Because the time taken to respond by firefighting teams is a form of work output, the response time is clearly a form of performance measurement. The relationship between the time and distances of 2000 incidents attended by 15 units within New York City at different times of the day. This study found that for short distances travel time increased with the square root of the distance and that

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for long travel distances the travel time increased linearly. (Kolesar and Walker,1979). No standard or norm has been cited for non-priority one cases in South Africa. (Stein, 2014).

The International FORUM of Fire Research Directors: A position paper on sustainability and fire safety defined the Fire safety issues as that could arise in the move toward energy efficiency, environmental protection and sustainable design and construction are revealed when one considers how this move might impact (1) the flammability of materials(ignition, heat release rate, and flame spread), (2) the toxicityof the products of combustion, (3)automatic suppression approaches, (4) the materials'resistance to fire(ability to maintain confinement and/or structural loading),and (5) firefighting strategies (physical accessibility, firefighter protection, hazards from electrically energized equipment such as photo voltaic panels and battery powered vehicles).

The Common Framework for Preparedness (the Common Framework) (2013) supports the development of preparedness capacity in a more coherent manner using a systematic country level approach that collectively assesses capacity and need, uses this assessment to jointly develop programmes and plans, and coherently implements these programmes and plans to strengthen preparedness. Preparedness is situated within an overall, nationally led, disaster risk management (DRM) context, which includes prevention, mitigation, preparedness, response and recovery measures. In the broadest sense, emergency management raises the understanding of risks and contributes to a safer, prosperous, sustainable and disaster resilient society. Emergency management is comprised of four interdependent components as follows:

- **Prevention and Mitigation.**
  To adapt to, eliminate, or reduce the risks of disasters in order to protect lives, property, the environment, and reduce economic disruption.
- **Preparedness**
  To be ready to respond to a disaster and manage its consequences through measures taken prior to an event.
- **Response**
  To act during, immediately before or after a disaster to manage its consequences.
- **Recovery**
  To repair or restore conditions to an acceptable level through measures taken after a disaster.

These four interdependent components may be undertaken sequentially or concurrently, but they are not independent of each other. Emergency management in provincial, territorial and federal governments adopts a comprehensive all-hazards approach to coordinate and integrate prevention and mitigation, preparedness, response and recovery functions to maximize the sustainable safety goals. Effective implementation of the four emergency management components should be informed by evidence-based risk assessment, strong public awareness and community engagement, all of which are key attributes of societal resilience.

Table 1: Research and Literature Review Comparison of Response Time Parameters

No	Research	Parameter Covered
1	Ahmed Jarallah Al-Jarallah (2015), Analysis of Characteristics and Factors Influencing Fire Incidents Response Times in Urban Areas in Saudi Arabia: Case Study of Dammam City.	- Physical Factors: Land zones, Fire Station location, population and accessibility. - Non Physical Factors: Time, Traffic Low, Administration and Socio-Culture

2	Benjamin (2016) Spatial modelling of emergency service response times.	- Location of fire station - Baseline hazard, cumulative hazard, - Relative risk,
3	Dennis (2015) Improving Fire Department Turnout Times: Training v. Sanctions in a High Public Service Motivation Environment.	- Organizational strategies (training v. policy enforcement with sanctions) - Training (Competency) - Station & Control Variables
4	Ed Claridge et al., (2013).New Zealand fire service response times to structure fires.	- Times for receipt of information, for dispatch, fire-fighter response - Fire appliance response speeds and distance relationship - Minimum and maximum response speeds
5	Keegan et al., (2017), Improving Fire Station Turnout Time.	- Configurational - Procedural, - Behavioral Factors
6	Pietrzak, (1979), The Effect of Fire Engine Road Performance on Alarm Response Travel Times.	- Travel Time Model (road and vehicle related factors) Fire Engines Performance Characteristics
7	Mainak Bandyopadhyay et al, (2016). Development of agent based model for predicting emergency response time.	Route selection behaviour and driving speed based on the proximity characteristics of road segment.
8	Tyler et al., (2018) Statistical Analysis of Fire Department Response Times and Effects on Fire Outcomes in the United States.	- alarm time - arrival time - Incident controlled.
9	Soufiene Djahel et al., (2015) Reducing Emergency Services Response Time in Smart Cities: An Advanced Adaptive and Fuzzy Approach.	- Traffic Management System (TMS) (Traffic Light Change (TL), Speed Limit Change (SL), Lane Clearance (LC), Emergency Response Plan.
10	Vincent (1998). A Study To Determine Reflex Time Of Responding Emergency Personnel For The Alhambra Fire Department.	- Reflex time of responding personnel - Acceptable reflex time standard - incident information - Individual Responders

Table 2: Time Correlation with Temperature and Sequence Of Events

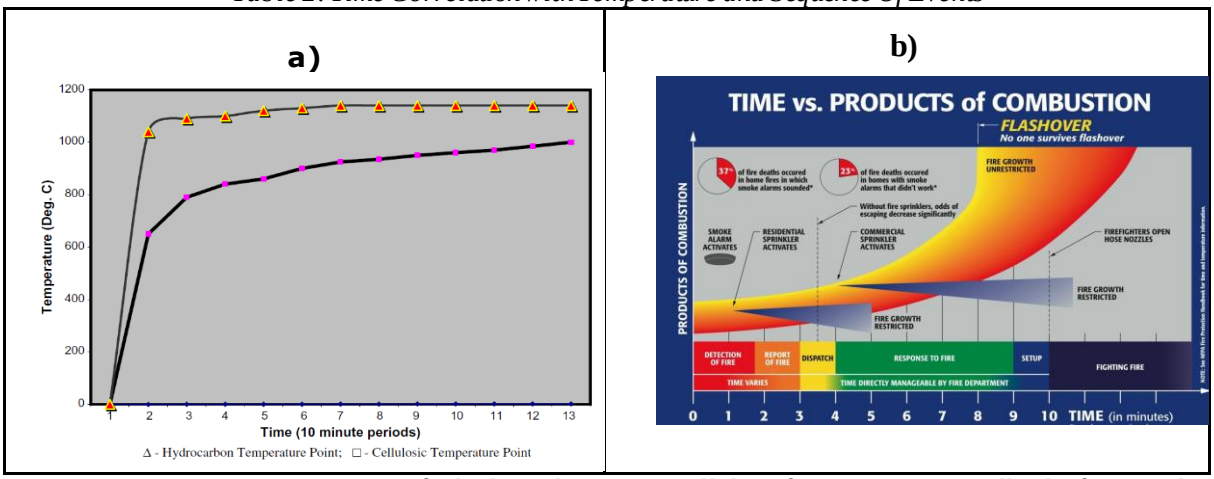

Figure a: Time temperature curves for hydrocarbon versus cellulosic fires. (Source: Handbook of Fire and Explosion Protection Engineering Principles)

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Figure b: Fire Growth Over Time And Sequence Of Events That May Occur From Ignition To Suppression. (Source: SFPE Handbook 2005)

4. Methodology

The following data have been collected and to achieve the goal of this 'Pilot Test Research' paper. A descriptive causal comparative method and semi structured interview technique was used as it attempts to determine the parameters to reduce emergency response time and the standard time required. A case study was carried out in oil and gas facility located in Bintulu, Sarawak Malaysia. Kidurong functions as the main industrial core of the Bintulu area. The semi structured interview technique was used to obtain and synthesize the opinions of experts from the expert's opinion / subject matter expert (SME) sector in Malaysia particularly those who involved in managing of emergency for Oil and Gas Industry and Government Authority.

Twenty 20 experts who had been working for a minimum of 15 years and were currently at the management level and operational level in their organizations. This subject matter experts (SME) from the various background and sector were interviewed using semi-structured interview schedule. The interviewees were selected based on an assessment of their importance for the management of the emergency preparedness and response. The questions embraced the following topics:

Table 3: Research Survey questionnaires (Pilot Test)

1.	*Name*
2.	*Designation*
3.	*Organization*
4.	*Please list and describe the parameters required to reduce emergency response time for an Integrated Facility.*
5.	*Form your expert opinion what are the ideal of 'Response Time' (in minute)?*

These experts were asked to complete the semi structured interview survey, which collected information about basic demographic characteristics and survey used open-ended question. A total of 20 experts completed the research survey, the results of which were organized into Identification of Parameters Required to Reduce Emergency Response Time.

5. Findings and Recommendations

Table 4a, 4b and 5 illustrates how the Pilot Test Research Survey findings can further inform theory about emergency response time from expert's opinion / subject matter expert (SME) perspectives it correlation with sustainable safety goals. This study suggests that the Variable Parameters Required to Reduce Emergency Response Time is complex, dynamic, and structured.

This findings study suggests that the 'Top 8', parameters/variables to be categorized/characterized based on the following priority:

a) Fire vehicle driver's competency
b) Automatic Fire Alarm System / Detection System
c) Fire station numbers & location
d) Drill / Exercise
e) Global Positioning System (GPS)
f) Incident Notification & Communication
g) Standard Operating Procedure (SOP) to response
h) Incident Layout Plan / Mapping

Table 4a: Expert Opinion on the most top 8 Variables

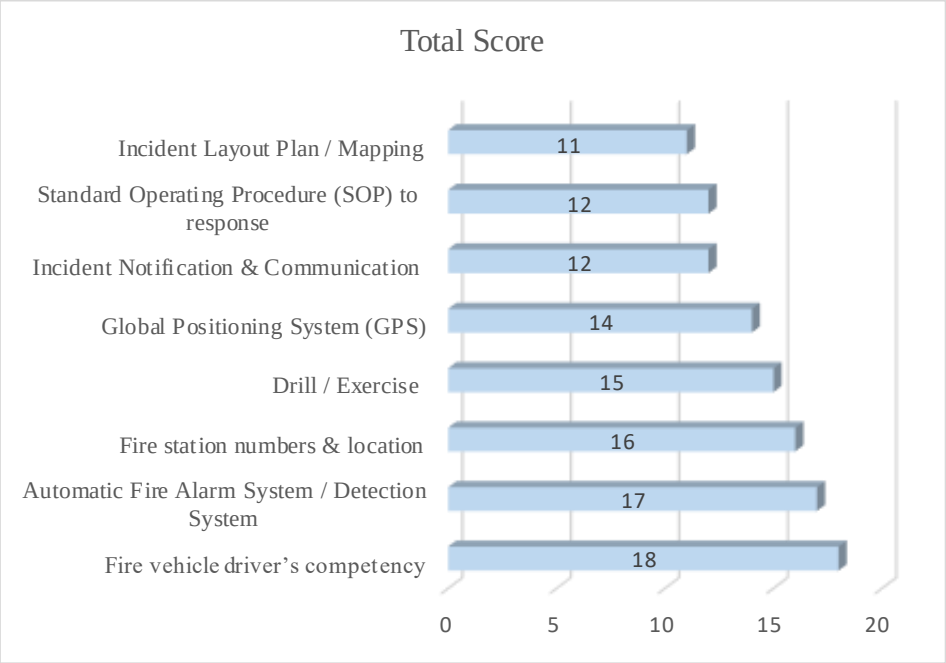

Table 4b: Expert Opinion on Response Time Parameters

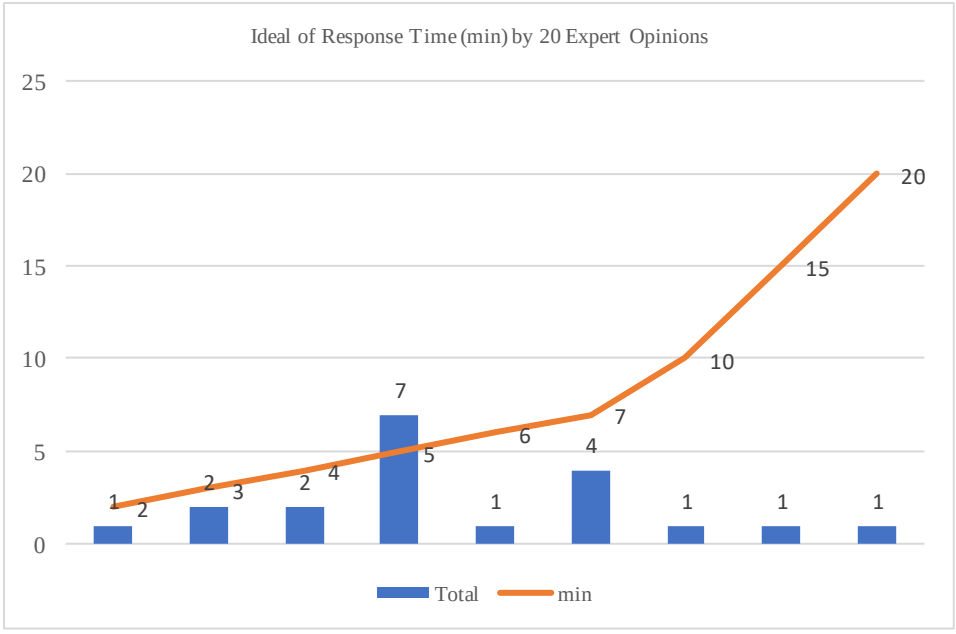

Table 5: Subject Matter Experts Survey Research Summary Analysis

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Expert Opinion & Ideal of Response Time (min)	Variables																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Expert Opinion & Ideal of Response Time (min)	Fire station numbers & location	Physical Road condition	Traffic condition	Fire vehicle condition	Fire vehicle driver's competency	Road user awareness and cooperation	Incident Notification & Communication	Drill / Exercise	Access road	distance from station to emergency scene.	Emergency response vehicle speed limit	Standard Operating Procedure (SOP) to response	Weather Condition	Incident Layout Plan / Mapping	Global Positioning System (GPS)	Firefighting Response Strategy	Automatic Fire Alarm System / Detection System
Expert # 1 & 5 min.	•	•	•	•	•	•											
Expert # 2 & 5 min.	•				•		•	•									
Expert # 3 & 2 min.	•				•					•	•						
Expert # 4 & 3 min.				•	•		•					•					•
Expert # 5 & 5 min.	•	•			•			•	•							•	•
Expert # 6 & 4 min.	•	•			•		•	•				•		•	•	•	•
Expert # 7 & 4 min.	•	•			•		•	•				•	•	•	•		•
Expert # 8 & 3 min.	•				•		•	•				•		•	•		•
Expert # 9 & 6 min.	•				•			•	•			•		•	•	•	•
Expert # 10 & 5 min.	•	•			•		•	•		•				•	•	•	•
Expert # 11 & 5 min.	•	•						•				•	•	•	•		•
Expert # 12 & 5 min.		•			•		•	•				•			•	•	•
Expert # 13 & 7 min.	•				•	•	•			•				•	•	•	•
Expert # 14 & 5 min.	•	•		•				•				•		•	•	•	•

Expert # 15 & 10 min.	•	•			•		•		•	•		•			•			•		•		
Emergency	•			•	•		•	•						•	•			•	•			
Expert # 17 & 7 min.		•			•	•	•	•				•			•	•				•		
Expert # 18 & 15 min.	•		•		•			•	•	•	•				•	•	•	•		•		
Expert # 19 & 7 min.	•	•			•		•	•				•			•	•				•		
Expert # 20 & 20 min.					•		•	•				•	•			•	•	•				

5.1 Relation between of Emergeny Response Time variables/parameters and Sustainable Safety Goals.

Sendai Framework for Disaster Risk Reduction 2015–2030.
Sendai Framework for Disaster Risk Reduction 2015–2030 (2015), states the present Framework will apply to the risk of small-scale and large-scale, frequent, and infrequent, sudden and slow-onset disasters caused by natural or manmade hazards, as well as related environmental, technological and biological hazards and risks. It aims to guide the multi-hazard management of disaster risk in development at all levels as well as within and across all sectors.

Expected outcome and goal.
The realization of this outcome requires the strong commitment and involvement of political leadership in every country at all levels in the implementation and follow-up of the present Framework and in the creation of the necessary conducive and enabling environment.
- *To attain the expected outcome, the following goal must be pursued:*

> *Prevent new and reduce existing disaster risk through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political, and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience.*

Sustainable Development Goals related to Fire Safety Goals.
The following each SDG is linked to fire and rescue services and what actions can be taken to maximize impact, either directly or through partnerships. The business case to do this is compelling: by embedding sustainable development goals in a fire and emergency service:

i) Sustainable Development Goals 6. (SDG 6 - Clean Water & Sanitation)
SDG 6 is about ensuring safe drinking water, sanitation and hygiene for all. This includes efficient use of water, treatment of wastewater and improvement of water quality. Water is a critical resource for firefighting. Therefore, we need to consider smart usage of freshwater

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as fire water as we are 'fighting fires with gold'. This means that firefighting operations should manage efficiently to assure the supply of water for emergencies used.

ii) Sustainable Development Goals 9. (SDG 9 - Industry, Innovation and Infrastructure)

In Boosting Sustainable Buildings Through Fire Safety, Resilience is one of the potential achievement of the SDGs. For instance, **SDG 9** states that to achieve the SDGs and empower communities, investment in quality, reliable, sustainable and resilient infrastructures is crucial. One of the example is 'Green buildings' and If a building is not fire resilient, the aftermaths of a fire will create considerable waste of materials which implies the use of important additional resources. This has substantial environmental, economic and social impacts.

iii) Sustainable Development Goals 11. (SDG 11- Sustainable Cities & Communities)

SDG 11 puts critical emphasis on efficient urban planning and underlines the need for sustainable human settlements and resilient buildings. Making building resilient, i.e 'Green buildings' seems crucial, particularly when the continent has been under stress from more frequent and more violent fires. With changing landscapes structures, putting people and their properties at significant risk. Truly greening our buildings and guaranteeing the emergence of sustainable cities and communities in this context demands efficient urban planning and to do so fire resilient buildings are essential.

iv) Sustainable Development Goals 13. (SDG 13 - Climate Action)

SDG 13 is about taking urgent action to combat climate change and its impacts. The world needs to anticipate, adapt and become resilient to the current and expected future impacts of climate through policies and disaster resilience preparation (supporting the Sendai framework for Disaster Risk Reduction). Emergency Fire Services can contribute to this SDG by decarbonizing their operations and supply chains through continuously improving energy efficiency, reducing the carbon footprint of products, services and processes, and setting ambitious emissions-reduction targets in line with climate science, as well as scaling up investment in the development of innovative low-carbon products and services.

v) Sustainable Development Goals 14. (SDG 14 - Life Below Water)

SDG 14 aims to conserve and sustainably use the oceans, seas and marine resources for sustainable development, reduce marine pollution and acidification, and restore marine ecosystems. By reviewing incident response tactics for minimizing water usage, we not only address SDG 3 but also SDG 14: less water is also less pollution. Assure proper fire-water containment before it runs off into rivers or soil, then safely transport and treat it with the objective of recycling it.

vi) Sustainable Development Goals 15. (SDG 15- Life on Land)

SD15's goal is to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification and halt and reverse land degradation, and halt biodiversity loss. Rising temperatures due to climate change increase the likelihood of such events. Projections for much of the US West alone show that an average annual 1°C temperature increase would increase the median burned area per year as much as 600% in some types of forests.

Table 6: Mapping of SDG with Fire Safety Sustainable Goals

Sustainable Development Goals	Fire Safety Sustainable Goals
SDG 6 - Clean Water & Sanitation	- Comprehensive and efficient Standard Operating Procedure (SOP). - Accurate Incident Layout Plan / Mapping
SDG 9 - Industry, Innovation and Infrastructure	- Reliable Automatic Fire Alarm System / Detection System - Strategic Infrastructure (fire station numbers & location) - Regular Drill / Exercise
SDG 11 - Sustainable Cities & Communities	- Excellence Capability Management (Fire vehicle driver's competency) - Effective and Reliable Incident Notification & Communication - Comprehensive and efficient Standard Operating Procedure (SOP). Incident Layout Plan / Mapping
SDG 13 - Climate Action	- Comprehensive and efficient Standard Operating Procedure (SOP). - Accurate Incident Layout Plan / Mapping
SDG 14 - Life Below Water	- Comprehensive and efficient Standard Operating Procedure (SOP). - Accurate Incident Layout Plan / Mapping
SDG 15 - Life on Land	- Comprehensive and efficient Standard Operating Procedure (SOP). - Accurate Incident Layout Plan / Mapping

5.2 Recommendation

Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction

The steady growth of disaster risk, including the increase of people and assets exposure, combined with the lessons learned from past disasters, indicates the need to further strengthen disaster preparedness for response, take action in anticipation of events, integrate disaster risk reduction in response preparedness and ensure that capacities are in place for effective response and recovery at all levels. Disasters have demonstrated that the recovery, rehabilitation and reconstruction phase, which needs to be prepared ahead of a disaster, is a critical opportunity to "Build Back Better", including through integrating disaster risk reduction into development measures, making nations and communities resilient to disasters.

Emergency Fire Services organizations deliver complex services including fire-risk prevention, mitigation and incident response covering residential areas, buildings, industrial facilities, public infrastructure and natural resources such as forests and grassland. The purpose of a firefighting service is to improve human safety and security and protect assets whilst minimizing impact on the environment. Firefighters can contribute to these global goals by reducing negative social, environmental and economic impacts of fire and creating a positive impact through a sustainable Emergency Fire Services organization.

- Incident Notification & Communication
- Regular Drill / Exercise
- Capability and Competency development
- Comprehensive and efficient Standard Operating Procedure (SOP).
- Accurate Incident Layout Plan / Mapping
- Reliable Automatic Fire Alarm System / Detection System
- Strategic Infrastructure (fire station numbers & location)
- Global Positioning System (GPS)

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In summary, based on the Pilot Test analysis and findings process can be concluded and to be strengthened based on the following study: -

Raman, M., et al (2006) examined 'Knowledge Management System for Emergency Preparedness: An Action Research Study' and received feedback from the respondents suggesting that the system can support the three main objectives of the project, i.e., to:

- *Improve the emergency communication process,*
- *Create a common platform for individuals and groups to share emergency-related information, and*
- *Improve the knowledge/information capture related to emergency preparedness.*

'Guideline for the Emergency Planning Process', stated that other guideline for an effective planning process is that it should provide for testing proposed response operations (Remold et al., 2003). Emergency drills and exercises provide a setting in which operational details may be critically examined. Furthermore, drills constitute a simultaneous and comprehensive test of emergency plans, staffing levels, personnel training, procedures, facilities, equipment, and materials. Finally, for Pilot Test all variables/parameters were significantly linked, and an emergency response time intervention program shall be executed. Comprehensive research on emergency response parameters to be explored more in order to prove the hypothesis.

6. Conclusion

Emergency Fire Services organizations deliver complex services including fire-risk prevention, mitigation and incident response covering residential areas, buildings, industrial facilities, public infrastructure and natural resources such as forests and grassland. The purpose of a firefighting service is to improve human safety and security and protect assets whilst minimizing impact on the environment. That purpose defines the basis for its contribution to a sustainable development of the world. A commonly used definition of sustainable development is 'development which meets the needs of current generations without compromising the ability of future generations to meet their own needs'. This implies a world which provides a safe and just space for humanity to live in, respecting the planetary boundaries (ecological ceiling) and providing basic human needs (social foundation).

Sustainable development will be out of the comfort zone of many experienced fire chiefs. As the world is changing, we are exposed to changing social, technological, environmental, economic, political, legal and ethical (STEEPLE) risks. Emergency Fire Services need to adapt and prepare for this changing landscape. Temperature rise, droughts, floods and natural hazards due to climate change, renewable energy, batteries, green buildings which use new building materials and structural systems (i.e. lightweight construction and engineered wood trusses), biomaterials, viruses, migration, etc. have an impact on the risk environment in which a fire and rescue service operates. New firefighting materials and tactics need to be adopted to mitigate these risks and reduce impact on biosphere, society and economy.

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SOCIAL SCIENCES & HUMANITIES CONFERENCE 2022 (SSHR 22) 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

Sungai Sarawak Barrage, Risk and Implications to the Community

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Abstract
The Sungai Sarawak Barrage is one of the three infrastructures in the Sungai Sarawak Regulation Scheme (SSRS). It is located on the North side of the diversion channel between North Junction point and Cameron point along the Prima Dona Reach of Sungai Sarawak. Since its operation in January 1998, there were several risks associated with the operation and presence of hydraulic structure in the rivers of Sarawak. Operating the barrage safely and efficiently to achieve its set objectives was a challenge to the operators of the barrage and to mitigate any risk this hydraulic structure may have on the community. Daily observation of tidal fluctuations and constant monitoring of the catchment is the key to mitigate the flooding

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of the city and to educate the riverine users to the new norm was the way forward. It is a challenge to try to quantify the risk, benefit and implication the barrage has on the community but to accept the new norm of having a regulated river is something the public and riverine users must adapt.

Keywords: barrage, benefit, community, risk, Sungai Sarawak

1. Introduction

The City of Kuching is located 30 nautical miles (52 km) from the Sungai Sarawak, river mouth at Muara Tebas which has its source it's source some 120 km from the Upper Kapuas mountain ranges, where Borneo Heights is located. Approximately 70 km the river divides Kuching city into North and South and the sub-urban and urban zones (Mah et al., 2011) and these areas are affected by tidal intrusion during the "King Tides". The Highest Astronomical Tide (HAT) is 6.5 or +2.5 m above Mean Sea Level (MSL) and is the highest in Southeast Asia (Sharp and Lim 2000). The low-lying areas in the city are affected for a period of approximately four days by the high tidal intrusion during the new moon and full moon which is monthly and fortnightly.

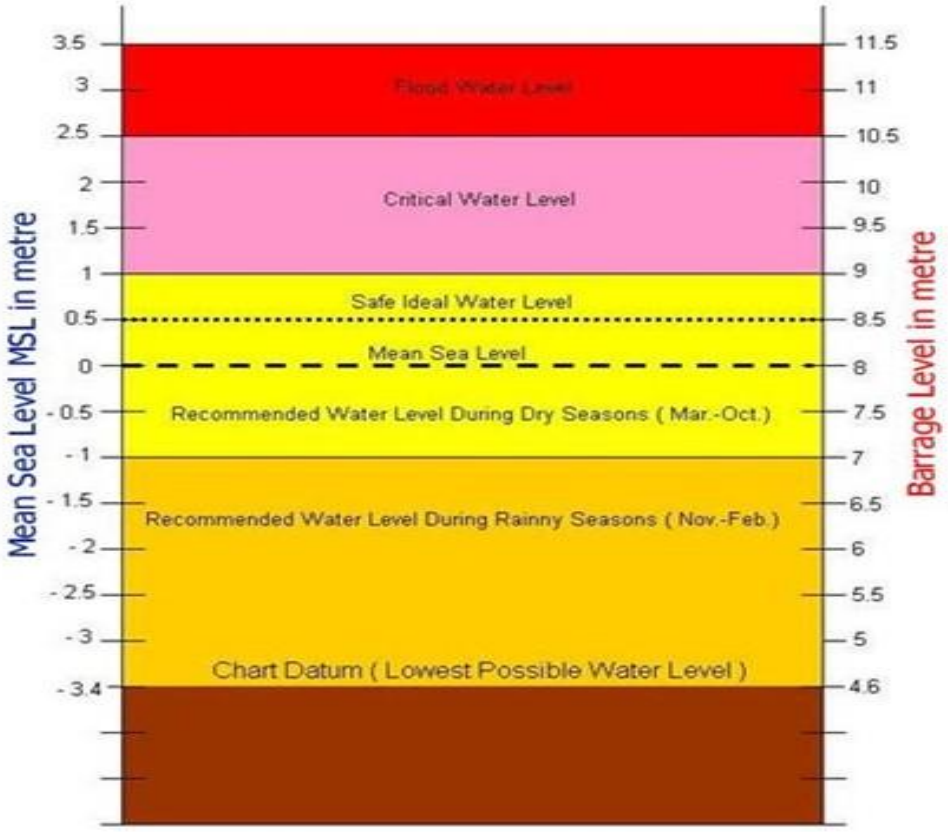
During the onset of the Northeast Monsoon, November to March, locally called "Landas" (Sharp & Howe, 2000) fluvial flooding might occur when a daily record of 285 mm (Sharp & Howe, 2000) or higher is experienced. In 1995, the Sarawak State Government decided to construct the Sungai Sarawak Regulation Scheme (SSRS) which comprises of a barrage, shiplock and bridge over these two infrastructures at the conference of North Junction point and Cameron point. An aerial view of the "three in one infrastructure" is in Figure 1.

Figure 1 Aerial view of the Sungai Sarawak Barrage (KASI Malaysia, 2017)

A barrage is an artificial obstruction at the mouth of a watercourse (Mah, D Y S, 2012) and the Sungai Sarawak barrage has it's risk and benefit to the community. It is designed to maintain (regulate) water level upstream of the barrage to a certain "safe water level" which is + 0.5 m above MSL or 8 m at the barrage stick gauge. At this level, any discharge could flow safely into the river. Figure 2 illustrates a proposed water level (Goh et al., 2021) to

maintain during the year. The operator of the barrage needs to ascertain the status of the catchment area in terms of rainfall for the last 24 and 48 hours, predicted weather conditions, water levels from the telemetry stations, predicted height of tide down river.

Figure 2 Proposed water level to be maintained (Goh et al., 2021)



2. Risk to the community

2.1 Population of Kuching city.

The main objective of barrage is to mitigate the flooding of Kuching city. Those residing in the low-lying areas of the urban and sub urban areas (Mah, Putuhena, et al., 2011) are at risk to encounter flooding especially during the "Landas" season which is from November to February (Lim & Sharp, 2001). The barrage was completed in August 1997 and commence operation in January 1998 and in December 1999 the barrage was tested with the heavy rainfall and "king tides" (Lim & Sharp, 2001). On the 23rd of December 1999, heavy rainfall was recorded at the catchment area and coupled with the King tide on the 23rd until 25th December 1999. The highest level recorded was on the 24th of December whereby the upstream level was 10.8 m (+2.8m MSL) was the first lipid test for the operation of the barrage and downriver water level was 11.3 m. (+3.3m MSL)

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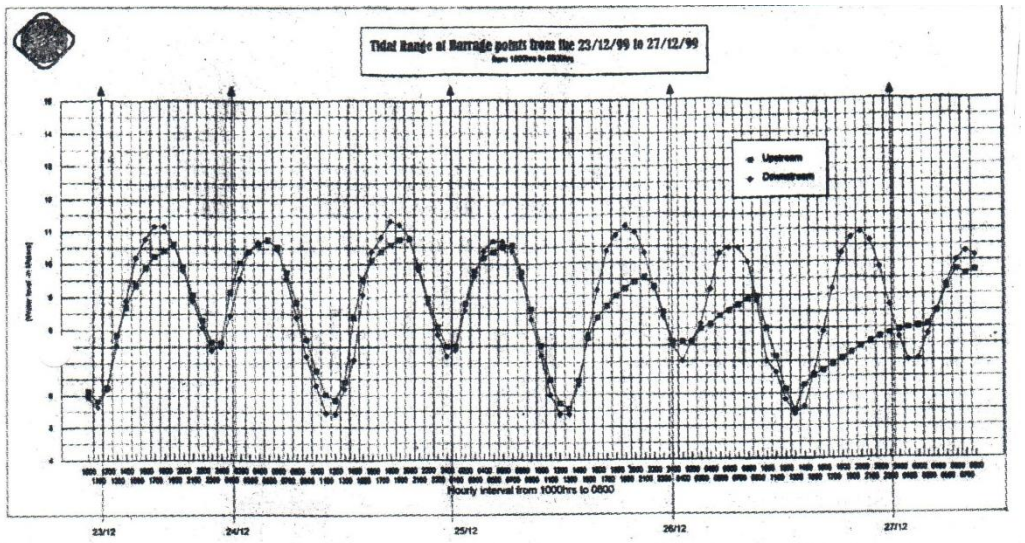
Figure 3 Barrage passes its first test-2000, January 6, Borneo Post



Barrage passes its first test

KUCHING, Tues. - The Sarawak River Board (SSB) which have the overall control of the Sarawak River Barrage has managed to pass through their first major challenge during the kingtides that were predicted at around Christmas 1999 which coincided with heavy rain.

According to the monitoring data provided by SSB which monitored the water levels both downstream and upstream of the Barrage, they have managed to keep the upstream water level lower than the downstream water level, which basically means that the Barrage has managed to stop the kingtides from flowing up the Sarawak River while at the same time, drained away the additional rainwater brought by the heavy rains.

"We can safely say that we have managed to control the problem of flooding upstream from the Barrage especially if heavy rains come at the time of kingtide. Flash floods caused by excessive rain which could build up due to poor or inefficient drainage is another matter," a spokesman of SSB said.

"SSB has six telemetry points within the catchment areas of the Sarawak River basin which automatically monitors and sends the data every half hourly to the main computer at the Barrage.

"Any excessive volume of water detected at these points will allow the board to alert the staff at the Barrage to prepare to flush out excessive water in order to be able to handle the volumes of water flowing down from upstream," the spokesman added.

Based on the data on the two water levels between 10 am on Dec 23 to 8 am on Dec 27, the highest levels of water were recorded at 7 pm on Dec 23 where the downstream water level (at the Barrage) was 11.2 metres and upstream water level 10.24 metres.

The highest levels of water on Dec 24 were at 6 pm when downstream water level was at 11.3 metres and upstream water level was at 10.57 metres.

By Dec 25, the highest downstream water level was 11.14 metres at 7 pm while the upstream water level at the same time was only 8.23 metres and by Dec 26, the difference is even greater with the highest downstream level recorded at 10.82 metres and the upstream water level was at 7.42 metres at 8 pm of that day.

The Sarawak River Barrage was first put into operation in 1997 when the State was experiencing the dry effects of El Nino and in 1998, the expected La Nina rains did not materialise at the end of the year.

So 1999 was the first time that the Barrage was able to experience high kingtides simultaneously with heavy rainfall brought about by the year end Landas monsoons. - Bp.

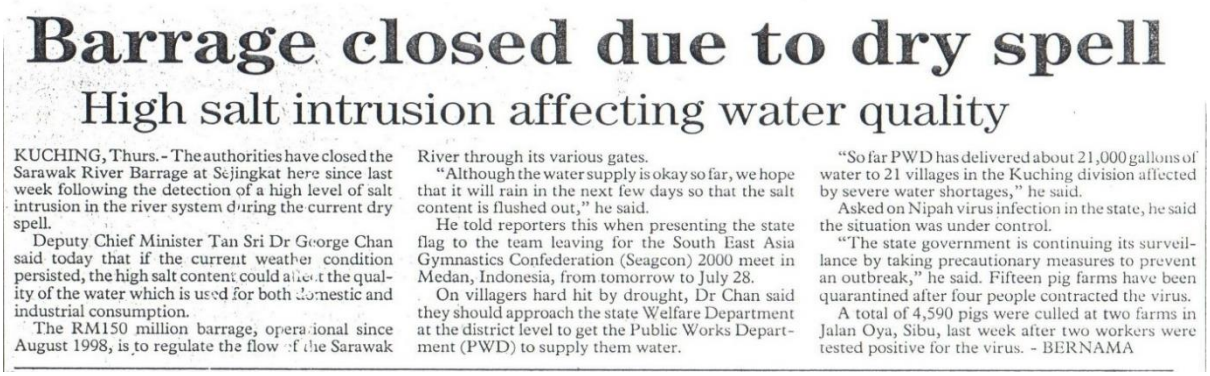
The graph above shows the tidal range of water level at the Barrage between Dec 23 and Dec 27.

There were several other occasions whereby the barrage managed to mitigate the flooding of Kuching city. The flood of 2004 was another crucial test as it was a 100-year flood event. Rainfall was 20 % more than the 1963 flood event. (KTA report, 2004). The period of flooding was reduced to three days as compared to the pre-barrage flood event (1963) which lasted more than a week. Other flood event was the flood of January 2009, January 2012 (two person lost their lives).

2.2 Saline intrusion on the raw water intake

Sungai Sarawak Kiri is subjected to tidal and saltwater is present in the river for a varying number of days during dry seasons, prior to 1998 (Said Salim et al., n.d.). During the dry spell where there is hardly any discharge from the catchment, the saline wedges will creep up to the raw water intake at Batu Kitang. When the barrage was in operation, the shipping community was not happy with the regulated water level of +0.5 m MSL (Figure 4). There were demands by the shipyards to raise the water level to the desired level so that they could "upslip "vessels for docking and repairs. In the process saline wedges creep up to the intake at Batu Kitang which is about 35 km from the barrage to the raw water intake. The impacts of barrage flushing and flooding-in operations on saline intrusion upstream (Law et al., 2011). These operations have adverse effects on the raw water quality at the water intake and was mitigated in 2005 by the construction of the Batu Kitang submersible weir (Said Salim et al., n.d.) (Figure 5).

Figure 4 Saline intrusion due to drought – 2000, July 21. Borneo Post



Barrage closed due to dry spell

High salt intrusion affecting water quality

KUCHING, Thurs. - The authorities have closed the Sarawak River Barrage at Sejingkat here since last week following the detection of a high level of salt intrusion in the river system during the current dry spell.

Deputy Chief Minister Tan Sri Dr George Chan said today that if the current weather condition persisted, the high salt content could affect the quality of the water which is used for both domestic and industrial consumption.

The RM150 million barrage, operational since August 1998, is to regulate the flow of the Sarawak River through its various gates.

"Although the water supply is okay so far, we hope that it will rain in the next few days so that the salt content is flushed out," he said.

He told reporters this when presenting the state flag to the team leaving for the South East Asia Gymnastics Confederation (Seagcon) 2000 meet in Medan, Indonesia, from tomorrow to July 28.

On villagers hard hit by drought, Dr Chan said they should approach the state Welfare Department at the district level to get the Public Works Department (PWD) to supply them water.

"So far PWD has delivered about 21,000 gallons of water to 21 villages in the Kuching division affected by severe water shortages," he said.

Asked on Nipah virus infection in the state, he said the situation was under control.

"The state government is continuing its surveillance by taking precautionary measures to prevent an outbreak," he said. Fifteen pig farms have been quarantined after four people contracted the virus.

A total of 4,590 pigs were culled at two farms in Jalan Oya, Sibu, last week after two workers were tested positive for the virus. - BERNAMA

Figure 5 Losses to local electronic factories - 2001, August 22, Borneo Post

Drought causes heavy losses to local electronic factories

KUCHING: Sarawak's electronic factories suffered heavy losses as a result of heavy salt content of the city water supply last month following a long dry-spell.

According to Deputy State Secretary Datu Dr. Hatta Solhee, the State government received complaints not only from electronic factories but also from residents of Kuching City.

"What we need is an efficient approach to manage our rivers as a resource by which it can accommodate all the demands by numerous users of the rivers, while not destroying the ecological system and natural beauty of these rivers," he said.

Dr. Hatta was opening a two-day workshop on 'Integrated River Basin Management' (IRBIM) at a leading hotel yesterday. He however cautioned that the state government could not satisfy the demands of all groups of water users and thus it must decide on priority. He explained that during last month's dry days, the government had to choose between meeting the needs of shippers and Kuching residents demanding for more drinking water.

Hatta hoped that the 100 course participants, mainly government officers, could provide inputs on how best the State government could implement the (IRBIM) in Sarawak. Sungai Sarawak had been chosen as a site to initiate a IRBIM pilot project in the state. Later when approached by newsmen after the ceremony, Hatta declined to elaborate on the heavy losses which electronic companies suffered.

2.3 Tambangs" crossing the river from Kuching city North to South

Tambangs (primitive craft) are an important means of riverine transport since the Brooke era (Figure 6). In a survey conducted on the 12 landing sites during the Sarawak Inland Water Transport (SIWT, 2008) study it is noted that 8830 passengers (Figure 7) were using the *tambang*s daily, to cross the Sungai Sarawak of which 7063 passengers were upstream of the barrage (8 landing sites). These figures had reduced tremendously to around 350 daily

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("short river crossing" above the barrage 2022 - SRB) with the pedestrian bridge spanning the Sungai Sarawak in 2017, the Darul Hana bridge and improved road infrastructure some of the landing sites are void of any passengers. There are 47 *tambang* owners operating upstream of the barrage.

Figure 6. Tambang waiting for passengers at a timber landing place (SIWT, UNDP, 2008)

Figure 7 Passengers using tambangs along Sungai Sarawak (SIWT, UNDP, 2008)

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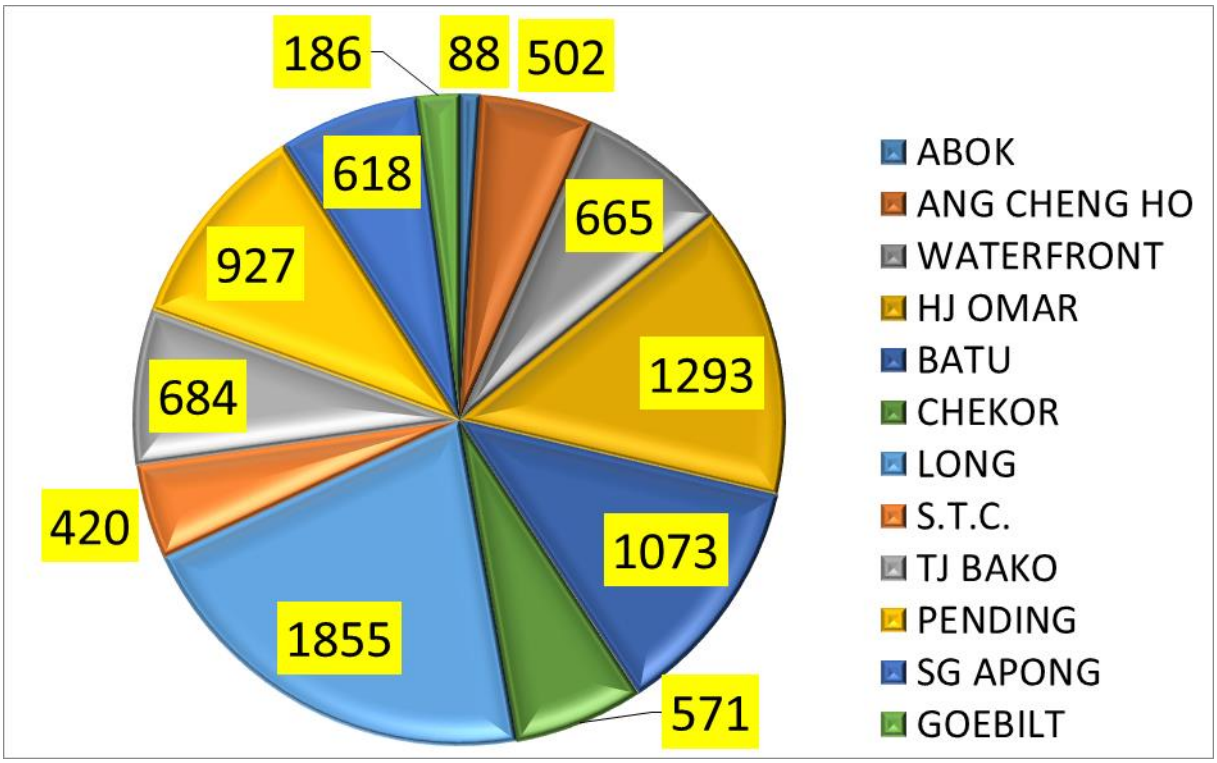

Some of the unseen issues that had vanish with the regulated water level are continuous swift currents encountered by the operators of the tambangs during the pre-barrage days whereby the boat operators need to master the art of "maneuvering skills". The risk of the tambang capsizing has also diminish. During the pre-barrage days there were cases of "slip and fall" as the river contains residuals of mud being carried downstream and deposit along the steps and jetties. Several improvements were made with the extension of the waterfront on these landing areas. Figure 8 and 9 illustrates something of the past but it is still in existence in some of the rivers in Sarawak. Figure 10 illustrates the new type of landing facility implemented by the Sarawak Rivers Board (SRB).

Figure 8 Illegal landing areas especially during low tides (SIWT, UNDP, 2008)

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Figure 9 Old wooden jetty replaced by long cemented landing steps. Survey of landing facilities (SIWT,UNDP, 2008)

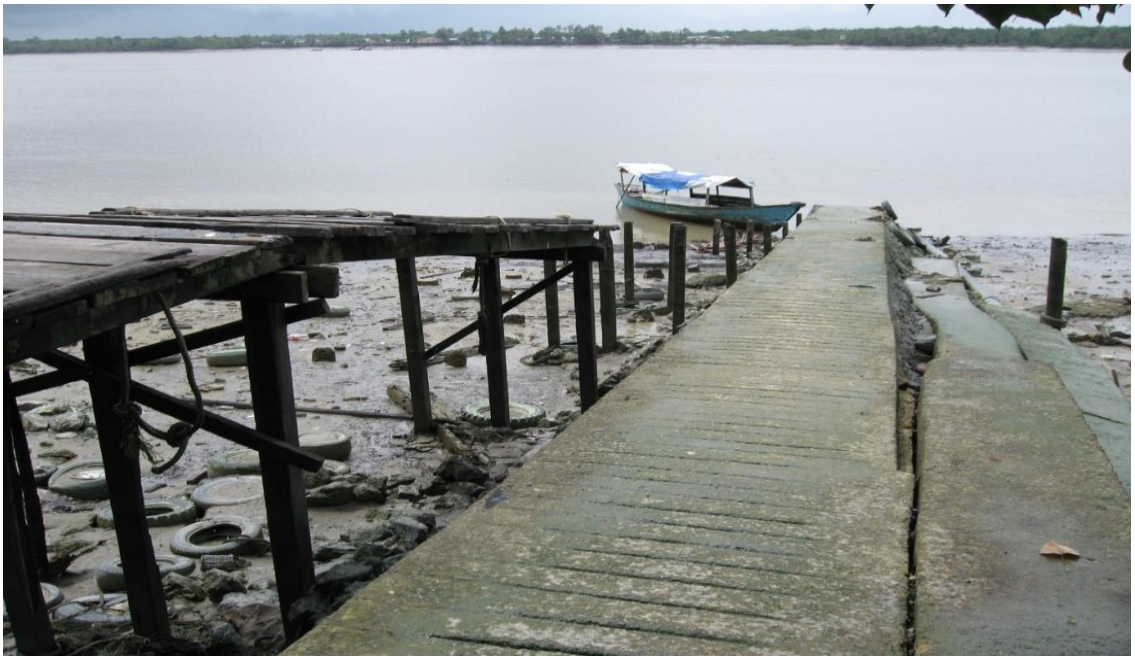

Figure 10 New landing facility with floating pontoon which rises and lowers with the regulated water levels. Survey of landing facility (SIWT, UNDP, 2008)

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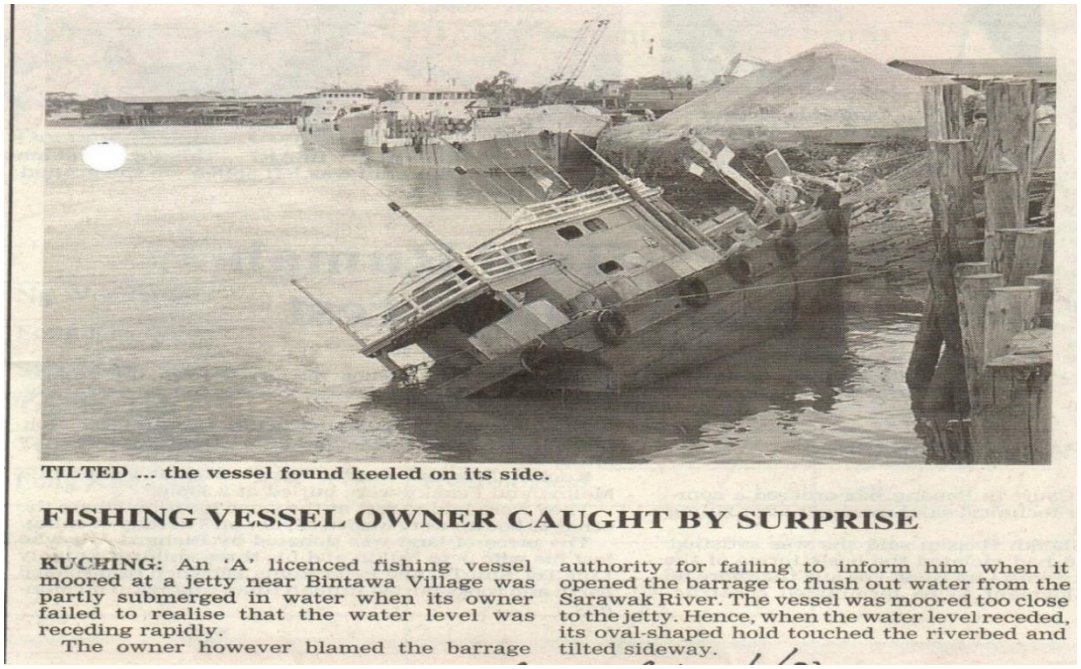
2.4 Shipping community - Domestic shipping and fishing vessels

For centuries prior to the construction of the barrage, the water level in Sungai Sarawak was fluctuating every minute but with the barrage regulating it, some of the shipping community became very complacent with the regulated levels. There are cases of vessels grounding and capsizing because of the lowering of water levels whereby during the pre-barrage days none of these issues exists as owners of vessels have the responsibility of ensuring their vessels are always afloat (Figure 11 & 12). The commercial wharfs are experiencing siltation and dredging needs to be conducted thus they are unhappy when water levels need to be lowered to create a reservoir for the anticipated rainfall at the catchment area. On the country the contractors of riverine projects are requesting for extremely low levels so that the riverbeds could be access pilings.

The fishing community which is located 8 km from the barrage are not happy with the whole infrastructure as they need to waiting until the shiplock is open as flooding of Kuching City takes precedence over their activities. During the pre-barrage days their movements were not restricted but with the barrage in place they need to adopt to the new norm. The regulated level has created a false sense of security to vessels owners. During the pre-barrage days with the flood and ebb tides (incoming and outgoing) water levels rise and falls every minute but with the regulated level the water level upriver is maintained unless there is heavy rainfall at the upper reaches of the catchment area. The honest is on the owners of vessels to ensure that their vessels are securely moored and always afloat. During the first few years of operation there were incidents whereby vessels capsize due to grounding but no loss of lives.

Figure 11 Fishing vessel capsize - 2002 January 31, Borneo Post

eISBN 978-967-2298-96-0



TILTED ... the vessel found keeled on its side.

FISHING VESSEL OWNER CAUGHT BY SURPRISE

KUCHING: An 'A' licenced fishing vessel moored at a jetty near Bintawa Village was partly submerged in water when its owner failed to realise that the water level was receding rapidly.

The owner however blamed the barrage authority for failing to inform him when it opened the barrage to flush out water from the Sarawak River. The vessel was moored too close to the jetty. Hence, when the water level receded, its oval-shaped hold touched the riverbed and tilted sideway.

Figure 12. Grounding of boats due to low water -2000, July 18. Borneo Post

Boats grounded due to low water level

A recently repaired boat stranded at the repair spot.

Boats waiting to be repaired but cannot be floated to the docks due to the low water levels.

KUCHING, Mon.- Low water levels in the Sarawak River are causing hardships for some boat operators as at least seven boats which had just been repaired are stranded on dry land.

The boat owners are appealing to the Sarawak Rivers Board (SSB) to open up the barrage gates to let in sea-water so that the water level will be high enough for them to float the boats.

SSB was said to be unable to do so as quite recently, sea water had reached the water intake outlets at the Batu Kitang Water Treatment Plant here which resulted in a 'salty' tap water for the City residents.

"Our boats (fishing boats and other types of boats) have been stranded for at least two weeks now and it is affecting our livelihood as we cannot do anything. Besides, the hulls of the newly repaired boats need to be submerged in water, otherwise the gum used to repair the hulls will dry out and we will have to spend more for the repair work," they claimed.

For the boat repairers, they are also in a fix as the repaired boats cannot be put into the water while more boats that needed repair cannot be brought to the repair yards.

According to them, their appeals to SSB had fallen on deaf ears and therefore urged the government to look into the problem.

They said they might consider meeting the Minister for Communications & Infrastructure Development Datuk Wong Soon Koh to seek assistance to look into their plight. - BP

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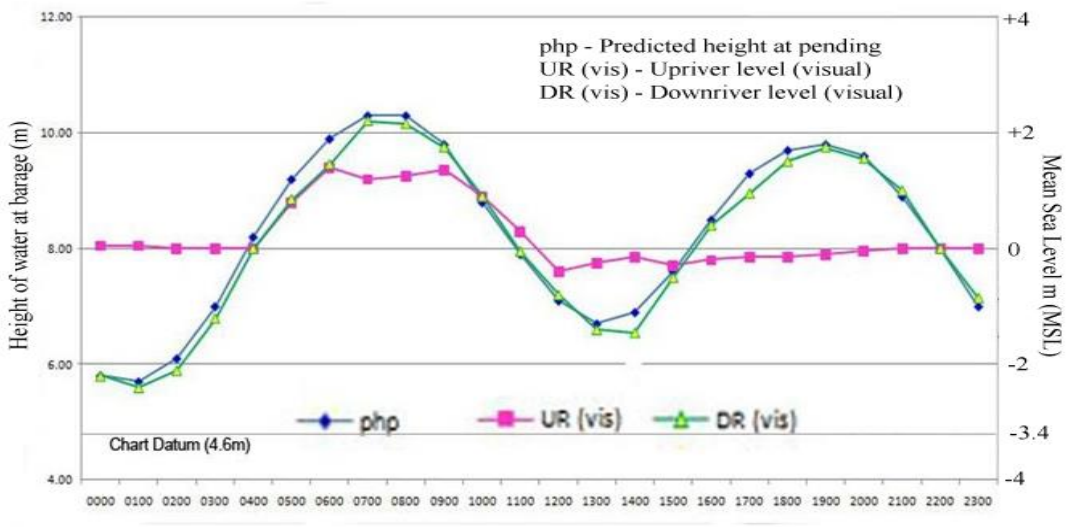
2.5 Shipyards

Above the barrage are four shipyards or slipways where fishing trawlers and smaller vessels are maintained by "up slip" and after repairs they are "down slipped". To enable the shipyards to conduct their operations the barrage operator is requested to raise the water level upstream by opening the barrage gates to a height of +1.4 m MSL or 9.4 m as their slipways are not long enough to reach the vessels when the level is maintained at the safe level of 0 to +0.5 m MSL or 8 to 8.5 m at the barrage. During this operation of flooding in, the barrage operators cannot close the barrage gates until the slip yard operator has confirmed that their vessel is firmly chocked and secured at the shipyard. Failure to comply would result in the capsizing of the vessel and injury to the crew or workers. By raising the upriver water level above the safe level, the barrage operators are creating a flash flood risk scenario in the event of a thunderstorm. The barrage gates cannot be open for the next few hours during this period, until the ebbing tide downriver and upriver are equal. The operator must monitor the status of the catchment area via its 24 telemetry stations (Mah, Hii, et al., 2011; Mah, Putuhena, et al., 2011) and meteorological report during this critical period of about six hours. A graphical representation of the water level upstream and downstream is illustrated graphically on Figure 13.

Figure 13 Effects of flooding in and flushing (Goh et al. 2021)



Barrage gates 1 - 4 were open at 0357 hrs., when the upstream and downstream levels were the same i.e., 8.0 m. The water level upstream will rise according to the tide. When the water reached the desired level (9.4 m) the barrage gates will be closed individually. With the closure of the barrage gates, the upstream level will hover around the desired level. During this period there must not be any heavy torrential rainfall at the catchment area as all the drains in the city are covered since the rainfall cannot be discharged into the river, thus causing an "induced" flooding of the city. The barrage operator has been given the task to make the critical decision to cancel the flood in operation at the last minute. However, the water level downriver will rise until the maximum level for that day is reached (10.2 m) and after that period the tide will ebb. (subside). After flooding in to 9 .4 m upstream (+1.4 m MSL) which is considered a critical level, effort must be made to lower it to a safe level. This can only be achieved during the next cycle of the tide which is about five hours later. The

barrage gates must open when the upriver and downriver are at the same as an unnatural river flow will be created if the is a head difference. When the water level reaches the desired water level the barrage gates will be closed separately. The barrage gates must never be closed altogether as the energy from the ebbing tide will create some form of tidal surge especially whereby the level is the same as the receding tide. The barrage gates should never be closed all together especially when it is at mid tide as a "tidal bore" could be created by such an action. The process of closure should be one gate at a time namely, Gate 1, Gate 4, Gate 2 and finally Gate 3. The sequence could be altered if all gates are not close together. It takes about 5 minutes to close a barrage gate and 15 minutes to open. Barrage gate 5 takes about 5 minutes to open and it will lie in the horizontal position when fully open and 15 minutes to close (Goh et al. 2021).

2.6 Riverbank protection

The opening of the gates must be done when the upriver and downriver levels are the same to avoid creating a head difference which will create an unnatural river flow (strong currents) which could result in riverbank slips, parting of vessels mooring lines, damage to landing areas, jetties, and other old weak infrastructures. There were a few occasions in the first two years whereby the barrage gates had to be opened with at least two- or three-meters head difference whereby structural damage to the apron of the barrage gate sill and scouring effects downriver were encountered. When the operator of the barrage needs to open the gates to lower the water level, even with notices published in the newspapers and enforcement vessel going around to inform the community of the intended action there will be certain riverine users who will ignore this information.

3. Implications of the Sungai Sarawak Barrage.

3.1 Flood mitigation

The major hydrological events during the pre-barrage and post-barrage events are January and February 1963, January 1976, February 2003, January 2004 (Bessaih, n.d.) and January 2009, resulting from prolong rainfall and spring tides. During the pre-barrage years (1998) the flood events period were about two weeks but with the barrage the period was reduced to about 3 days as draw down of water accumulated behind the gates could be achieved after a day or two. During a flood, there are social, cultural, economic and ecological vulnerability. Social and cultural vulnerability refers to loss of life health impacts (injuries), loss of vitality, stress, social impacts, loss of personal articles, and loss of cultural heritage. Economic vulnerability alludes to direct and indirect financial losses by damage to property assets, basic material and goods, reduced productivity, and relief efforts. Ecological vulnerability comprises anthropogenic pollution of waters, soils and ecological systems with their biota (Schanze Jochen et al., n.d.). The presence of the barrage could mitigate the flooding of Kuching city.

3.2 Community staying at the low-lying zone of the urban areas

The regulating of upstream water level to MSL has eliminated all the low-lying areas from the bimonthly "nuisance"issue flooding caused by the high tidal fluctuations of 6.5 m during the new moon and full moon locally called "king tides" (Sharp & Howe, 2000). This phenomenon has been in existing since the beginning of time as nothing could grow along the river banks. When the barrage commence operation, the community could utilize the land and extended their homes downward. The low lying areas are free of these issues since 1998.

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3.3 Passengers transiting the river with the primitive crafts called "Tambang"

The regulated water level has cut of the strong tides of approximately 2 knots (m/s) especially during the ebb tide. The presence of the barrage has created a lake like effect to the riverine users and thus improving the level of safety for the low powered vessels like the tambangs.

3.4 Raw water supply

Kuching city is assured of raw water supply and with the completion of the Bengoh dam in 2016, is anticipated to meet the increasing demand of the city and the greater Kuching and Samarahan area until 2030 (Hwee et al., 2014). The barrage will prevent the saline intrusion towards the raw water intake by ensuring its flooding in operation does not exceed the critical level of 9.4 m (1.4 m above MSL as the submersible wier is designed to that level).

3.5. Improving the ecstatic of Kuching Water Front.

The regulated water level has improved the ecstatic of the waterfont. Without the barrage the urgly and dirty river banks will be exposed. Figure 14 illustrates the dirty and ugly river banks whne the regulated level is lowered.

Figure 14 Ugly and dirty river banks during low tide. Survey of landing facility (SIWT UNDP 2008)

3.5 Transportation of muddy sediments

The Santubong causeway had reduced the transportation of muddy sediments to the foreshores of Santubong and Damai beaches. The Santubong river used to be an alternative waterway to the fishing vessels and other domestic vessels but with the closing of the river at North Junction point in 1994, this alternative route experience extensive sedimentation on both sides of the causeway.

4. Conclusion

The Sungai Sarawak Barrage has achieved all it's objectives to a certain degree not forgetting that there are no structures in the world that could control mother nature. In the mitigation of

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flooding of Kuching city, since its inception, the fortnightly "king tide" is eliminated and frequency and period of flooding has reduced and mitigated. The city is assured of raw water supply for the ensuing years. The riverine regime has changed and there could be other environmental issues especially during this time of the year when the water level is maintained. It would be interesting to conduct a detail cost benefit on the social, economic, cultural, productivity, environmental and impact from flood and the cause consequences on the risk, benefit and implication of the Sungai Sarawak Barrage.

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eISBN 978-967-2298-96-0

Work from Home and Work-Life Balance During Movement Control Order (MCO) for Working Parents in Kota Kinabalu, Sabah

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Abstract
When the COVID-19 was declared as a global pandemic countries had to make an adjustment to reduce the spread of infection by implementing lockdown. It pushes for inevitable changes to occur in the workforce as state had to interfere with the working arrangement. One of the various action or measure that was taken by Malaysia was to implement Movement Control Order (MCO). This implementation had pushed non-essential business or sectors to change their working arrangement towards working from home. The question whether this arrangement can bring balance to both work and family/personal life has been going around among political and academic debates. Therefore, the objective of this paper is to examine the extent of the impact of working from home in the work-life balance for working parents in Kota Kinabalu, Sabah during Movement Control Order (MCO). Using a qualitative approach a data was collected from 10 respondents from an in-depth interview which comes from various socio-economic backgrounds. The finding from this research show that working from home does improve their capacity to balance work and life commitments even though it may took a bit of time-management and discipline to ensure the stability between both sides.

Keywords: Work from home, Telework, Remote working, Movement Control Order, Work-life balance, Working parents, Malaysia.

1. Introduction

Working from home have become an essential work arrangement for many workers in Malaysia when Movement Control Order was being implemented in the year of 2020[1]. The unprecedented changes allow work and daily life to experience a significant impacts on the workers. Working from home is not entirely new for the workforce in Malaysia. It had been suggested that this arrangement had been practiced during the Economic Transformation Programme as an initiative to increase women participation in labor market and as well as

[1] *SOP Perintah Kawalan Pergerakan (PKP)*: n.p, 2021.

attracting skilled-talented individual[2]. However despite the good initiative taken by the government, working from home have been unpopular in terms of implementation in Malaysia. Therefore, it peak a lot of interest in the research fields across various of disciplinary to study the impact of work from home in workers. One of the topic popular in related to the work from home is the work-life balance.

Work-life balance is commonly understand as a balancing between work and personal life for an individual to ensure no disruption between the two that could potentially affected their quality of life[3]. Notably, when the first implementation of Movement Control Order was being done, the government had refrained people from moving freely outside and halt business and work operation to curve the infection from spreading. This also include the closing of educational sectors as schools and university had to be closed during that period of time[4]. Thus, it simultaneously create the environment where work and housework/childcare were present for those who working from home.

When taking account on the topic of work-life balance it is important to have an understanding of how the pandemic changes the demand of housework/childcare with lockdown being placed. In a research carried out by Andrew *et. al.* (2020) the household or childcare responsibilities have increase during the period of lockdown among women which causes major changes to the demands of domestic responsibilities[5]. It shows that women have taken more responsibility during the lockdown than before. However, the finding were not relevant to the workers who continuously working from home during the lockdown due to the factors that were connected to it such as loss of job and furlough among these women.

Del Boca *et. al.* (2020) expands those findings by taking on the perspective on both genders, man and women, and what was found was that the increase in the demand of domestic responsibilities had influence on how both spouses delegate their responsibility respectively[6]. The increase in women domestic responsibility dependant on how men worked and increase in man domestic responsibility dependant on how women worked during the lockdown. Whereas Sevilla and Smith (2020) argues that the lockdown actually create equality in the share responsibility of childcare and housework between man and women[7].

These differences in findings give an understanding on the possible challenges and changes that workers, in particular, working parents have to go through in their daily lives. Nonetheless, in a Malaysia context, the critical issue that need to be look at in the prior research was the family system. It have been noted that in Malaysia there is two type of family system existed, which is the traditional family system and companionship family system[8]. The

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[5] Alison Andrew et. al., (*How are mothers and fathers balancing work and family under lockdown?:*Institute for Fiscal Studies:2020) 5-30.

[6] Daniela Del Boca et. al., (*Women's and men's work, housework and childcare, before and during COVID-19*: Springer,2020) 1001-1017.

[7] Almudena Sevilla and Sarah Smith, (*Baby steps:The gender division of childcare during the COVID-19 pandemic:* Oxford University Press,2020) S169-S186.

[8] Siva Sankari A/P Ramani et. al., (A*n exploratory study on challenges faced by working women and their perceived supports towards remote work in malaysia:* Asia Pacific University, 2022) 73-87.

traditional family system has a role divided between father and mother whereas the companionship family system represent both parents that share the responsibility of labor force and family upbringing[9].

Considering this, it may cause a significant changes on the workers work-life balance as not only their home become the temporary place of work but also the involvement of non-working hours (housework/childcare duties) in the same setting. Hence, this paper examine the extent of the impact of working from home in the work-life balance for working parents during the Movement Control Order.

2. Method

For this paper we draw the data from 10 in-depth interviews that was carried out from February 2022 until April 2022 as a part of study on the impact of work from home. The selected participants was based on their involvement in working from home during the Movement Control Order which is correlative with findings from Chung *et. al.* (2020)[10].The approached taken for this paper was qualitative in which semi-structured interviewed was conducted. This is to allow flexibility during the interviews as question can be developed in achieving the objective of this study.

The process of the analysis begin by importing the interviews document to Atlas-ti software. Information were then extracted and separated into codes to make it easier for the categorization. The code system follows the principle - one topic or idea should occur in one place in the code system[11] in order to avoid repeated occurrence in the data coding. Through the codes obtain from the data then the process moved towards dividing the codes into relevant themes. It is known as the process of thematic analysis in which it is quite popular for qualitative research.

3. Results

Image 3(I): Word cloud

[9] Shamila Jayasingam et. al., (*Demystifying the life domain in work-life balance: A Malaysian perspective*: Springer, 2021).

[10] Heejung Chung et. al., (*Working from home during the COVID-19 lockdown: Changing preferences and the future of work*, University of Birmingham, 2020) 4-36.

[11] Quim Castellà and Charles Sutton, (*Word storms: Multiple of word clouds for visual comparison of documents*: Korea, 2014).

A word cloud is a known branch of data that show language or text data that could be used to have the impression on the text documents obtain from the interview. Lohmann *et. al.* (2015) justify that the word cloud also can be used as a starting point for a much more deeper text analyses[12]. Hence, based on the image 3 provided above, the word cloud provide visualization of the frequency of words that present in the different text of documents from the interview.

Table 3: Demography and codes

ID	Working Sectors	Age	Status	Codes
01	Government	39	Married	● Work-routine ● Work demand
02	Government	48	Single parents	● Personal life ● Work adaptation ● Work boundaries
03	Government	48	Married	● Work demand ● Multiple responsibilities ● Work adaptation
04	Private	45	Married	● Work adaptation ● Multiple responsibilities
05	Private	45	Married	● Multiple responsibilities ● Work adaptation ● Work demand
06	Government	50	Married	● Personal life ● Multiple responsibility
07	Government	36	Married	● Work demand ● Multiple responsibilities ● Work adaptation
08	Government	35	Married	● Personal life ● Work adaptation
09	Private	42	Married	● Multiple responsibilities ● Work adaptation
10	Government	44	Single parents	● Personal life ● Multiple responsibilities

Based on the table 3, it is a representation on the demography of the participants that were involved in the interview and as well as codes that present during the analysis - using the software of Atlas-ti. Each text documents have this pre-occuring codes which are work-routine, work-demand, personal life, work adaptation, work-boundaries and multiple responsibilities. These codes are the impact of work from home that shape the extent of participant work-life balance during the Movement Control Order. Thereon, using the thematic analysis these codes were arranged into several themes; which are, ***Theme 1: Work routine***, ***Theme 2: Work demand***, ***Theme 3: Personal life***, ***Theme 4: Work adaptation***, ***Theme 5: Work boundaries*** and ***Theme 6: Multiple responsibilities*.**

[12] Steffen Lohmann et. al., (*ConcentriCloud: Word cloud visualization for multiple text documents*: Germany, 2015).

4. Discussion

Work-life balance in the previous literature had talked about the increase of domestic responsibilities during the lockdown which had greatly affected the working parents generally between their work and personal life. But whether it affected them positively or negatively is very much apparent in this research. Out of the ten participants participated in the interview there were four of them who seen working from home affected their work-life balance in a negative way while six of the participant managed to keep their work-life balance in a positive way when working from home. The extent of this impact into their work and daily lives can be discussed trough the themes formulated in this research.

4.1Theme 1: Work routine

Previously, it has already mentioned that lockdown and Movement Control Order bound to create changes in workers work routine and also daily lives[13]. But the changes in the work routine were barely elaborate in the context of work-life balance since the major changes for these working parents noticeable were the domestic responsibilities. However, from the data collected there is a significant changes that work from home have contributed to their work-life balance in the aspect of work routine. Work routine can also be known as the a work pattern that workers often applied in their life. When working from home was being implemented in the Movement Control Order, the work routine was deeply affected the first participant (ID: 01). From a routine that was manageable when working at the traditional office, participant (ID: 01) found it hard to reorganized her work pattern at home as the time spend on the work tasks became longer than what she normally experienced in the traditional work place. Therefore, it disrupted her normal routine that she should be doing at home during the regular days. This has slightly impacted her work-life balance in a negative way.

4.2Theme 2: Work demand

When the domestic responsibility meet with the work demand it can be a challenging thing to do to maintain the work-life balance from working at home. Del Boca *et. al.* (2020) had even mentioned the delegation between domestic responsibility between man and women also took account on the work demand of individual when working from home[14]. However, the perspective talked more on the increase of domestic responsibility rather than the changes in the work demand. Thus, the lack of elaboration made it easier to speculate. But in this paper, we were able to look into the aspect of work demand and its impact on the work-life balance. When collecting data through the interviews, participant (ID: 01, 03 and 07) experience the increase in work demand when working from home. Participant (ID: 01) said in her own words that increase of work demand has something to do with the involvement of her students; "*I have to spend more time with work because student only send their work one by one…"*, participant (ID: 03) said; "*my focus was more on work than managing family because of the rules applied when working from home…",* and participant (ID: 07) said "*I can only say that 80% of time spend in work due to challenges with adaptation of work from home…".* However, the demand of work does not necessarily impacted the work-life balance in a negative way. The demand was there but it can be still manageable for some workers. For example, participant (ID: 05) explains that

[13] Daniela Del Boca et. al., (*Women's and men's work, housework and childcare, before and during COVID-19*: Springer,2020) 1001-1017.

[14] Daniela Del Boca et. al., (*Women's and men's work, housework and childcare, before and during COVID-19*: Springer,2020) 1001-1017.

"even though I spend time more in my work but it does not hinder me from spending time with my family…".

4.3Theme 3: Personal life

To have time for personal life is very much important to work-life balance as it can contribute to a better quality of life. According to a research from Chung *et. al.* (2020), they recorded that working from home open the ability for both mother and father to have a better personal life as they can spend more time with children and spouses' during the lockdown[15]. This can be particularly interesting since it show a positive experience of working from home and as well the work-life balance. We were able to justify those findings as four of the participant (ID: 02,06,08 and 10) in the research have experienced balanced between work and daily lives due to the time they were able to spend on focusing personal life such as more time with one self, more time with family, and more time to do housework. Thus show the importance of having time with personal life can improved work-life balance for those who work from home.

4.4Theme 4: Work adaptation

As previously mentioned, work from home arrangement is not common in Malaysia. Thus, the possibility of those who experienced work from home for the first time during the Movement Control Order were very high likely. Work adaptation is a part of process in which the workers were trying to achieve work adjustment whenever some changes occur within organization or individual requirements[16]. On the prior research, the work adaptation primarily focused on its impact towards individual well-being but overlooked the impact it has on work-life balance. From the data collected, participants had mentioned that work adaptation does significantly became one of the aspect for them to achieve work-life balance. For example, participant (ID: 02,04,05 and 08) simultaneously were able to have balanced between work and daily lives due to adaptation with working from home; "*with the formulated timetable of online learning class with the students…I was able to have time on my own relaxing in my own yard."* - ID:02, "*the little experience with work from home before the pandemic…I was able to adjust the progress of my work with spending time with the family."* - ID:04, "*the work time I made it the same as I was working at the office so I make sure to stop when it's time…"* ID:05 and "*between work and time spend with family was quite manageable because during the break I'll check up on them…"* (ID:08). The work adaptation eventually contribute to positive impact on their work-life balance when working from home. Which also show the importance of this aspect in achieving effective work from home arrangement if one day it can become the new norm in the workforce.

When work adaptation could not be achieve when working from home then it will be negatively impacted their work-life balance since the effort to adjusting themselves with the current situation could take more of their time and focus. These were proved in the data collection as participants (ID:03,07 and 09) struggle to adapt with working from home which impacted their work-life balance generally. Participant (ID:03) said "*the rules for working from home does took time to adapt since I still have a family to focus on.",* followed by participant (ID:07) "*the integration of online learning when working from home was not easy and it was the reason why I have to focus more on my work than family…"* and later on emphasized by

[15] Heejung Chung et. al., (*Working from home during the COVID-19 lockdown: Changing preferences and the future of work*, University of Birmingham, 2020) 4-36.

[16] Beryl Hesketh, (Work adjustment: ScienceDirect, 2004) 683-685.

"*certain work tasks that could not be done at home does put pressure on me and it can be a hindrance when I have two twin boys that need to look after too…"* (ID:09).

4.5Theme 5: Work boundaries

The work boundaries have been the biggest concern in working from home since it is likely for work and non-work domain to overlap one another[17]. It also have been addressed as the main factors that often cause conflict between work and family. When work from home was being implemented, it is possible for workers to be vulnerable with the disruption of work-life boundary thus causing a challenge to both work and daily lives management. This was justify by participant (ID:02), *"crossing the line of work boundaries when working from home does not happen often at that time but I can feel the struggle of maintaining it since the demand of work can be increasing due to the weakness of integration in online learning between me and my students..".*

4.6Theme 6: Multiple responsibilities

In the previous research, the lockdown during pandemic have resulted with the increase of domestic responsibility either between man and women. With also the responsibility coming from work it can be a struggle to find the time and space in order to carry out both responsibilities during lockdown. The involvement of childcare/housework and paid work at home have become a worrying trend in the topic of working from home. Thus, it is best to understand the extent of those aspect going to impact the work-life balance of working parents. Based on the results, the multiple responsibility does not necessarily can be handle easily by working parents that work at home. Participant (ID:03,07 and 09) found that often time when working at home they still could not escape from also doing the childcare or housework due to the guilt for not doing so, for example "*when working from home…my mind wanted to focus on the job hundred percent just like in the office but I can't help but feel guilty for ignoring my role as a mother and a wife at home…"* participant ID:03. This was similar with the experience of participant (ID:07) as she said that "*as a working mother, there is a lot of sacrifices that needs to be made in terms of time and well-being…".*

However, the result mostly taken from the women perspectives and it can be different for the man. As prior research have shown that working from home provide the positive aspect in the work-life balance for man as they get to spend more time with their own children and spouses[18]. The results were constant with the data collected for this research as participant (ID:05) mentioned that working from home does bring balance in his work and daily lives as he get to spend more time with his children and were able to helped his wife with the housework, "*…I've got to spend more time with my family once my work is done…I've got to do the childcare/housework duty together with my wife…".* This show positivity that were able to be gain from balancing both responsibility when working from home.

[17] Danielle M. Gardner et. al., (*Managing boundaries between work and non-work domains: Personality and job characteristics and adopted style*: The British Psychological Society, 2021) 1-28.

[18] Heejung Chung et. al., (*Working from home during the COVID-19 lockdown: Changing preferences and the future of work*, University of Birmingham, 2020) 4-36.

eISBN 978-967-2298-96-0

5. Conclusion

As work from home arrangement become the new norm in this ongoing pandemic era, workers are expected to get used to this arrangement for the long run. It is one of the initiative to introduce work from home more widely to sectors that had not previously embraced this work arrangement fully. The data in this paper suggest that despite the unprecedented circumstances of lockdown experience by the working parents during the pandemic, the extent of its impact on their work-life balance were still predominantly positive. The evidence also able to see the positive reaction from working father as they were able to be more involved in domestic responsibility by working from home. This is likely to erase the stigma or concerned around flexible working arrangement in Malaysia. The research also shows that even if they were some that able to received positive outcome in their work-life balance but there were others were still struggling to maintain both work and daily lives when working from home. This can be move forward for a future discussion either through managers or an organizations in order to effectively solve the issue of balance between work and personal life. With the open dialogue it may contribute to a more effective working from home as it slowly become the new norm in the workforce in the future by providing a more stronger policy for a flexible working.

Acknowledgement

The project team under (SDK0150-2020) would like to thank all the participant who had been deeply involved in the interviews. We would also like to extend a special thank to University Malaysia Sabah as this project made possible due to the funding provided under the schemes of (SDK0150-2020).

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SOCIAL SCIENCES & HUMANITIES CONFERENCE 2022 (SSHR 22) 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

Masalah penggunaan teknologi, maklumat dan komunikasi (TMK) dalam kalangan masyarakat di Sabah di kala penularan pandemik Covid-19

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Abstract
Penularan wabak Covid-19 telah memberi impak besar kepada kehidupan manusia sejagat. Perubahan gaya hidup untuk mengadaptasi kehidupan norma baharu menjadi tuntutan kepada seluruh masyarakat global. Di Malaysia, penularan virus Covid-19 yang semakin meningkat telah menyebabkan kerajaan melaksanakan Perintah Kawalan Pergerakan (PKP). Akibatnya, aktiviti rutin masyarakat menjadi sangat terhad dan terkawal. Penggunaan aplikasi berteraskan teknologi, maklumat dan komunikasi atau TMK menjadi platform perhubungan khususnya menggunakan internet dan transaksi atas talian (online). Artikel ini mengenalpasti masalah-masalah yang dihadapi oleh masyarakat di Sabah khususnya penggunaan TMK dalam rutin harian mereka. Dengan pendekatan kuantitatif, data diperolehi melalui kaedah tinjauan *Google form* dengan saiz sampel seramai 1,228 melibatkan tiga daerah utama iaitu Kota Kinabalu, Sandakan dan Tawau. Artikel ini mendapati bahawa terdapat tiga masalah utama yang dihadapi oleh masyarakat di Sabah iaitu infrastruktur, kos dan keselamatan. Masalah ini bukan sahaja dihadapi oleh masyarakat yang tinggal di kawasan bandar malah memberi kesan langsung kepada masyarakat di luar bandar. Ketiga-tiga masalah ini saling berkaitan, justeru

pihak kerajaan disaran untuk memastikan dasar pembangunan infrastruktur yang sedia ada mahupun yang dalam perancangan dipertingkatkan bagi disesuaikan dengan keperluan semasa.

Keywords: TMK, Covid-19, infrastruktur, kos, keselamatan, Covid-19

1. Pengenalan

Penularan pandemik Covid-19 telah memberi pelbagai kesan kepada masyarakat global. Ianya telah menekan masyarakat seluruh dunia untuk mengadaptasi kehidupan norma baharu yang melibatkan semua aspek aktiviti harian. Pihak kerajaan telah mengambil langkah drastik sebagai sebahagian daripada usaha untuk membendung penularan Covid-19 dengan melaksanakan kawalan pergerakan seluruh rakyat dalam negara. Dalam ertikata lain, rakyat diarah untuk duduk di kediaman masing-masing dan dilarang berinteraksi secara fizikal diantara individu.

Di Malaysia, tindakan yang sama seperti yang dilaksanakan di luar negara turut diambil dengan melaksanakan Perintah Kawalan Pergerakan (PKP). Pelaksanaan PKP di negara ini telah melalui beberapa fasa ekoran penularan pandemik Covid-19 yang semakin menganas. Fasa pertama pengisytiharan PKP bermula pada 18 Mac 2020 sehingga 31 Mac 2020. Namun, PKP telah dilanjutkan dari masa ke semasa mengikut kategori kawalan pergerakan dan tertakluk kepada keputusan semasa Majlis Keselamatan Negara (MKN). Ekoran daripada pendirian kerajaan untuk menguatkuasakan PKP, pergerakan masyarakat menjadi sangat terhad dan teramat sukar untuk menjalankan aktiviti seharian mahu pun berurusan dengan sesiapa sahaja secara bersemuka. Situasi ini telah memaksa masyarakat untuk mencari kaedah mahupun pendekatan baru sebagai alternatif untuk melaksanakan rutin harian tanpa bersemuka. Justeru, penggunaan aplikasi berteraskan teknologi, maklumat dan komunikasi (TMK) menjadi platform perhubungan khususnya menggunakan internet dan transaksi atas talian (*online*).

Penggunaan TMK melalui pelbagai jenis perkakasan dan perisian seperti telefon pintar (smart phone), komputer riba, *Shopee, Lazada, Grab dan Foodpanda* antara platform yang digunakan untuk pelbagai urusan dan transaksi. Walau bagaimana pun, penggunaan TMK masih berhadapan dengan pelbagai cabaran dan masalah merangkumi aspek penting seperti kemudahan infrastruktur, pengetahuan teknologi, faktor geografi, kos, dan aspek keselamatan dan kerahsiaan. Apakah masalah utama yang dihadapai oleh masyarakat Sabah dalam penggunaan TMK dikala pandemik Covid-19 sedang melanda? Inilah persoalan utama yang cuba dirungkai di dalam artikel ini.

2. Penggunaan TMK Dalam Kalangan Masyarakat

Penggunaan TMK dalam kalangan rakyat Malaysia semakin berleluasa dan menyebabkan kebergantungan masyarakat terhadap perkhidmatan atas talian dalam pelbagai aspek. Dalam kajian Tih Sio Hong (1998) mendapati penggunaan TMK menjadi semakin kritikal khususnya kepada masyarakat siber. Mereka menggunakan perkhidmatan internet untuk berkomunikasi dengan sesiapa sahaja di pelusuk dunia dan mewujudkan jaringan komunikasi. Golongan ini semakin bertambah dan mencetus peluang pasaran yang berpotensi dan luas. Dalam laporan digital yang dikeluarkan oleh *Hootsuite* and *We Are Social* pada tahun 2019, pengguna di Malaysia membelanjakan lapan jam lima minit setiap hari dalam aktiviti atas talian dan Malaysia kini berada pada tahap 80 peratus dalam penembusan Internet (Bernama, 2019).

Di dalam laporan Jabatan Perangkaan Malaysia (2019), peratusan individu yang berumur 15 tahun dan ke atas yang menggunakan Internet adalah 81.2 peratus pada tahun 2018, menunjukkan peningkatan sebanyak 1.1 mata peratus berbanding 80.1 peratus pada 2017. Bagi penggunaan computer, berlakunya peningkatan sebanyak 0.7 mata peratus daripada 69.8 peratus pada 2017 kepada 70.5 peratus pada 2018. Untuk penggunaan telefon bimbit secara individu, peningkatan peratusan mata sebanyak 0.2 mata peratus daripada 97.7

peratus ke 97.9 peratus pada tahun 2017 ke 2018. Jelasnya, data ini menunjukan bahawa penggunaan TMK oleh individu di negara ini semakin popular dan meluas meskipun sebelum pandemik Covid-19 melanda negara.

Kajian terkini Jabatan Perangkaan Malaysia (2021) mendapati bahawa trend penggunaan TMK sentiasa menunjukkan peningkatan. Menurut Dato' Sri Dr. Mohd Uzir Mahidin, Ketua Perangkawan Malaysia, "peratusan capaian isi rumah kepada internet menunjukkan peningkatan kepada 91.7 peratus pada 2020 berbanding 90.1 peratus pada 2019. Capaian oleh isi rumah terhadap telefon bimbit dan komputer juga masing-masing meningkat kepada 98.6 peratus dan 77.6 peratus pada 2020" (Department of Statistics, 2021). Impak daripada pandemik Covid-19 telah memperlihatkan peningkatan yang ketara berbanding dengan tahun sebelumnya. Dapatan satu tinjauan mendapati bahawa membuat pesanan barangan atau perkhidmatan dalam talian, mendapatkan maklumat kesihatan, menggunakan perbankan internet, menjalani kursus tidak formal dalam talian dan menjalani kursus formal dalam talian adalah antara aktiviti utama oleh kebanyakkan pengguna individu (Mohd Husni Mohd Noor, 2021).

Menurut Nuradli Ridzwan Shah et al. (2020), penularan Covid-19 telah mengubah gelagat manusia dan ianya perlu difahami untuk persediaan menghadapi masa akan datang sekiranya berlaku penularan wabak penyakit yang bersifat pandemik. Dalam kajian yang dibuat oleh Grashuis et al. (2020) di Amerika Syarikat (AS), pamdemik Covid-19 telah mencetuskan variasi utama amalan membeli belah untuk barangan runcit. Semasa gelombang Covid-19 mula mengganas, didapati pengguna mengambil langkah berjaga-jaga dengan tidak atau kurang mengunjungi kedai-kedai runcit. Apabila kes mulai reda, barulah pengguna kembali mengunjungi kedai runcit. Perubahan amalan membeli-belah secara tradisional beralih arah kepada pembelian secara atas talian. Hal ini dapat dilihat daripada peningkatan jualan atas talian seperti Amazon dan Lazada (Ahmad, 2020). Ianya jelas menunjukkan bahawa pengguna beralih kepada pembelian atas talian semasa pandemik.

Di negara Greece, aktiviti atas talian mempamerkan perubahan ketara yang merangkumi tele-kerja, tele-konferensi, e-pembelajaran dan tele-kesihatan dan seterusnya melonjakkan fenomena mobiliti maya (*virtual mobility*) dalam kalangan rakyatnya (Mouratidis & Papagiannakis, 2021). Pandemik Covid-19 telah merungkai betapa pentingnya aktiviti dalam talian yang bertindak sebagai pengganti dan pemudah cara untuk melaksanakan pelbagai aktiviti rakyat. Dalam satu kajian terhadap perkhidmatan perbankan atas talian (*e-banking*) yang dibuat di Indonesia, pengguna lebih cenderung menggunakan perkhidmatan perbankan atas talian sewaktu pandemic Covid-19 khususnya pengguna perkhidmatan perbankan konvensional (Sudarsono et al., 2020). Dapatan ini konsisten dengan laporan Global Trade Daily yang ditulis oleh Chaitali Avadhani menegaskan bahawa pandemik Covid-19 telah memangkin proses digilitasi perbankan kerana kebaikan yang ditawarkan. Penggunaan telefon pintar telah menyumbang peningkatan dalam perbankan internet dan disokong lagi dengan fasiliti perbankan yang menawarkan perkhidmatan operasi 24/7 serta kelancaran transaksi perbankan. Kesannya menyemarakkan lagi industri perbankan digital (Chaitali, 2020).

Selain daripada aktiviti pembelian atas talian, penggunaan TMK turut menampakkan kesan yang sangat ketara dalam pembelajaran dan pengajaran di sekolah mahupun di institusi pengajian tinggi. Dalam kajian Ewa Wanda Ziemba dan Monika Eisenbardt (2021), pengajaran menjadi aktiviti akademik utama semasa pandemik Covid-19. Pandemik ini telah mempercepatkan penggunaan pelbagai peralatan TMK seperti platform e-pembelajaran, aplikasi komunikasi dan media sosial untuk menyokong aktiviti pengajaran dan penyelidikan. Di peringkat pengajian tinggi, penggunaan TMK bukan sesuatu yang baru dan ia sudah lama diwacanakan sejak tahun 2003 lagi.

Dalam rencana Profesor Madya Dr Fariza Puteh-Behak (2021), kesan Covid-19 turut memberi impak besar kepada pengurusan universiti, para ahli akademik, pelajar dan ibubapa berikutan peralihan dan penyesuaian penggunaan teknologi dalam pelbagai aspek pentadbiran, pembelajaran dan pengajaran di universiti. Meskipun teknologi digital mulai menjadi sebahagian daripada norma baharu dalam proses pembelajaran dan pengajaran di institusi

pengajian tinggi, namun masih wujud masalah dalam penggunaan TMK seperti kekurangan fasiliti, kurang pengetahuan dan kemahiran (ibid).

Tidak dinafikan pandemik Covid-19 telah menyebabkan lonjakkan akses dan penggunaan teknologi digital disebabkan kawalan pergerakan dan norma penjarakkan sosial. Pelbagai kebaikan diperolehi seperti pembelajaran atas talian bebas sempadan tetapi pada masa yang sama ia mewujudkan jurang digital dalam pelbagai golongan (Nor & Amran, 2021). Di Malaysia, meskipun proses digitalisasi pesat berlaku namun jurang digital masih berlaku dalam pelbagai aspek ekonomi disebabkan kekurangan peralatan digital, kurang kemahiran, dan tahap pendidikan yang rendah (Mohammad et al., 2021). Menurut Halina Sendera Mohd Yakin et al (2021) meskipun kerajaan telah membina pusat internet di luar bandar namun pusat tersebut kurang menyerlah kerana masih ramai masyarakat luar bandar tidak menyedari tentang kewujudan dan lokasi pusat internet di kawsan mereka. Faktor lokasi dan bilangan pusat internet yang terhad serta jauh daripada kawasan kampung mereka menyebabkan perkhidmatan yang disediakan tidak dapat digunakan sepenuhnya.

3. Kaedah Kajian

Kajian ini merupakan kajian berbentuk kuantitatif. Data diperolehi melalui tinjauan menggunakan instrumen borang soal-selidik. Item-item di dalam instrumen diadaptasi daripada instrumen yang direka oleh Lau & Yuen (2014) dalam kajian penggunaan dan literasi internet. Pengumpulan data telah bermula pada bulan April 2021 sehingga Oktober 2021. Proses ini turut melibatkan tinjauan soal-selidik, data entri ke dalam perisian SPSS serta semakan kesahihan data. Disebabkan oleh pelaksanaan Perintah Kawalan Pergerakan (PKP) bagi mengawal penularan virus Covid-19 disepanjang tempoh pengumpulan data, kajian ini telah memilih untuk menggunakan kaedah tinjauan *Google form* sebagai platform untuk mendapat maklum balas responden secara atas talian (online). Data yang diperolehi dianalisa secara discriptif.

3.1 Persampelan

Saiz sampel dalam kajian ini ialah seramai 1228 orang responden merangkumi penduduk daripada daerah Kota Kinabalu, Sandakan dan Tawau. Kaedah *multi state sampling* digunakan bagi pemilihan sampel kajian. Penentuan kawasan kajian dipilih mengikut kepadatan penduduk berdasarkan strata kawasan kajian. Ketiga-tiga daerah mempunyai kepadatan penduduk di Sabah justeru 384 adalah jumlah minimum responden daripada setiap daerah berdasarkan kepada saranan jadual Krejcie & Morgan (1970).

Jadual 1: Saiz sampel responden

Daerah	Jumlah Minimum	Jumlah Sampel Terpilih
Kota Kinabalu	384	424
Sandakan	384	402
Tawau	384	402
Jumlah	**1152**	**1228**

4. Dapatan Kajian Dan Perbincangan

4.1 Latar belakang responden

Jadual 2: Demografi responden mengikut kawasan kajian secara berstrata.

		Strata					
		Bandar		Luar bandar		Keseluruhan	
		N	%	N	%	N	%
Daerah	Kota Kinabalu	349	38.5%	75	23.3%	424	34.5%
	Sandakan	310	34.2%	92	28.6%	402	32.7%
	Tawau	247	27.3%	155	48.1%	402	32.7%
	Jumlah	906	100.0%	322	100.0%	1228	100.0%
Jantina	Lelaki	337	37.2%	144	44.7%	481	39.2%
	Perempuan	569	62.8%	178	55.3%	747	60.8%
	Jumlah	906	100.0%	322	100.0%	1228	100.0%
Kategori umur	20 tahun dan ke bawah	82	9.1%	43	13.4%	125	10.2%
	21-30 tahun	425	46.9%	161	50.0%	586	47.7%
	31-40 tahun	168	18.5%	40	12.4%	208	16.9%
	41-50 tahun	157	17.3%	53	16.5%	210	17.1%
	Lebih 50 tahun	74	8.2%	25	7.8%	99	8.1%
	Jumlah	906	100.0%	322	100.0%	1228	100.0%
Tahap pendidikan	Sekolah rendah dan ke bawah	28	3.1%	20	6.2%	48	3.9%
	LCE/ SRP/ PMR/ PT3	39	4.3%	12	3.7%	51	4.2%
	MCE/ SPM/ SPMV	264	29.1%	91	28.3%	355	28.9%
	Sijil/ Matrikulasi	50	5.5%	15	4.7%	65	5.3%
	HSC/ STPM/ Diploma	246	27.2%	102	31.7%	348	28.3%
	Sarjana muda dan ke atas	279	30.8%	82	25.5%	361	29.4%
	Jumlah	906	100.0%	322	100.0%	1228	100.0%
Status perkahwinan	Bujang	498	55.0%	185	57.5%	683	55.6%
	Berkahwin	408	45.0%	137	42.5%	545	44.4%
	Jumlah	906	100.0%	322	100.0%	1228	100.0%
Kategori pekerjaan	Pekerja kerajaan	240	26.5%	56	17.4%	296	24.1%
	Pekerja swasta	380	41.9%	135	41.9%	515	41.9%
	Bekerja sendiri/ berniaga	133	14.7%	60	18.6%	193	15.7%
	Pelajar	102	11.3%	51	15.8%	153	12.5%
	Lain-lain	51	5.6%	20	6.2%	71	5.8%
	Jumlah	906	100.0%	322	100.0%	1228	100.0%
Kategori pendapatan	RM1000 dan ke bawah	165	18.2%	58	18.0%	223	18.2%
	RM1001-RM2000	300	33.1%	125	38.8%	425	34.6%
	RM2001-RM3000	121	13.4%	36	11.2%	157	12.8%
	Lebih RM3000	198	21.9%	41	12.7%	239	19.5%
	Tiada pendapatan	122	13.5%	62	19.3%	184	15.0%
	Jumlah	906	100.0%	322	100.0%	1228	100.0%

Jadual 3: Masalah yang dihadapi oleh masyarakat berkenaan penggunaan TMK (N=1228)

	Ya		*Tidak*	
	N	%	N	%
1. Talian internet yang tidak baik	753	61.3%	475	38.7%
2. Sukar membeli kemudahan internet	381	31.0%	847	69.0%
3. Kos penggunaan kemudahan internet adalah mahal atau tinggi	768	62.5%	460	37.5%
4. Saya tidak memerlukan Internet	60	4.9%	1168	95.1%
5. Kurang pengetahuan atau kemahiran untuk menggunakan internet	252	20.5%	976	79.5%
6. Kos peralatan untuk menggunakan internet yang tinggi	631	51.4%	597	48.6%
7. Kebimbangan keselamatan atau hak persendirian	860	70.0%	368	30.0%
8. Perkhidmatan internet tidak terdapat di kawasan ini	296	24.1%	932	75.9%
9. Perkhidmatan internet terdapat di kawasan ini namun tidak dapat memenuhi keperluan isi rumah	567	46.2%	661	53.8%
10. Kurang keyakinan diri untuk menggunakan TMK	348	28.3%	880	71.7%

Dapatan kajian mendapati terdapat sepuluh masalah yang dihadapi oleh responden berkenaan penggunaan TMK pada ketika pandemic Covid-19 melanda. Masalah infrastruktur seperti ketiadaan fasiliti, talian internet tidak baik, dan tiada perkhidmatan internet di kawasan kediaman merupakan masalah yang dihadapi pengguna.

Daripada 1228 responden yang ditinjau, 61.3 peratus menyatakan bahawa mereka bermasalah dengan talian internet yang tidak baik. 24.1 peratus pula berhadapan dengan ketiadaan perkhidmatan internet di kawasan mereka. Bagaimanapun sebanyak 46.2 peratus responden menyatakan bahawa mereka mempunyai perkhidmatan internet dalam kawasan mereka tetapi perkhidmatan agak terhad dan tidak dapat memenuhi keperluan isirumah. Masalah kemudahan infrastruktur bukanlah masalah baharu yang dialami oleh masyarakat di negeri ini. Masalah yang melibatkan infrastruktur bukan sahaja berkaitan dengan kemudahan asas seperti jalan raya, bekalan air bersih dan bekalan elektrik tetapi merangkumi perkhidmatan penyampaian. Dalam satu kajian yang dibuat oleh Goliong et al. (2020) mendapati isu capaian internet merupakan salah satu cabaran yang dihadapi oleh guru dalam menjalankan pembelajaran dan pengajaran dalam talian. Hal ini turut disokong oleh Nor Musfirah (2021) mendapati bahawa pelajar luar bandar menghadapi masalah jaringan internet yang tidak kuat atau stabil menyebabkan mereka tidak dapat mengikuti sesi pembelajaran sepenuhnya dengan berkesan.

Pada masa yang sama, masyarakat yang tinggal di luar bandar berhadapan dengan jurang digital diantara masyarakat bandar dan luar bandar, golongan yang berkemampuan dan tidak berkemampuan mahupun jurang generasi antara muda dan tua (Halina et al., 2021; Nor

& Amran, 2021). Umpamanya dalam salah satu kes yang viral dalam media sosial pada tahun 2020 sehingga mendapat perhatian daripada pelbagai pihak termasuk perdana menteri ketika itu, pelajar Universiti Malaysia Sabah (UMS), Veveonah Mosibin, yang terpaksa untuk memanjat pokok untuk mendapatkan talian internet (Lee, 2020). Kes Veveonah merupakan salah satu senario yang dihadapi oleh kebanyakan masyarakat yang tinggal di luar bandar. Akibatnya, masyarakat luar bandar berhadapan dengan keciciran bukan sahaja dalam aspek maklumat-maklumat semasa malah menganggu proses pembelanjaran dan pengajaran khususnya para pelajar disebabkan oleh kekurangan atau ketiadaan perkhidmatan internet di kawasan mereka.

Faktor kos juga didapati menjadi salah satu masalah kepada kebanyakan responden. 62.5 peratus merasakan kos penggunaan internet adalah mahal dan tinggi. Secara terperincinya, golongan pengguna yang berumur 20 tahun ke bawah adalah yang paling terkesan iaitu 72 peratus ketegori umur ini menyatakan bahawa kos penggunaan internet adalah mahal. Disamping itu, dapatan kajian mendapati bahawa kos peralatan menggunakan internet juga merupakan masalah yang dihadapi dengan skor peratusan sebanyak 51.4 peratusan. Faktor kos merupakan masalah yang dihadapi khususnya penduduk yang kurang berkemampuan. Hal ini disokong dalam kajian yang dibuat oleh Yahaya & Adnan (2021) tentang pembelajaran atas talian oleh pelajar di institusi pengajian tinggi awam. Para pelajar terpaksa membelanjakan kos internet yang mahal dalam menjalankan pembelajaran secara atas talian. Ini bukan sahaja cabaran kepada pelajar malah memberi bebanan kepada keluarga khususnya mereka yang kurang berkemampuan.

Selain itu, kebimbangan pengguna terhadap aspek keselamatan terutamanya berkaitan dengan hak dan kerahsiaan maklumat peribadi, harta dan sebagainya menjadi salah satu masalah kepada masyarakat berkaitan penggunaan TMK. Dapatan kajian mendapati 70 peratus responden menyatakan kebimbangan mereka terhadap aspek keselamatan atau hak persendirian maklumat sebagai satu masalah. 30 peratus pula menyatakan ianya bukan masalah. Faktor keselamatan maklumat peribadi dan kerahsiaan merupakan kebimbangan dan masalah kepada masyarakat berkaitan TMK. Hal ini sememangnya wajar diberi perhatian yang serius. Menurut Pranggono & Arabo (2021), kumpulan penjenayah cyber dan *Advanced Persistent Threat (APT)* mensasarkan sistem dan golongan yang terdedah (mudah diserang). Kajian mereka mendapati berlakunya korelasi diantara pandemik Covid-19 dan peningkatan serangan cyber semasa pandemik. Dapatan ini menyokong kajian yang dibuat terdahulu oleh Mandal & Khan (2020) tentang serangan cyber sewaktu pandemik seperti pelanggaran data (data breaches), *phishing scam*, *email scams* dan *ransomware*. Dalam satu kajian yang dibuat oleh Fox pada tahun 2000 (dipetik dari Farhan, Shamsul & Ahmad (2016)) apabila seramai 86.0 peratus daripada pengguna internet bimbang sekiranya terdapat individu atau syarikat yang tidak dikenali akan mendapatkan maklumat mereka melalui internet, 70.0 peratus lagi bimbang akan keselamatan nombor kad kredit dan 60.0 peratus lagi risau ada individu yang akan mendedahkan maklumat peribadi mereka ekoran telah berlaku transaksi melalui internet.

5. Kesimpulan

Pandemik Covid-19 telah membawa kesan yang pelbagai kepada dunia. Ia telah mengubah norma kehidupan masyarakat secara global untuk mengadaptasi norma gaya hidup baharu meskipun sedikit kelegaan dengan penghasilan vaksin. Pelaksanaan Perintah Kawalan Pergerakan (PKP) mendorong peralihan melakukan rutin harian secara maya melalui aplikasi maklumat, komunikasi dan teknologi atau TMK. Kajian secara kuantitatif yang dibuat terhadap masyarakat di Sabah mendapati terdapat tiga masalah utama yang dihadapi berkaitan

penggunaan TMK iaitu masalah infrastruktur, kos dan keselamatan maklumat yang merangkumi kerahsiaan peribadi dan hak. Masalah-masalah ini dihadapi oleh masyarakat Sabah secara keseluruhannya termasuklah masyarakat yang tinggal di kawasan bandar. Pastinya kawasan di luar bandar lebih kritikal disebabkan jurang pembangunan berlaku diantara kawasan bandar dan luar bandar. Oleh itu, pihak kerajaan perlu memastikan setiap dasar pambangunan infrastruktur yang sedia ada mahu pun perancangan pembangunan akan datang dilaksanakan dengan lebih efisien serta dirancakkan dari masa ke semasa bersesuaian dengan keperluan semasa khususnya di negeri Sabah.

Penghargaan
Penulis merakamkan penghargaan kepada Universiti Malaysia Sabah (UMS) atas dana penyelidikan SDK0290-2020.

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eISBN 978-967-2298-96-0

Cabaran Pengajaran dan Pembelajaran di Rumah (Pdpr) Semasa Era COVID-19: Analisis Pemetaan di Malaysia

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Abstrak

Penularan pandermik COVID-19 telah mengubah sistem pengajaran dan pembelajaran di kebanyakan negara seluruh dunia. Malaysia merupakan salah satu negara yang turut menerima dampak pandermik COVID-19 sehingga terpaksa mengimplimentasikan program pengajaran dan pembelajaran di rumah (PDPR) demi mengekang penularan wabak tersebut. Sehubungan dengan itu, kajian ini bertujuan untuk mengenal pasti cabaran yang dihadapi oleh pelajar universiti di seluruh Malaysia sepanjang mengimplimentasikan PDPR. Oleh hal demikian, seramai 2394 orang pelajar universiti awam dan swasta telah dijadikan sampel dalam kajian ini. Respon daripada kelompok pelajar tersebut dianalisis secara inferensi (Analisis Reruang, *Principal Component Analysis* & *Mann-Whitney U test*) dan deskriptif (frekuensi & peratus). Kajian ini mendapati bahawa faktor lokasi memberi pengaruh yang sangat signifikan terhadap cabaran yang dihadapi oleh pelajar universiti semasa menjalani PDPR. Pelajar yang menetap di kawasan luar bandar didapati lebih cenderung berdepan dengan masalah teknikal dan capaian internet, penurunan fokus terhadap pembelajaran, gangguan kesihatan fizikal, isolasi sosial dan literasi digital yang rendah berbanding pelajar yang menetap di kawasan bandar. Sekiranya diperincikan lagi, pelajar yang tinggal di Sabah, Perlis, Melaka dan Wilayah persekutuan Kuala Lumpur didapati paling berisiko berdepan dengan cabaran-cabaran tersebut. Kajian seumpama ini amat penting untuk dijadikan rujukan

sokongan kepada pihak berautoriti dalam memperkasakan lagi pelaksanaan PDPR di Malaysia.

Kata kunci: Pendidikan, pengajaran dalam talian, pelajar universiti, Wabak COVID-19

1. Pengenalan

Pencapaian pendidikan merupakan salah satu penanda aras terpenting dalam menentukan kualiti hidup satu-satu masyarakat. Tahap pencapaian pendidikan yang rendah sering dikaitkan dengan jangka hayat yang lebih pendek, masalah kesihatan dan kesukaran untuk bertahan ketika sakit (Raghupathi & Raghupathi, 2020). Justeru itu, kecekapan sistem pendidikan sesebuah institusi mahupun negara perlu dititikberatkan demi meningkatkan tahap pencapaian pelajar. Ianya termasuklah daripada aspek pelaksanaan sesebuah dasar pendidikan dan kaedah pengajaran yang dijalankan.

Ironinya, penularan pandermik COVID-19 yang bermula di Wuhan, Hubei, China pada Disember 2019 lalu (Jafar et al., 2021; Jafar et al., 2022; Dollah et al., 2022) telah mengubah sistem pendidikan di kebanyakan negara. Sebahagian besar negara di seluruh dunia telah beralih daripada mengimplementasikan sistem pengajaran secara bersemuka kepada sistem pengajaran dan pembelajaran di rumah (PDPR) termasuklah di peringkat pengajian tinggi (Chakraborty et al., 2021; Keržič et al., 2021). Peralihan sistem pengajaran ini berlaku dengan sangat drastik ekoran daripada keperluan semasa pada waktu itu untuk menangani krisis penularan Wabak COVID-19 (Ating, 2020; Yeo et al., 2021). Pelaksanaan sistem ini yang dilakukan secara mengejut mewujudkan masalah yang tersendiri memandangkan banyak negara khususnya negara membangun masih lagi baru dalam mengimplementasikan PDPR secara menyeluruh di semua wilayahnya (Zalat et al.,2021). Kemudahan infrastruktur informasi dan teknologi komunikasi (ICT) yang tidak mencukupi (Zalat et al., 2021), rendahnya capaian internet (IAU, 2020), defisit elektrik (Adeoye et al., 2020; Fawaz & Samaha, 2021), persekitaran tempat tinggal yang tidak kondusif untuk pembelajaran di rumah (Loganathan et al., 2021) dan literasi digital yang rendah dalam kalangan guru dan pelajar (Kabir et al., 2021) merupakan antara cabaran yang terpaksa dihadapi oleh beberapa negara membangun semasa mengimplikasikan PDPR.

Selain itu, beberapa kajian lepas turut mendapati bahawa pengimplementasian PDPR turut menyebabkan pelajar mengalami masalah kesihatan mental (kebimbangan, kemurungan & tekanan) (Kecojevic et al., 2020), masalah kesihatan fizikal (Kamsani & Mahat., 2021), isolasi sosial (Loganathan et al., 2021), penurunan kualiti tidur (Marelli et al., 2020) dan kesan keatas pencapaian akademik (Aucejo et al., 2020). Ironinya, jenis masalah atau cabaran yang dihadapi oleh pelajar semasa melaksanakan PDPR umumnya adalah tidak sama di setiap kawasan. Zhu (2020) misalnya mendapati bahawa wujud jurang digital diantara pelajar di kawasan bandar dan luar bandar di China. Hampir separuh pelajar di kawasan luar bandar di negara tersebut didapati tidak dapat mengikuti PDPR disebabkan mempunyai keterbatasan untuk memiliki peralatan eletronik seperti komputer, laptop dan telefon pintar.

Masalah atau cabaran yang berbeza seharusnya ditangani menggunakan strategi pemerkasaan yang berbeza. Oleh itu, sebelum langkah-langkah pemerkasaan dilakukan, perlunya terlebih dahulu memahami jenis cabaran yang dihadapi oleh pelajar di setiap kawasan secara terperinci. Ianya bertujuan agar langkah-langkah pemerkasaan yang dilakukan setelah itu menjadi lebih sistematik, terarah dan berfokus. Malangnya, kajian berkaitan cabaran PDPR daripada sudut pandang geografi (berlandaskan kepada perbezaan aspek ruang kawasan) sangat jarang dilakukan khususnya yang melibatkan analisis pemetaan. Walhal perkara ini amat mustahak untuk diterokai memandangkan setiap ruang kawasan khususnya di negara membangun cenderung mempunyai cabaran PDPR yang tersendiri.

Malaysia merupakan sebuah negara membangun yang sehingga kini masih lagi mengimplementasikan pelaksanakan PDPR khususnya diperingkat pengajian tinggi. Isu penularan Pandemik COVID-19 yang seolah-olah tidak berpenghujung (Imang et al., 2021) dan diburukkan lagi dengan kewujudan varian baru (ie Delta, Omicron & Deltacron) menjadi antara penyebab utama PDPR masih lagi diteruskan di Malaysia. Walaupun demikian, setakat ini masih belum ada kajian menyeluruh yang pernah dijalankan di Malaysia untuk meneroka masalah yang dihadapi oleh pelajar semasa mengikuti PDPR. Justeru itu, kajian ini bertujuan untuk meneroka dan memetakan cabaran yang dihadapi oleh pelajar pengajian tinggi di seluruh Malaysia.

2. Kaedah Kajian

2.1 Reka bentuk Kajian

Kajian ini menggunakan pendekatan kuantitatif. Menurut Jones et al., (2013), penilaian keatas saiz populasi yang besar secara relatifnya dapat dilakukan dengan mudah melalui tinjauan. Oleh itu, pendekatan tinjauan keratan rentas telah diterapkan dalam kajian ini bagi memahami cabaran penggunaan e-learning dalam kalangan pelajar pengajian tinggi di Malaysia. Untuk menghindari risiko pendermik COVID-19, kutipan data dilakukan secara dalam talian menggunakan aplikasi KoBoToolbox.

2.2 Prosedur Pengutipan Data

Pendekatan tinjauan keratan rentas telah dijalankan pada 21 Oktober 2021 sehingga 6 Disember 2021. Responden dalam kajian ini terdiri daripada pelajar pengajian tinggi swasta (9 buah universiti) dan awam (18 buah universiti) yang menetap di seluruh Malaysia (13 buah negeri & 2 wilayah persekutuan). Sampel ditentukan menggunakan teknik persampelan bertujuan (purposive sampling) dengan jumlah responden seramai 2394 orang. Saiz sampel tersebut (2394 orang) dianggap memadai kerana telah pun melebihi jumlah sampel minimum. Ini kerana, jumlah sampel minimum untuk mewakili jumlah populasi melebihi 1,000,000 orang atau infinity dengan 99% tahap kepercayaan hanya seramai 463 orang (Adam, 2020). Whatsapp dan Facebook merupakan dua platform utama yang dijadikan sebagai medium hebahan dalam kajian ini. Kedua-dua aplikasi tersebut (whatsapp & facebook) merupakan platform komunikasi dan sosial dengan popularity paling tinggi di Malaysia.

2.3 Instrumen Kajian

Sebahagian soalan instrumen tinjauan kajian ini diubah suai daripada kajian Kim et al., (2005), Zembylas et al., (2008) dan Adnan & Anwar (2020). Secara umumnya, instrumen tinjauan ini mengandungi maklumat latar belakang responden (Bahagian A) dan cabaran yang dihadapi oleh pelajar pengajian tinggi semasa PDPR dijalankan (Bahagian B). Setiap soalan berbentuk skala likert dengan lima pilihan jawapan bermula daripada ‘1 (=sangat tidak setuju) hingga ‘5 (=sangat setuju). Jumlah soalan pada Bahagian B adalah sebanyak 35 item. Disebabkan soalan pada Bahagian B adalah dalam bentuk negatif, maka skor yang lebih tinggi mewakili tahap cabaran yang lebih tinggi dan sebaliknya. Bagi menjamin kebolehpercayaan dan kesahan instrumen yang digunakan dalam keadaan baik, maka terlebih dahulu dijalankan kajian rintis ke atas 50 orang responden (Johanson & Brooks, 2010; Bujang et al., 2018). Hasil analisis mendapati keseluruhan soalan (35 item) didapati layak untuk digunakan memandangkan nilai koefisien korelasinya ($r_{\chi\gamma}$) adalah lebih besar berbanding nilai kritikal bagi pekali r korelasi Pearson (Fanani & Djati, 2016). Nilai minimum koefisien korelasi kajian ini adalah sebanyak 0.299 melebihi nilai kritikal bagi pekali r korelasi pearson dengan nilai pada signifikan 0.5% iaitu sebesar 0.273

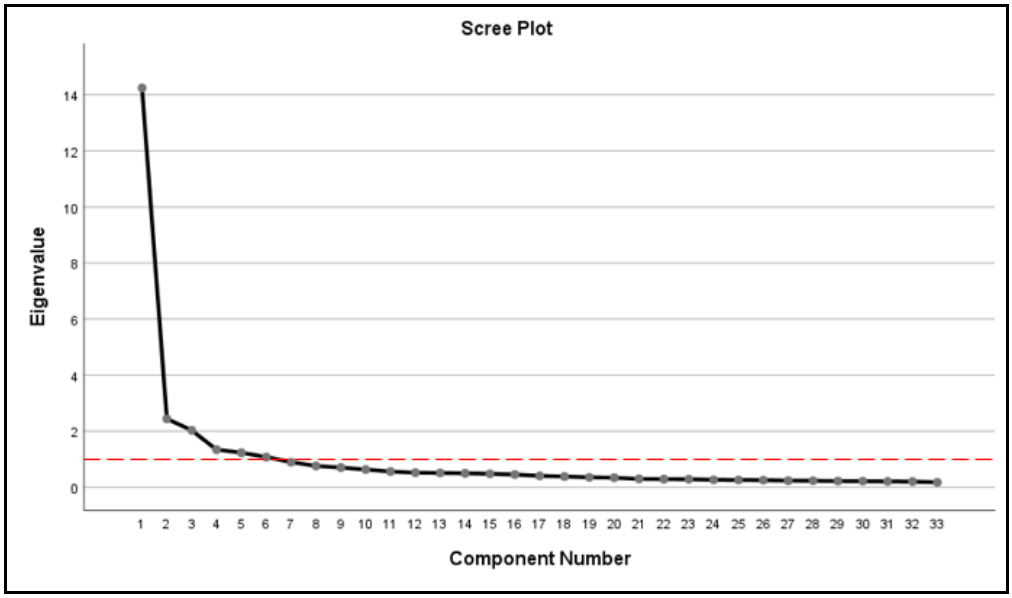
(Niño-Zarazúa, 2012). Hasil ujian kebolehpercayaan pula menunjukkan nilai alpha sebesar 0.935. Ini bermakna instrumen kajian ini sesuai untuk digunakan disebabkan mempunyai nilai alpha dalam kategori cemerlang (Taber, 2018).

2.4 Analisis Data

Data mentah yang telah dikutip kemudiannya dianalisis menggunakan perisian IBM SPSS versi 26. Dalam kajian ini, analisis deskriptif seperti frekuensi dan peratusan digunakan untuk menjelaskan latar belakang responden. Selain daripada analisis deskriptif, data yang diperoleh juga turut dianalisis menggunakan analisis reruang (GIS), analisis komponen utama (PCA) dan Mann-Whitney U test.

PCA berfungsi untuk meringkaskan data Konstruk B daripada 35 item menjadi 6 komponen. Hal ini amat bertepatan dengan fungsi analisis PCA iaitu untuk mengekstrak informasi penting bersumberkan data statistik menjadi satu set pembolehubah ortogon baharu yang disebut sebagai komponen utama (Mishra et al., 2018). Disebabkan nilai loading factor pembolehubah (item) B1 dan B19 adalah kurang daripada 0.5, maka kedua-dua pembolehubah tersebut terpaksa dikeluarkan terlebih dahulu sebelum melakukan analisis PCA untuk kali yang kedua (Kirch et al., 2017; Simanjuntak, 2018). Hasil ujian Bartlett's untuk kali kedua PCA dijalankan adalah signifikan (X^2=54959.59, df=528, $p<0.05$) sekaligus mengisyaratkan bahawa sampel layak difaktorkan. Bilangan komponen ditentukan dengan bantuan Scree Plot seperti yang ditunjukkan pada Rajah 1. Berdasarkan rajah tersebut, sebanyak 6 komponen yang terhasil dengan nilai eigen lebih tinggi daripada 1 (De Barros et al., 2020).

Rajah 1: Bilangan Komponen



Nilai kumulatif varians daripada 6 komponen yang terhasil adalah sebanyak 67.78 peratus (Jadual 1). Ini bermakna, sebanyak 67.78 peratus cabaran pelajar pengajian tinggi di Malaysia diwakili oleh 6 komponen tersebut (Nasution, 2019). Menurut William et al., (2010), dalam bidang kemanusiaan, nilai kumulatif varians minimum adalah sebanyak 50 peratus. Oleh itu, jumlah peratusan varians yang direkodkan dalam analisis ini boleh diterima kerana telah pun melebihi tahap minimum tersebut.

Jadual 1: Nilai kumulatif varians

Komponen	***Initial Eigenvalues***		
	Jumlah	% Varians	Kumulatif %
1	14.24	43.159	43.16
2	2.44	7.397	50.56
3	2.03	6.159	56.72
4	1.34	4.063	60.78
5	1.23	3.733	64.51
6	1.08	3.269	67.78
7-33	0.90-0.23	2.71-0.70	70.49-100

Hasil analisis PCA dipersembahkan dalam bentuk peta tematik menggunakan Sistem Maklumat Geografi (GIS). Tujuan peta tematik adalah untuk menunjukkan corak taburan tema yang dipilih (Slocum et al., 2009). Cabaran pelajar pengajian tinggi akan dipersembahkan menggunakan Peta Choropleth yang mampu menunjukkan taburan nilai berdasarkan ton warna. Kaedah yang digunakan dalam pengkelasan pula adalah natural break iaitu satu kaedah bagi mengoptimumkan pengkelasan dengan cara mengurangkan varians dalam kelas dan memaksimumkan varians antara kelas (Jenks, 1967). Analisis Mann-Whitney U (analisis bukan parametrik) pula digunakan untuk menilai perbezaan persepsi antara pelajar bandar dan luar bandar berhubung dengan cabaran PDPR. Penggunaan analisis bukan pametrik dalam kajian ini atas alasan data (6 komponen) tidak bertaburan secara normal.

3. Dapatan Kajian

3.1 Latar Belakang Demografi

Daripada jumlah keseluruhan sampel kajian ini, seramai 1723 orang (72%) adalah wanita dan hanya seramai 671 orang (28%) lelaki. Sebahagian besar responden kajian ini juga terdiri daripada pelajar yang telah berkahwin (2339 orang, 97.7%), beragama Islam (1722 orang, 71.9%) dan melanjutkan pengajian di universiti awam (2283 orang, 95.4%). Informasi lanjut berkaitan latar belakang demografi responden ditunjukkan pada Jadual 2.

Jadual 2: Latar belakang demografi responden (n = 2394)

Latar Belakang	Kategori	Frekuensi	Peratus (%)
Jantina	Lelaki	671	28
	Perempuan	1723	72
Status Perkahwinan	Bujang	2339	97.7
	Berkahwin	55	2.3
Agama	Islam	1722	71.9
	Kristian	499	20.8
	Buddha	116	4.8
	Hindu	41	1.7
	Lain-lain	16	0.7
Status Institusi Pendidikan	Universiti Awam	2283	95.4
	Universiti Swasta	111	4.6

3.2 Cabaran Pengajaran dan pembelajaran di Rumah (PDPR)

Hasil analisis PCA mendapati bahawa terdapat enam cabaran utama yang dihadapi oleh pelajar semasa PDPR dijalankan (Jadual 3). Cabaran paling besar adalah daripada aspek

(Ko1) penurunan fokus terhadap pembelajaran (var(X)=18.91%). Kemudian diikuti oleh (Ko2) gangguan kesihatan fizikal (var(X)=12.62%) dan (Ko3) gangguan kesihatan mental (var(X)=11.41%). Selain itu, golongan pelajar juga menghadapi (Ko4) masalah teknikal dan capaian internet (var(X)=10.37%) serta (Ko5) isolasi sosial (var(X)=7.36%). Cabaran terakhir adalah terkait dengan (Ko6) ketidakmahiran pelajar dalam mengikuti PDPR (var(X) = 7.11%).

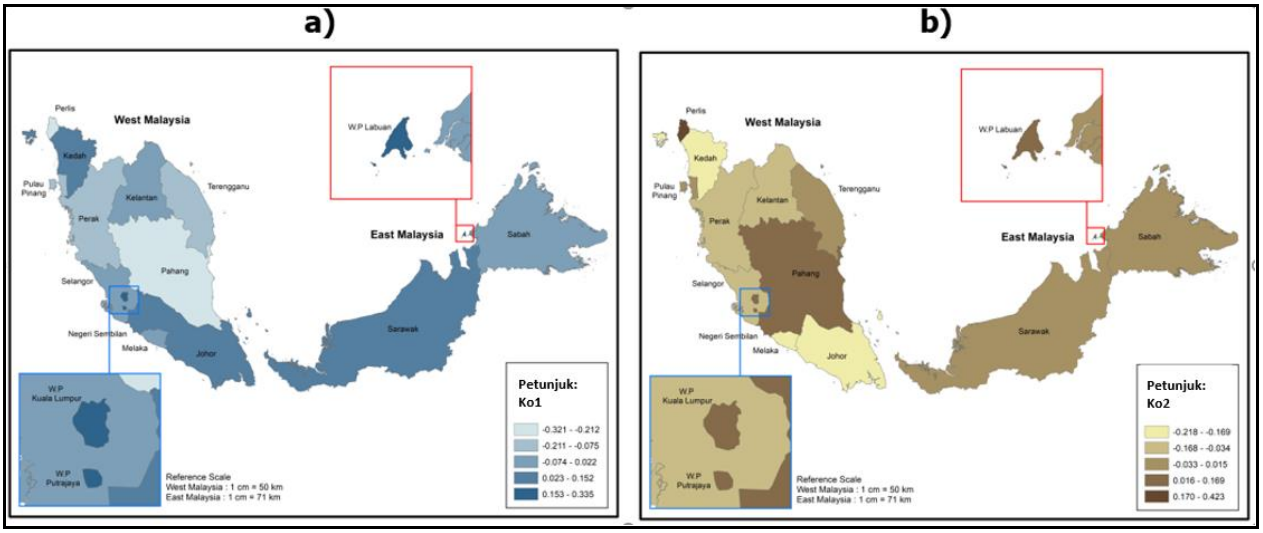
Jadual 3: Cabaran Pengajaran dan Pembelajaran di Rumah (PDPR)

Komponen (Domain)/Item	Loading factor	Varians (%)
Komponen 1 (Ko1) Penurunan Fokus Terhadap Pembelajaran		
B22) Mudah berasa bosan disebabkan teknik pembelajaran PDPR yang sangat terbatas	0.735	18.91
B16) Kekurangan motivasi disebabkan suasana pembelajaran di rumah tidak seperti berada di universiti	0.733	
B21) Kesukaran untuk fokus disebabkan kaedah pembelajaran e-learning yang membosankan	0.725	
B18) Produktiviti pembelajaran merosot	0.691	
B8) Kekurangan motivasi kerana tidak dapat bersemuka dengan rakan dan pensyarah	0.682	
B17) Sukar memahami isi kandungan subjek yang diajar	0.678	
B23) Sukar untuk fokus disebabkan keadaan rumah yang tidak kondusif	0.621	
B15) Mudah mengantuk semasa kelas dijalankan	0.600	
B20) Sukar untuk menyelesaikan tugasan kumpulan secara digital	0.591	
B24) Kesukaran untuk fokus disebabkan gangguan kerja-kerja lain di rumah	0.551	
Komponen 2 (Ko2) Gangguan Kesihatan Fizikal		
B4) Kesakitan dibahagian belakang	0.795	12.62
B3) Kesakitan dibahagian tengkuk/ leher	0.779	
B6) Sengal-sengal mata	0.757	
B5) Kabur penglihatan	0.684	
B2) Sakit kepala	0.671	
B7) Keletihan melampau	0.583	
Komponen 3 (Ko3) Gangguan Kesihatan Mental		
B12) Mudah mengalami kemurungan	0.782	11.41
B13) Mudah mengalami tekanan jiwa	0.738	
B14) Mudah mengalami kegelisahan/keresahan	0.708	
B10) Berasa terasing	0.634	
B11) Kurang perhatian peribadi	0.629	
B9) Berasa kesunyian	0.580	
Komponen 4 (Ko4) Masalah Teknikal dan Capaian Internet		
B29) Akses internet saya terhad disebabkan jaringan internet di kawasan rumah saya rendah	0.799	10.37
B28) Akses internet saya terhad disebabkan kos internet sangat mahal	0.743	
B30) Gangguan bekalan elektrik sering berlaku di rumah saya	0.724	
B31) Komputer riba peribadi saya perlahan	0.652	
B32) Saya terpaksa berkongsi komputer riba dengan adik-beradik	0.565	
Komponen 5 (Ko5) Isolasi Sosial		
B25) Kurang akrab bersama rakan-rakan sekuliah	0.813	7.36
B27) Tidak dapat mengenali ramai rakan-rakan di universiti	0.765	
B26) Kesukaran untuk berkomunikasi dengan rakan sebaya dalam talian	0.720	
Komponen 6 (Ko6) Rendahnya Literasi Digital		
B35) Menggunakan *e-learning* tidak semudah menggunakan sistem lain	0.745	7.11
B34) Tidak mudah untuk menjadi mahir dalam pembelajaran e-learning	0.736	
B33) Saya dapati *e-learning* sukar digunakan	0.668	

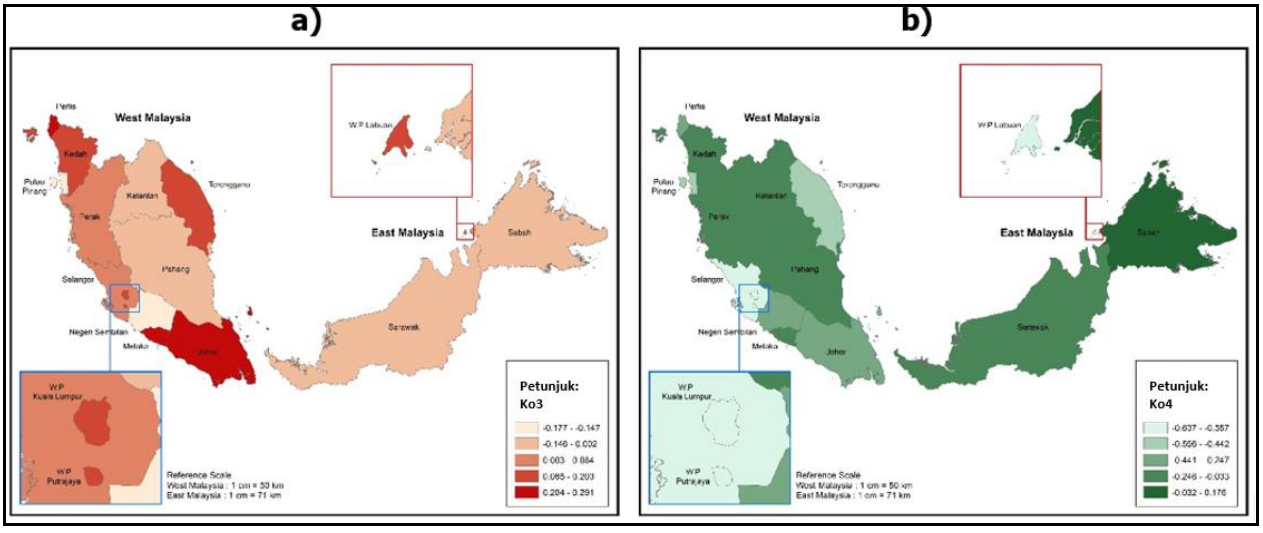
3.3 Cabaran PDPR Mengikut Negeri di Malaysia

Sekiranya diteliti berdasarkan ruang geografi, setiap kawasan mempunyai cabaran yang berbeza-beza semasa PDPR dijalankan. Berbanding negeri-negeri yang lain, golongan pelajar di Negeri Sabah misalnya paling cenderung mengalami masalah teknikal dan capaian internet (Z-Scores=0.1758) serta literasi digital yang rendah (Z-Scores= 0.1000) (Rajah 3b & 4b). Berbeza dengan Wilayah Persekutuan Kuala Lumpur yang mempunyai kemudahan teknikal dan capaian internet paling baik untuk melakukan PDPR berbanding negeri lain (Z-Scores=-0.6373) (Rajah 3b). Walaupun begitu, pelajar di Wilayah Persekutuan Kuala Lumpur pula paling cenderung mengalami masalah penurunan fokus terhadap pembelajaran (Z-Scores= 0.3347) dan isolasi sosial semasa e-learning dijalankan (Z-Scores= 0.2000) (Rajah 2a & 4a). Negeri Perlis dan Melaka pula masing-masing mempunyai pelajar yang paling cenderung mengalami gangguan kesihatan fizikal (Z-Scores= 0.4226) dan kesihatan mental (Z-Scores= 0.2913) (Rajah 2b & 3a).

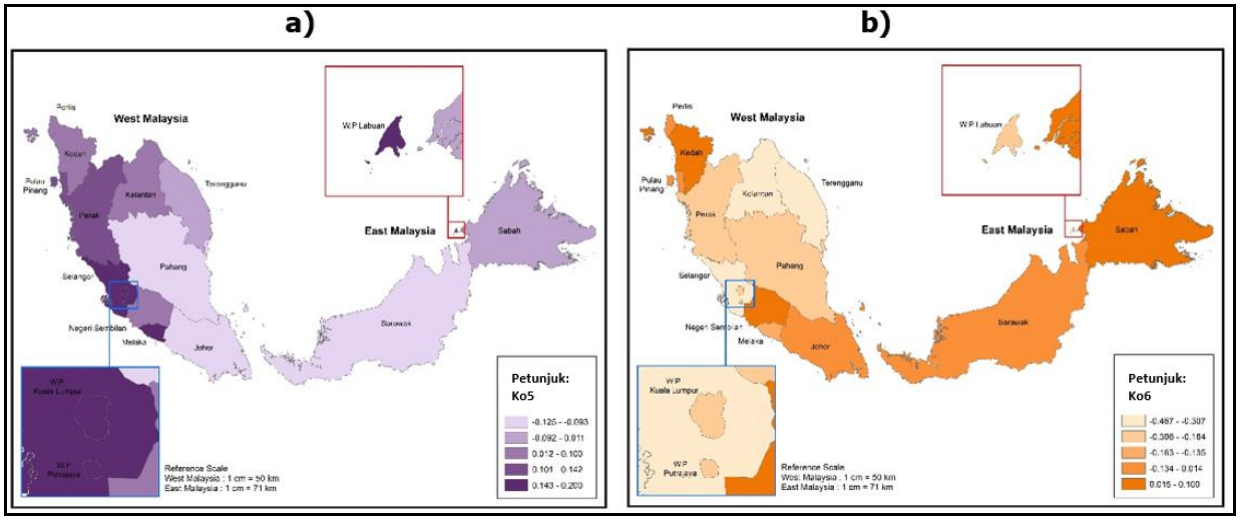
Rajah 2a & 2b: Cabaran PDPR daripada aspek Ko1) Penurunan Fokus terhadap Pembelajaran dan Ko2) Gangguan Kesihatan Fizikal



Rajah 3a & 3b: Cabaran PDPR daripada aspek Ko3) gangguan kesihatan mental serta Ko4) cabaran teknikal dan capaian internet



Rajah 4a & 4b: Cabaran PDPR daripada aspek Ko5) isolasi sosial dan Ko6) rendahnya literasi digital



3.4 Perbezaan Persepsi antara Pelajar Bandar dan Luar Bandar berhubung dengan Cabaran PDPR

Kajian ini juga mendapati bahawa terdapat perbezaan signifikan berhubung dengan cabaran PDPR antara pelajar bandar dan luar bandar. Ianya termasuklah daripada aspek penurunan fokus terhadap pembelajaran (p=<0.001), gangguan kesihatan fizikal (p=0.001), masalah teknikal dan capaian internet (p=<0.001), isolasi sosial (p=0.002) dan rendahnya literasi digital (p=<0.001). Berbanding pelajar di bandar, golongan pelajar yang menetap di luar bandar didapati lebih cenderung mengalami masalah-masalah tersebut (Ko1, Ko2, Ko4, Ko5 & Ko6). Walaupun begitu, bagi masalah gangguan kesihatan mental pula didapati tidak wujud perbezaan signifikan (p=0.297) antara pelajar bandar dan luar bandar (Jadual 4).

Jadual 4: Hasil analisis Mann-Whitney U

Komponen/ Domain	Lokasi	Frekuensi (%)	*Mean Rank (MR)*	Nilai-P
Ko1) Penurunan fokus terhadap pembelajaran	Bandar	988 (41.27)	1127.3	<0.001
	Luar Bandar	1406 (58.73)	1246.8	
Ko2) Gangguan kesihatan fizikal	Bandar	988 (41.27)	1142.7	0.001
	Luar Bandar	1406 (58.73)	1236.0	
Ko3) Gangguan kesihatan mental	Bandar	988 (41.27)	1179.9	0.297
	Luar Bandar	1406 (58.73)	1209.8	
Ko4) Masalah teknikal dan capaian internet	Bandar	988 (41.27)	965.3	<0.001
	Luar Bandar	1406 (58.73)	1360.6	
Ko5) Isolasi sosial	Bandar	988 (41.27)	1145.5	0.002
	Luar Bandar	1406 (58.73)	1234.1	
Ko6) Rendahnya literasi digital	Bandar	988 (41.27)	1129.5	<0.001
	Luar Bandar	1406 (58.73)	1245.3	

Mann-Whitney U (nilai-p) dengan tahap signifikan (α=0.05)

4. Perbincangan

Lokasi menetap pelajar universiti memainkan peranan yang penting dalam mempengaruhi keupayaan mereka untuk menjalani PDPR. Justeru itu, bagi meningkatkan tahap keberkesanan PDPR secara menyeluruh di Malaysia, keutamaan dalam memperkasakan program tersebut haruslah diberikan keatas pelajar luar bandar berbanding pelajar di kawasan

bandar. Ini kerana, pelajar yang tinggal di kawasan luar bandar cenderung menghadapi pelbagai masalah (Ie penurunan fokus terhadap pembelajaran, gangguan kesihatan fizikal, masalah teknikal & capaian internet serta rendahnya literasi digital) untuk menjalani PDPR berbanding pelajar yang menetap di bandar (Rujuk Bahagian 3.4). Hasil kajian ini selaras dengan beberapa penemuan kajian lepas bahawa pelajar yang tinggal di kawasan luar bandar lebih dominan berdepan dengan masalah capaian internet (Mason & Rennie, 2004; Lynch, 2020; Adeoye et al.,2020) dan ketidakmahiran menggunakan peranti eletronik (Anand et al., 2012).

. Sekiranya diperincikan lagi, pelajar universiti yang menetap di Sabah merupakan kelompok yang paling ramai mengalami masalah teknikal dan capaian internet serta rendahnya literasi digital (Rujuk Rajah 3b & 4b). Hal ini bukanlah sesuatu yang mengejutkan memandangkan sebahagian besar daerah di Sabah masih lagi tergolong dalam kategori kawasan luar bandar. Bahkan, Sabah juga merupakan negeri termiskin (Khan, 2020) dan mempunyai kadar pertumbuhan ekonomi yang paling perlahan berbanding 12 negeri lain di Malaysia (Bernama, 2021). Bukan itu saja, malah Kemudahan infrastruktur asas seperti bekalan elektrik dan liputan jaringan telekomunikasi yang terdapat di negeri tersebut juga masih jauh ketinggalan berbanding negeri lain (Borneo Today, 2021). Justeru, tidak menghairankan sekiranya lebih separuh (52%) pelajar di Sabah mengalami kesukaran untuk menjalani program PDPR semasa perintah kawalan pergerakan (PKP) dilaksanakan disebabkan tidak mempunyai akses internet dan peranti elektronik (Ie telefon pintar, komputer, laptop) (BH Online, 2020). Peratusan pemilikan alat peranti eletronik yang rendah dalam kalangan pelajar luar bandar pula secara tidak langsung membantutkan peningkatan literasi digital mereka (Mohamed et al., 2012).

Walaupun begitu, pelajar universiti yang mempunyai literasi digital dan akses internet yang rendah tidak semestinya mengalami masalah penurunan fokus terhadap pembelajaran. Buktinya, jumlah pelajar yang menetap di Wilayah Persekutuan Kuala Lumpur lebih cenderung mengalami masalah penurunan fokus terhadap pembelajaran berbanding pelajar yang menetap di Sabah (Rajah 2a). Tidak hanya sekadar itu, malah kes isolasi sosial dalam kalangan pelajar universiti di Wilayah Persekutuan Kuala Lumpur juga adalah yang paling tinggi berbanding negeri-negeri lain di Malaysia (Rajah 4a). Walhal, kemudahan teknikal dan internet di Wilayah Persekutuan Kuala Lumpur adalah yang terbaik di antara semua negeri di Malaysia (Rajah 3b). Ini bermakna, untuk meningkatkan pencapaian akademik (peningkatan fokus terhadap pembelajaran) dan tahap interaksi pelajar universiti semasa PDPR diimplementasikan tidak cukup dengan hanya sekadar memperkasakan kemudahan internet dan literasi digital. Tapi sebaliknya, harus juga mengambil kira peranan tenaga pengajar (Ie pensyarah, guru & tutor) daripada aspek pedagogi dalam meningkatkan kualiti pengajaran dan pembelajaran mereka kearah yang lebih efektif dan efisyen.

Hal ini kerana, strategi pengajaran yang berkesan amat penting untuk menarik minat pelajar mengikuti program PDPR (Yengin et al., 2010; Ananga, 2020). Oleh hal demikian, dalam era pandermik ini, tenaga pengajar perlu menampilkan teknik pengajaran yang lebih kreatif, inovatif dan bervariasi agar mampu meningkatkan tumpuan dan minat pelajar semasa mengikuti program PDPR. Selain itu, melalui pelaksanaan program PDPR ini, interaksi yang dilakukan antara tenaga pengajar dengan pelajar juga haruslah bersifat dua hala (BH Online, 2021). Dalam erti kata lain, sistem pengajaran mestilah beralih daripada sudut pandang "learner as sponge" kepada "learner as active construction of meaning" (Wilson & Peterson, 2006). Ini kerana, selain daripada lebih interaktif, pengimplementasian komunikasi dua hala juga mampu memberi manfaat kepada pembentukan psiko-emosi seseorang individu agar lebih bersikap terbuka, menimbulkan rasa positif, rasa tenang dan rasa lebih dihargai (Aziz et

al., 2020). Tidak hanya terhad dalam konteks interaksi antara tenaga pengajar dan pelajar sahaja malah komunikasi dua hala antara pelajar dengan pelajar lainnya juga penting untuk mengurangkan masalah isolasi sosial dalam kalangan pelajar universiti. Oleh itu, seorang tenaga pengajar harus mempunyai teknik dan modul pengajaran yang bersesuaian dengan kehendak semasa agar tahap interaksi pelajar universiti dapat dipertingkatkan semasa program PDPR dijalankan.

5. Kesimpulan

Dapatlah disimpulkan bahawa kedudukan geografi atau lokasi menetap pelajar memainkan peranan yang sangat penting dalam mempengaruhi keupayaan mereka untuk menjalani program PDPR. Pelajar yang menetap di kawasan luar bandar umumnya didapati lebih cenderung berdepan dengan masalah teknikal dan aksessibiliti internet, penurunan fokus terhadap pembelajaran, gangguan kesihatan fizikal, isolasi sosial dan rendahnya literasi sosial berbanding pelajar yang menetap di kawasan bandar. Hal ini secara tidak langsung menunjukkan bahawa pelajar yang menetap di luar bandar mempunyai tahap kemudahterancaman atau kerentanan (vulnerability) yang lebih tinggi terhadap pelaksanaan PDPR berbanding pelajar yang menetap di bandar khususnya bagi negeri Sabah, Perlis, Melaka dan Wilayah Persekutuan Kuala Lumpur. Oleh hal demikian, penekanan terhadap proses pemerkasaan PDPR di Malaysia haruslah menumpukan kepada golongan sasar iaitu kelompok pelajar yang rentan.

Hasil kajian ini amat penting untuk dijadikan data sokongan kepada pihak berautoriti (pemegang taruh) dalam memperkasakan lagi pelaksanaan PDPR di Malaysia. Hal ini kerana, dengan memahami kedudukan lokasi golongan sasar (kelompok pelajar rentan) secara terperinci akan memudahkan proses pemerkasaan PDPR dilakukan dengan lebih sistematik dan efisyen. Selain itu, dalam kajian ini novelty yang berjaya ditonjolkan adalah daripada sudut pendekatan yang digunakan untuk meneroka cabaran PDPR. Berbeza dengan kebanyakan kajian lepas sebelum ini, penerokaan terhadap cabaran PDPR dalam kajian ini dilakukan menggunakan pendekatan reruang.

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SOCIAL SCIENCES & HUMANITIES CONFERENCE 2022 (SSHR 22) 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

Estimation of Biophysical structures of Lowland Dipterocarp Forest using discrete return LiDAR data

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Abstract
It is challenging to measure biophysical forest structure due to the high spatial inconsistencies and three-dimensional characteristic of forest structure. Field-based approach are time-consuming and passive optical remote sensing techniques are limited in their ability to detect structural changes occurring below the top of the canopy. This cause the variations in vertical and horizontal forest structure difficult to assess. Light Detection and Ranging (LiDAR) remote sensing that produces three-dimensional point cloud has been identified as one of the best technologies for measuring forest structures. This study used LiDAR discrete return that offered the vertical distribution to extract the biophysical properties of lowland *Dipterocarp* forest. The aim of this study is to use LiDAR data discrete return to gather the variables of forest structure such as tree height and crown area to estimate Diameter Breast Height (DBH). The DBH was estimated using model's logarithm, cubic, power and linear was established for tropical rainforest. The best model is determined based on the correlation between the estimated DBH and in-situ data. The result shows the best model is cubic and linear model with R^2 is 0.76, 0.75 and RMSE 0.32 and 0.29, respectively.
Keywords: Forest structure, LiDAR, Tropical forest

1. Introduction

Forest act as a component that offset the natural processes such as absorb carbon and supply oxygen (atmosphere), infiltration and landslide (soil) and rainfall interception and runoff (hydrology). It is important to investigate the biophysical of forest structure to assess the health of forest ecosystems, moreover, the parameters of forest structure are needed in forest inventory, forest management, estimation of aboveground biomass and hydrological models (Asner, 2002). In general, in-situ data in tropical forest is limited (Palace et. al,2008), particularly in Malaysia, the information on forest structure still insufficient and costly to collect (Phua and Saito, 2003). This is due to difficulties to gather the forest structure data, especially in remote areas. Instead of factor cost and time, the extreme geographical factor is the main problem. It is impossible to gather all information about forest structure over large areas using ground measurements. The complexity of the forest canopy in the tropical forest limits the study of the forest canopy structure.

On the other hand, forest management requires detailed information on forest structure to evaluate the current status of our forest, to calculate maintenance cost and benefits and determine the best management practices to ensure the sustainability of forests (Nelson, Swift and Krabil, 1988). An alternative approach using remote sensing data had been developed (Nilsson, 1996). There are intensive studies had been done on the extraction of forest structure using remote sensing technique. However previous studies focused on temperate, deciduous and pine coniferous (Nelson, Swift and Krabil, 1988; Nilsson, 1996; Næsset, E. 1997) and rarely reported in Tropical region.

In Malaysia, previous studies applied remote sensing techniques in forestry includes mapping forest activities for forest survey and biomass indicator (Hashim et al., 1999), mapping of forest cover types (Khali Aziz, 1999), forest fire detection and forest monitoring (Hussin,2000); sustainable forest management (Khali Aziz, 2001); estimation of aboveground biomass in forest (Alexandra, et. al, 2011; Okuda, et. al 2004); estimation of forest area (Mohd Hasmadi & Kamaruzaman; 2008); mapping mangrove forest reserve (Hasmadi, et al, 2011), mapping densities species of *Diterocarp* (Stephen, et al, 2013); detection forest deforestation and degradation (Phua, et al, 2014) estimation of tree height and delineation of tree crowns (Jamru, Hashim & Phua, 2015); treetop detection (Jamru & Hashim, 2019) and extraction of biophysical structure of vegetation (Chubey, Franklin & Wulder, 2006). However, there is still lack on the studies of forest structure for Tropical forest, especially in Malaysia. Whereas, the precision of the forest structure information has a high demand for government and private sector for an effective forest management sustainable.

Nowadays, remote sensing become an important data source for forest inventory, which provides consistent data collections cycles, reproducible, stable platform and applicable at regional or continental scales (Chubey, Franklin & Wulder, 2006). Indeed, modern technologies such as remote sensing are necessary for monitoring forest areas and carbon changes (Secretariat GCOS, 2009). There are several approaches to measure forest structure variable using optical and radar remote sensing systems. Usually medium resolution with resolution more than 10 meter was used for national scale estimation. However, high resolution satellite image with resolution less than 4 meter is used for forest stand level estimation (Wulder et. al, 2004). Different in forest types and forest disturbances effects the spectral information of satellite image. Medium resolution satellite image is less effective to be used in tropical or dense forest

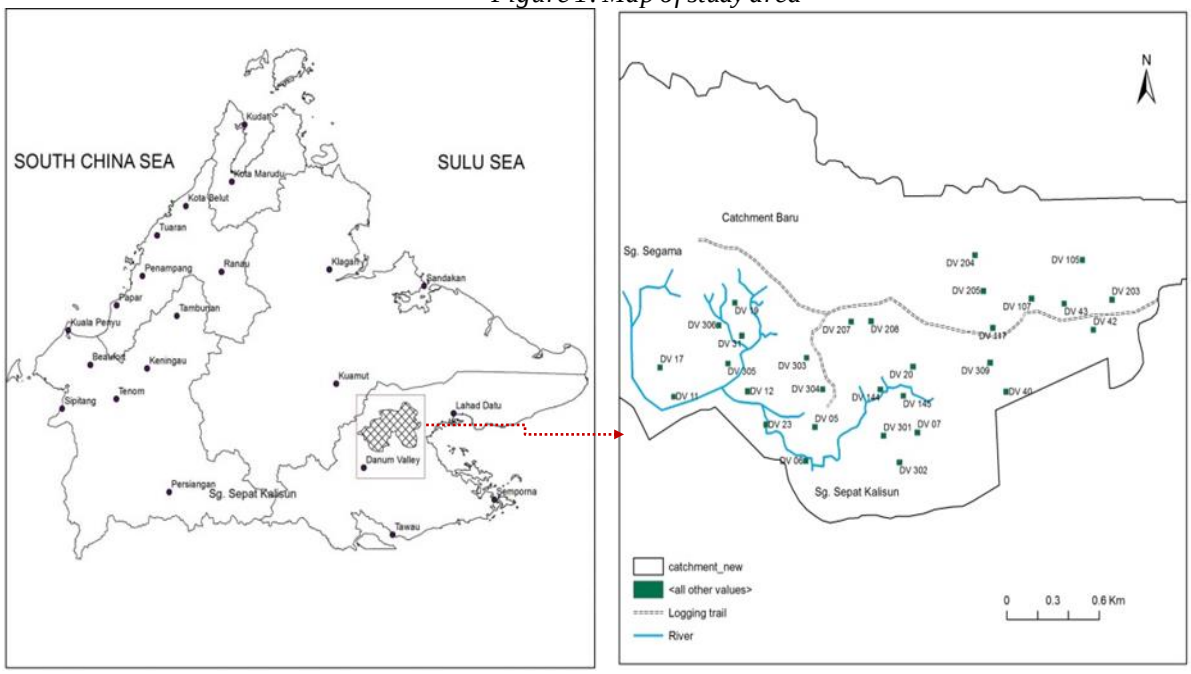
(Gibbs, et al, 2007). Therefore, high resolution satellite image was introduced to overcome this problem. In fact, high resolution satellite image is useful for forest information extraction and modern forest inventory.

The characteristic of forest is high spatial variability inconsistencies and three dimensional. Thus, for this study the optical imagery is not suitable as the signal of passive sensor is not able to penetrate into the lower layer of forest structure and only provided horizontal distribution. The active remote sensing LiDAR has been chosen for this study. LiDAR widely known as a vegetation characterization tool has the ability to produce a vertical distribution. There are three types of LiDAR currently in use, namely fullwave form, discrete return and terrestrial. Popescu, Wynne & Scriyani (2004) noted that small footprint emits of millions of laser pulses that provide very high-resolution three-dimensional data. In this study, airborne LiDAR discrete return used to obtain forest structure variables. The purpose of this study is to investigate the potential of LiDAR discrete return to characterize the biophysical of forest structure based on LiDAR height distribution in order to provide forest inventory data and useful application in sustainable forest management. Beside that the detailed information on forest structure will may assist in forest surveys and tree census data. At the same time, this approach also reducing fieldwork effort, time, costs and increasing accuracy, consistency and reliable data.

2. Methods

2.1 Study area

Figure 1: Map of study area



Source: (Author)

Danum Valley located at the south eastern part of Borneo Island (Figure 1), specifically at 4˚50′N-5˚00N and 117˚35′E -117K45′. Total area of 43,800 ha of land is under Sabah foundation

management. Danum valley consists of three sub-catchment which is Baru,Sapat Kalisun and Segama. Forest of Danum is dominated by by *Dipterocarps*, particularly *Parashorea malaanonan* and *P. tomentella* together with *Shorea johorensis.* Even though *Dipterocarps* dominate the upper canopy, understory species from families such as *Euphorbiaceae* and *Rubiaceae* can make up over 85% of small stem. Overall, 44 types of species have been recorded during this study.

2.2 Satellite and ancillary data

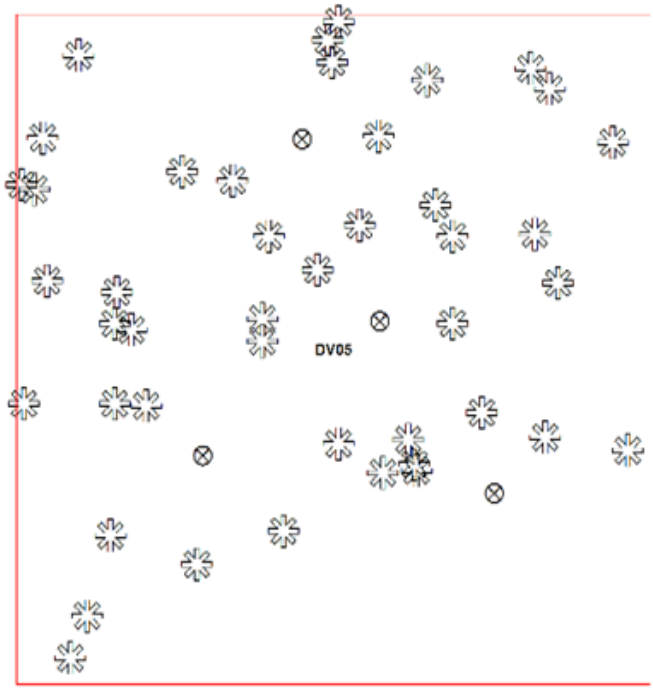
2.2.1 LiDAR data

LiDAR discrete return data used in this study was acquired on 11 October 2013 using laser Optech- HD ILRIS system. The total area of interest has been scanning was 20.59 km^2 with flying height is 500 meters and swath overlap is 35%. LiDAR discrete return small footprint has been chosen for this study since this laser system provides fourth return that emit the laser for each layer of forest structure. The point cloud has been class to non-ground and ground point cloud. Non- ground used to represent the characteristic of forest structure. Meanwhile, Ground point cloud will generate the surface.

2.2.2 In-situ measurement

The study area was sampled using square plot with plot size 30m x 30m (figure 2). The parameter of forest structure has been collected is tree height, DBH, tree crown, tree position and species. All trees with DBH larger or equal to 10 cm within the plot area were measured. For tree positioning, the horizontal distance was measured from the Northwest corner of the plot. Plot location was determined using Differential GPS with error of ±20 cm. In this study, the estimation of DBH focused in the plot DV20, DV144 and DV145 with total 127 trees were measured.

Figure 2: Location of the trees inside the plot



2.3 Extraction of biophysical forest structures

The extraction of biophysical forest structure for this study includes the processes of generating the Canopy Height Model (CHM), delineation and classification tree crown. Both of parameters used for estimating DBH that cannot directly retrieve from LiDAR data.

2.3.1 Tree Height

The Canopy Height Model was obtained by subtracting of DSM in first return and DTM in the last return. The CHM was validated with the tree height was measured in the field. The manual delineation tree crown was done on LiDAR CHM data for those trees can identify from field data. Overall, third per forth tree is recognized from CHM data.

2.3.2 Tree crown detection and delineation

The segmentation of tree crown was carried out using eCognition Developer 8.7. The multi resolution segmentation method has been used to delineate the tree crown based on LiDAR height distribution. Individual tree crown detection is to extract the objects or tree crowns from the high-resolution LiDAR data. There were various algorithms for tree crowns detection and delineation have been developed such as valley following (Gougeon & Leckie, 2006) region growing (Ke & Quackenbush,2008), watershed technique (Wang, Gong & Biging; 2004) and multi-scale object segmentation (Hay, et. al, 2005). The multiresolution segmentation is a segmentation approach based on the local homogeneity criteria. The segment size was determined by the scale of the parameter that measuring the maximum possible homogeneity. The segmentation based on the parameter that set up for scale parameter, the shape and the compactness. There is no standard value of criterion for segmenting a tree crown, the segmentation is based on the trial and error approach until the results is appropriate match with the image objects of interest. All over the process

segmentation of tree crown was carried out more than 14 times using different parameter (scale, shape and compactness) was applied to perform the hierarchical classification. Figure 2 shows the results of segmentation of tree crown based on different parameter and level. In this study, the best segmentation of tree crown is at level three (refer Table 1).

Figure 2: Segmentation of the tree crowns

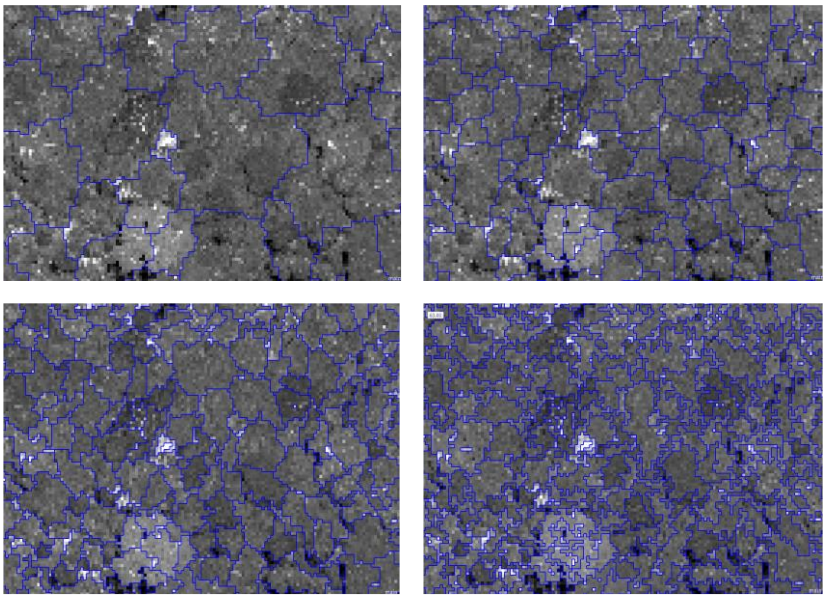


Table 1: Image segmentation hierarchy

Level	Scale	Shape	Compactness
1	24	0.5	0.5
2	18	0.8	0.7
3	10	0.8	0.7
4	10	0.1	0.5

The segmentation trees crown exported as a polygon according to the plot for data analysis. The segmentation result was compared with the in-situ data to identify the individual trees. The tree position measures in the field were overlaid with the crown segments from the LiDAR data. The generated crown variables were analysis against field measured variables for correlations.

2.3.3 Estimation of DBH

There are several models were developed to estimate the value of DBH including linear, logarithmic, power and cubic (Asmare, 2013). The CPA values were used as an input parameter in all selected models to attain DBH estimated value. The estimation model used for DBH estimation are defined as follow;

$$DBH\,(\text{cm}) = 0.0715*\text{CPA} + 20.627 \quad (5)$$

$$DBH\,(\text{cm}) = 18.904*\log\,(\text{CPA}) - 14.754 \quad (6)$$

$$DBH\,(\text{cm}) = 6.829*\text{CPA}^{0.5569} \quad (7)$$

$$DBH\,(\text{cm}) = 0.0042*\text{CPA}^2 + 0.6743*\text{CPA} + 2.3516 \quad (8)$$

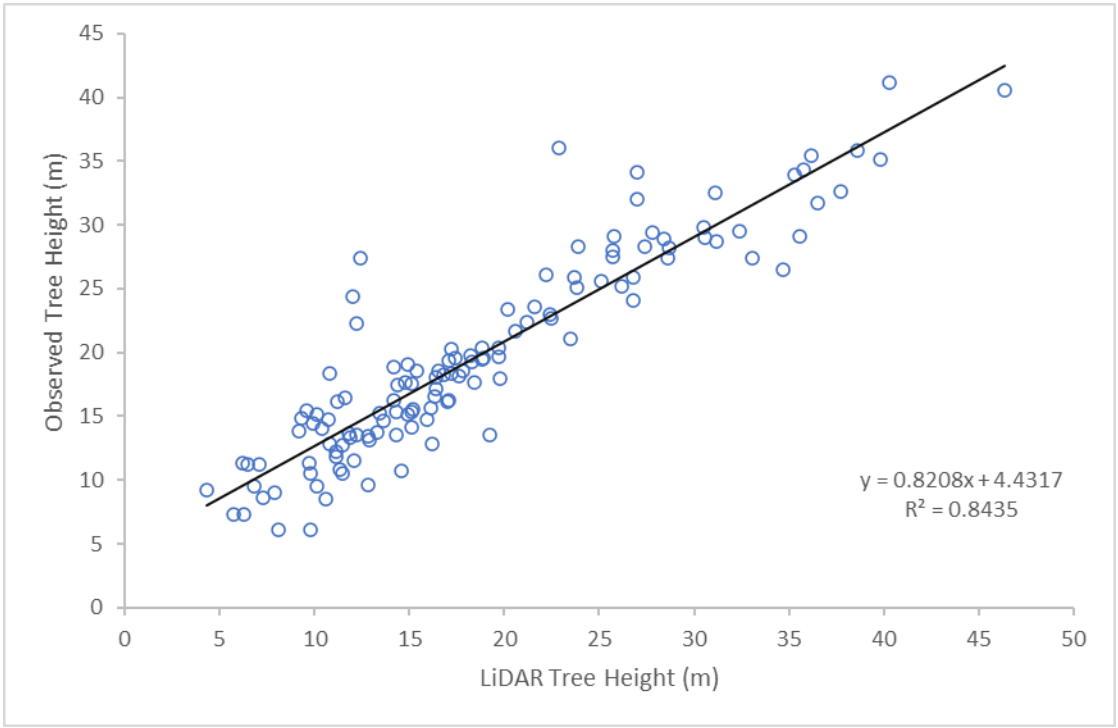
At this stage, the final output obtained in processing phase was analysed. The estimation of DBH was performed for forest before being analysed. All estimated values of DBH are validated and compared to the actual DBH values recorded during field work for accuracy assessment, reliability and correlation value between them.

3. Results & Discussion

3.1 Tree Height

Figure 3 shows a good correlation between the in-situ tree height and tree height form LiDAR data with p-value and R^2 value being <0.001 and 0.84, respectively. The highest tree in the plot DV20, DV144 and DV145 was 35.6m, 46.4 and 40.3, respectively. While, the lowest tree was 6.3, 5.7 and 4.3m, respectively. Most of the tree inside the plot are dominated by the middle layer, and tree height ranges from 10 to 40m. There is a significant amount of scatter in the plot, which appears to be due to measurement error for in-situ tree height range height of 20 to 40m. When looking more closely at the location of plots on the edge of hills with steep slopes, it was discovered that it had contributed to the error. This finding is supported by Liu, Zhang, Peterson & Chandra (2007) who discovered that topographical condition and the study area's ecosystem had a substantial impact on tree height accuracy. Due to geographical characteristics, bias may occur during the generation of CHM. The forested area, as we know, has a dynamic mountainous and steep slope that is difficult to filter and failing to filter the point cloud outlier will result in an inaccuracy in the return pulse

Figure 3: Regression between LiDAR tree height data and in-situ tree height data

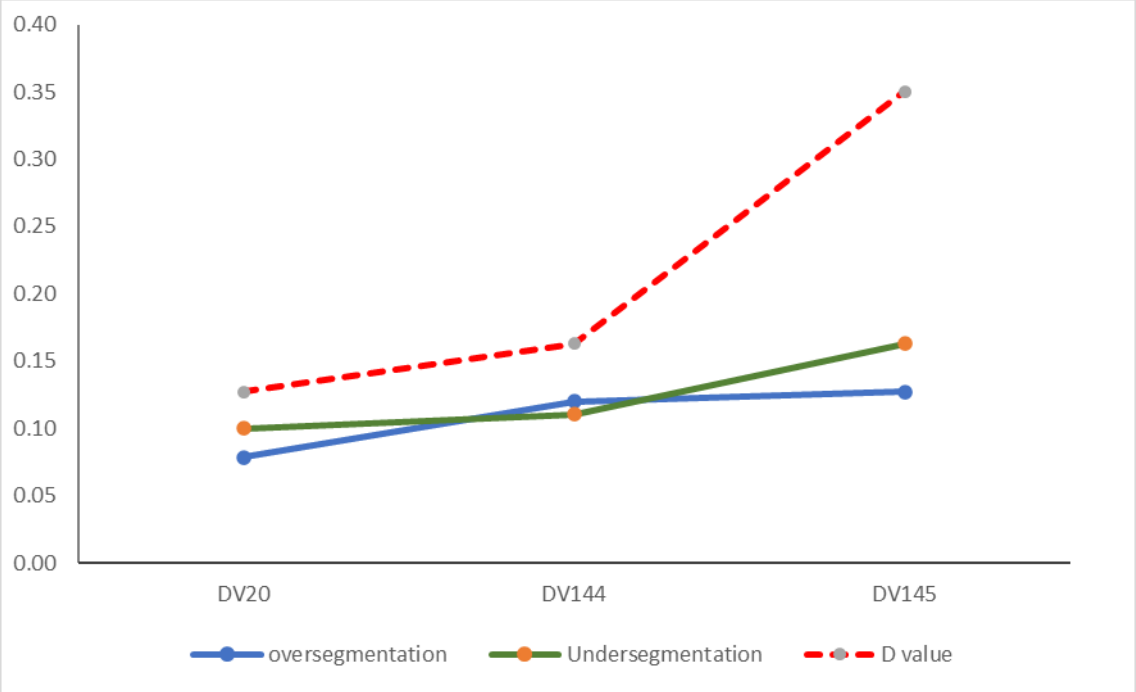


3.2 Tree crown area

The complexity of the Tropical forest becomes a limitation for structural analysis. In dense forest, nonuniform, varied environments with a wide range of tree heights make defining tree crowns challenging. The extraction of tree crown areas in this study is based on the CHM that generated using LiDAR data. The D index for the goodness of the segments was used to asses

the accuracy of segmentation tree crown area. The D index for the validation segmentation tree crown area for three plots shown in Figure 4. DV20, DV144 and DV145 recorded 0.08,0.12 and 0.13 for the over segmented crown, respectively. Plot DV20, DV144 and DV145, respectively had 0.10, 0.11 and 0.16 under segmented crown. The value of closeness index (D) of the goodness segments tree crowns for lowland dipterocarp forest is 0.13,0.16 and 0.35 for DV20, DV144 and, DV145, respectively. The range for over-segmentation and under-segmentation is zero to one, indicating a good segmentation result. The error in segmentation is recognized as a result of the environment in the forest, which has a high density of trees and commonly has trees near close to one other. Furthermore, due to the combination of large and small tree crowns, huge crowns are frequently overestimate. In a nutshell, tree crown delineation is based on the tree crown's morphology. There is no perfect algorithm that can accurately outline the geometry of the tree crown.

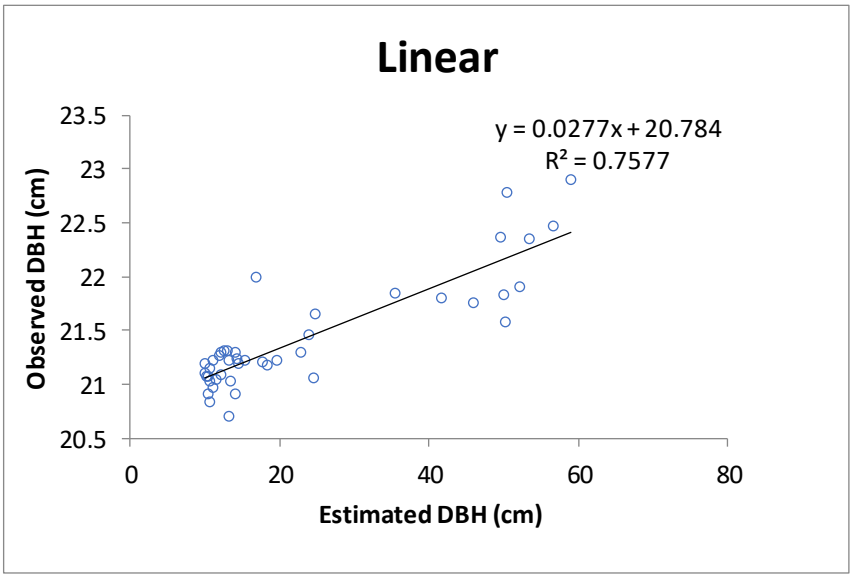
Figure 3: D index

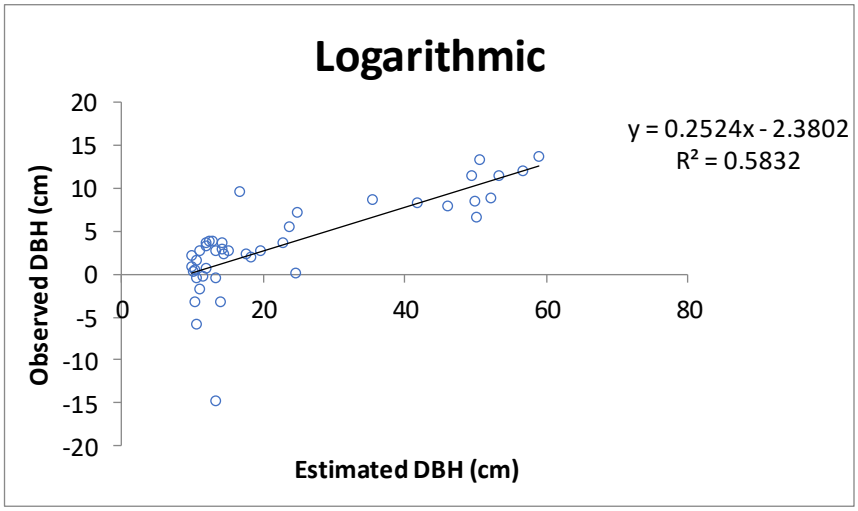


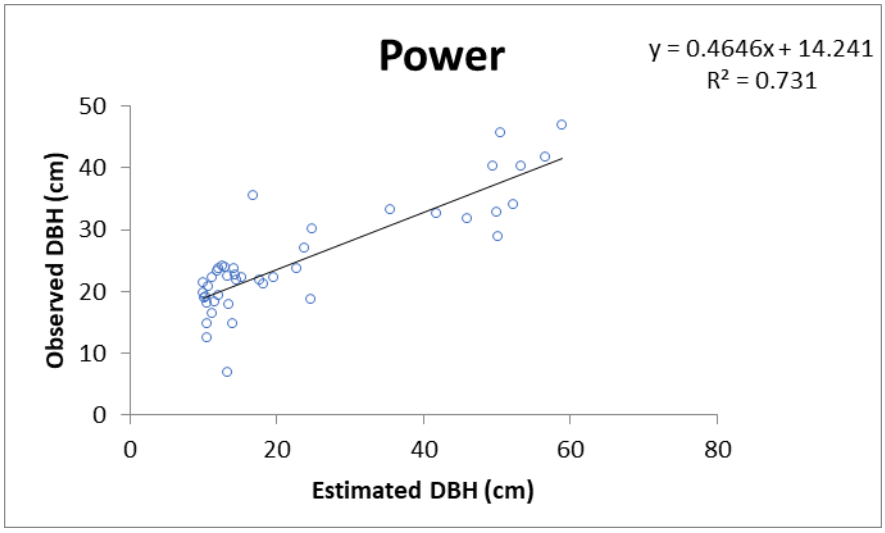
3.2 DBH estimations

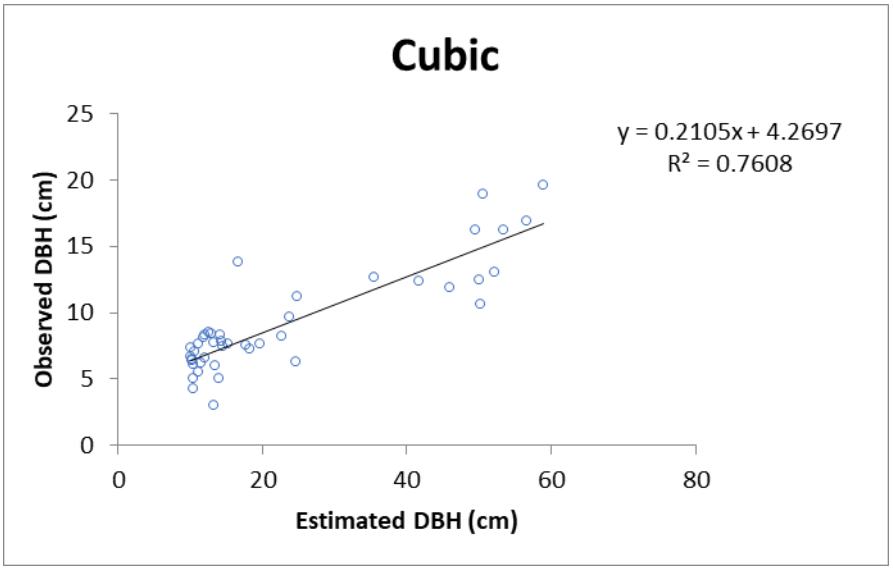
The allometric model was used to estimate DBH variable based on the relationship with tree crown area. The allometric has been used in this study are linear, logarithmic, power and cubic. All the estimated values of DBH are validated and compared to the actual DBH values recorded during field work for accuracy assessment. Based on figure 3, the cubic and linear models with R^2 0.76 and 0.75 were the best for estimating DBH close to the field data. The allometric equations explained at least 76 and 75 percent of the variation in DBH. The cubic and linear equations performed better than the logarithmic and power equations in terms of forecasting DBH. Furthermore, analysis showed that crown area is a dependable predictor of DBH and there is a strong relationship between crown area and DBH. This means that crown area more expansive in response to large diameter. There are numerous studies about the relationship between crown area and DBH. For instance, study by Ige & Erhabor, (2013), which predicted the crown area based on the DBH, performed exceptionally well. The parameters tree crown and DBH had a substantial positive connection (Lockhart, Weih & Smith; 2005; Hirata, Tsubota & Sakai; 2009).

Figure 3: Correlation between observed and estimated DBH









4. Conclusion

This study shown that LiDAR data successfully used for forest structure extraction and estimation. Furthermore, the results of this study are significant for additional research to implement in practise. This would increase the efficiency of the data collection process, fill in the gaps in forest inventory data and aid in the monitoring of long-term ecosystem management.

Acknowledgment

This paper was a part of the project Q.J130000.3009.00M10 "Airborne LiDAR sensing of tropical forest structures for assessment of water resource in Sabah". This is a collaborative between Universiti Teknologi Malaysia and Universiti Malaysia Sabah under scheme "Research Acculturation collaborative Effort (RACE) that funded by Ministry of Higher Education. The authors also would like to thanks to Research Management Centre (RMC), Universiti Malaysia Sabah (UMS) for financial support and fully funded to attend this conference and publish this article journal.

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SOCIAL SCIENCES & HUMANITIES CONFERENCE 2022 (SSHR 22) 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

Gamification in Chemistry Unit Learning and Engagement of Undergraduate Engineering Students during the COVID-19 Pandemic

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Abstract

In 2020, the global education sector faced a major transformation switching from traditional physical learning to online distance learning (ODL) due to the impact of COVID-19 pandemic. ODL began popular because the students can learn from home without attending school and it is also an effective measure to reduce the risk of spreading infection through face-to-face learning. This can be categorised under the flexible education. However, some statistics showed that the student participation rate in online classes is low. Survey results also showed that students are less motivated and disengaged through learning in front of the desktop screen. Some students are absent from the class as they realise that the recordings are available online and they can view them after that class. This has resulted in the low motivation of instructors or educators. Hence, to improve the live classrooms participation rate, this study examined the use of gamification in the electronic quiz (e-quiz) to access the effectiveness of the deliverance of a lesson. Interactive apps such as Kahoot! and Socrative were used in this study as the gamification platforms. An online questionnaire via Google form was distributed to the undergraduate engineering students who enrolled in the chemistry-related unit. The findings reported that integrating gamification with online learning can greatly improve the students' engagement during the live classroom and able to achieve unit learning outcomes. The students were satisfied with the informative e-quizzes conducted via Kahoot! Platform than others. Thus, different gamification digital tools can be applied to enhance the online learning experience and improve student participation rate.

Keywords: Gamification, e-Quiz, Online Distance Learning, Engagement.

1. Introduction

The COVID-19 pandemic has caused significant changes in global education. With the rise of e-learning through digital platforms, engaging students through online discussions has become more challenging than ever. Online learning has been a popular learning approach in higher education ever since the COVID-19 pandemic, providing high-quality education to various students across the globe at a low cost (Allen & Seaman, 2010; Mahmud & German, 2021). Online learning provides all the student-student and student-teacher interactions in an online platform by delivering and reflecting on course content and sharing thoughts (Awang et al., 2022; Lee et al., 2011). As an additional strategy for content delivery, the online learning interface also consolidates the communication and connection between students (Blignaut & Trollip, 2003). However, low student participation in online discussions became the main challenge for educators (Anthonysamy, Ah Choo, & Soon Hin, 2021; Hew et al., 2010). Compared to face-to-face teaching, online learning requires more student engagement and participation to achieve the expected level of understanding and learning. Gamification is defined as using game elements to motivate and attract users to a non-gaming environment (Hamden Hamid et al., 2022; Deterding, Dixon, Khaled, & Nacke, 2011). It has been proposed as an effective way to tackle the low student participation rate. The proposal aims to investigate whether gamification in online teaching and learning is capable to increase the student participation rate.

In-class research has been carried out on the effectiveness of gamification in teaching, and investigating the positive effects of gamification on student enthusiasm, participation, and learning have been demonstrated (Prensky, 2001). However, gamification does not always bring positive outcomes. Research also provides evidence that the use of gamification in teaching and learning has no effect and some reported negative effects (Dicheva, Dichev, Agre, & Angelova, 2015). One possible factor of the no effect or negative effects might be the Interface or design of the gamification tool. The meticulous gamification design contributes greatly to effective gamified learning activities (Devedžić & Jovanović, 2015). In addition, the published studies that employ gamification in teaching do not consider the design or Interface of the online gamification tool. This study addresses a) choosing different gamified designs for online learning, b) adding a control group, and c) gamification for evaluating the effectiveness of gamified online learning.

Students studying courses in universities or schools mostly lack motivation and participation in a physical classroom. According to Bouwmeester et al. (2019) finding, they have reported traditional strategies cannot solve the low participation rate of students. Therefore, this kind of teaching and learning experience doesn't boost engagement in the process (Ortiz-Rojas, Chiluiza, and Valcke, 2019). Therefore, some studies suggest that gamification should be introduced into the education system as an effective method to improve learners' participation and motivation (Azhar & AB Jalil, 2022; Munuyandi et al., 2021). Gamification can make the learning process fun through friendly peer competition. It is challenging and rewarding; thus, it is an alternative to encourage students to participate in learning (Hamari et al., 2016). Gamification encourages the critical thinking and multitasking skills of the learners (Ding, Er, & Orey, 2018; Caponetto, Earp, & Ott, 2014). In addition, gamification provides participants' data about learners learning. Therefore, teachers, parents, and administrators can access this timely information and data for better planning of teaching and learning (Zainuddin, 2018).

Only a few studies have investigated the use of gamification to assess student learning (Göksün & Gürsoy, 2019; Ismail et al., 2019). Therefore, there is a knowledge gap in the literature regarding the effects of using gamification for online learning. This proposal uses

gamification as an e-learning tool to improve student participation and performance. This proposal aims to determine the impact of quizzes using two online gamification tools on undergraduate engineering students' academic performance and participation at a private, specifically concerning the chemistry unit. This study aims to assess the effect of online gamified learning on students' learning performance and engagement. The primary research question in this study is: what are the impacts of using gamification applications on students' performance and participation? The secondary questions are: does gamification as an informative quiz assessment, particularly in lectures positively influence students' learning outcomes?; Is there a significant difference between the paper-based test and the gamified electronic quizzes in the students' learning achievement?; What is the learning experience and perception of students' participating in gamified learning activities using two different platforms? The proposal uses two online gamification platforms. They are not the same and have different unique evaluation tools and designs. At the same time, this research attempts to evaluate the advantages and disadvantages of these game platforms based on their specific functions and evaluation characteristics.

2. Theoretical Background

Due to COVID-19 impact, current education has been changed to an online delivery version. Students were forced to accept this method regardless of their readiness (Raju et al., 2021). Online education is able to expand educational opportunities for various communities, increase the student population and promote new pedagogical methods (Platt et.al., 2014; Koehler et.al., 2004).

The effectiveness of online education has been assessed in the previous investigation (Butnaru et.al., 2021). Educational level does not affect online education effectiveness, however, teaching and learning materials and technical issues are governing the online education delivery (Leong Lim et. al. 2020; Butnaru et.al., 2021). The next level of online learning, which is better than physical class delivery should be considered (Nguyen, 2015). One of the reasons that affect the effectiveness is the lack of students' interests and staying motivated (Al-Karaki et.al., 2021). In order to improve the effectiveness of student engagement in online platforms, it is suggested to implement some activities to enhance this (Jamalai Jamali & Krish, 2021). Therefore, this investigation examines the effectiveness of online delivery incorporated with gamification activity.

3. Methodology

Gamified electronic quizzes (e-quiz) are tools that can effectively assess learning performance. Gamified e-quiz can be an alternative solution to paper-based quizzes. The game concept can be a promising learning tool for attracting students to participate in peer competitions, especially in the classroom. The independent parameter in this study is the pedagogical intervention: traditional paper-based quizzes and online gamified e-quizzes. One of the dependent parameters examined is the student's learning experience, measured through an online questionnaire. These quizzes are conducted during the intervention, especially in lectures. Another dependent variable is student participation in learning.

Participants

The target learning group was undergraduate engineering students majoring in chemical engineering, petroleum engineering, and environmental engineering at a private university in Sarawak, Malaysia. The participants consisted of 49 students who were invited to participate in the survey at the end of the semester. The consent question was firstly given in the online

questionnaire. The consent question has clearly stated the study was voluntary. Due to the Covid19 pandemic, the physical interview was eliminated and replaced by the online questionnaire.

Procedure

Kahoot! and Socrative were chosen in this study as the gamification tools. These two were selected due to the easy design of the quiz, and the students can access the tools individually via their gadgets (mobile phone and personal laptop) simultaneously. Multiple-choice questions were used to design the E-quiz. Six informative quiz assessments (6 gamified e-quizzes [2 Kahoot! & 2 Socrative]) were designed to assess and evaluate individual learners' understanding of the day's topics during the lecture hours.

An online questionnaire was used to evaluate the effectiveness of the intervention activities and the students' performance during the Covid- 19 Pandemic. In this online questionnaire, multiple-choice, multiple-choice grid, linear scale and short answer were used to evaluate the effectiveness of the gamification. The online questionnaire link and QR code were distributed to the students via Google form at the end of the semester. The questions covered the criteria of the research questions required to address this study. The linear scale ranges from Disagree – 1 to Agree – 5; No – 1 to Yes – 5; Not very -1 to Very much -5. "Any additional comments regarding the e-quiz?" was used as the open-ended question for this online questionnaire. The feedback and responses were thematically analyzed. The goal was to verify the students' engagement in receiving gamified teaching and obtain data on the learning experience.

Ethics Consideration

Ethical approval for this study was obtained from Ethics Office, Curtin University Malaysia and met the requirements described in the National Health and Medical Research Council's (NHMRC) National Statement on Ethical Conduct in Human Research (2007). The approval number is HRE2021-0456.

4. Results and Discussion

The online questionnaire link of the Google form was distributed from April 2021 to November 2021. A total of 49 students voluntarily responded to the online questionnaire. Due to the Covid19-pandemic, all physical classes were converted into online distance learning (ODL). Thus, the study cannot compare the effectiveness of the paper-based quiz and gamified electronic quiz (e-quiz) or use the paper-based quiz as the control. To grab the students' attention, gamified e-quizzes were designed using two different platforms, i.e. Kahoot! and Socrative. Table 1.0 shows the standard deviation, median, variance and mean calculated from the 8 linear scale questions. The mean value was determined from the average value from the linear scale of 1 to 5. The average mean Score is about 3.86 to 4.69. Most of the students prefer employing a gamification component in the quiz instead of using a traditional paper-based quiz.

Students who used the gamified application or environment have agreed that using e-quizzes for a lesson has helped them better understand the learning outcomes. This has reported a mean value of 4.61 and a standard deviation value of 0.64. The gamified environment was designed to recap the learning outcomes of a specific lecture or topic by the end of a session. The students were given the option not to display their actual name in the e-quiz as most of the students wish to stay low profile, which is mainly affected by the local Malaysian culture. Moreover, the lively gamified environment has attracted the students to participate in the q-quiz and indirectly formed a healthy competitive atmosphere. The championship was displayed at the end of the quiz, praise and encouraging words were given to the top three students to

boost achievement and increase learning motivation. Thus, this has been attributed to a mean value of 4.65. Most of the students favor e-quiz in ODL.

Most of the students respond that they spend less revision or understanding time on topics with e-quiz (mean value = 4.06). The user-friendly gamification tool can simplify higher-level subjects. The students find this tool can assist them in understanding and memorizing facts or theories (Hanus and Fox, 2015). Further employment of gamification can allow students to review their knowledge before exams. They can also use educational games as their supportive study tool. Cooperating educational games in ODL can allow the students to regard "learning" as "playing" and learn easily, especially people in the millennium who are more likely to have smartphones and are heavily reliant on the internet (Zapalska et al., 2012; Mumtaz, 2001). This finding is in line with the mean value of 4.69 that most of the students enjoy the online learning and teaching session with e-quiz.

This links to the design of the gamification application. The questions are divided into three main categories, i.e., Timing, Score and Interface. The mean value of the Timing is 3.86, the lowest value reported in Table 1.0. This was mainly due to exciting feelings and increased pulse when the students played the e-quiz, especially "Kahoot!". The students commented the duration to complete a question in Kahoot! was too short and made some students feel like they were left in the dust. This has resulted in a negative response to timing criteria.

Most of the students agree that the gamified Interface has attracted their attention. The Interface of the gamification is the major contribution to engaging the student in the e-quiz session via ODL. These online educational games can improve participants' learning motivation and change their perceptions of learning. Learning can be interesting and fun if online educational games are designed and applied properly. By incorporating the animation online educational game into the e-quiz, the lively background music or response to the e-quiz at the same time has enhanced the ODL experience. The educators can provide feedback to participants after each session. Moreover, students can join the e-quiz on their own devices with their creative nicknames and form a healthy competition among the participants. In addition, the features of gamified e-quiz can be used to review the content and deliver it in the classroom.

A mean value of 4.31 indicated the participants were satisfied with the gamified e-quiz scoring system. Due to the nickname feature of the gamified e-quiz, healthy competition among the participants has urged the participants to do well on the quiz. The results of the e-quiz were generated right after the e-quiz session. Meanwhile, the paper-based quizzes cannot produce this competitive environment in the classroom because marking the answered paper-based quiz requires time to complete.

Table 1: The standard deviation and mean analysis of the students on the employing of the gamification as an informative quiz assessment

	Standard deviation	Median	Variance	Mean
Do you prefer to attend an online session with e-quizzes?	0.60	5.00	0.36	4.65
How effective is e-quizzes to understand the learning outcomes for a specific lecture/topic?	0.64	5.00	0.41	4.61
Do you think an e-quiz is better than a paper-based quiz?	0.65	5.00	0.43	4.69

Did you enjoy the session with the e-quiz?	0.58	5.00	0.34	4.69
Do you spend less revision/understanding time for those topics with e-quiz?	0.77	4.00	0.60	4.06
How satisfied were you with the e-quiz conducted in Kahoot!/Socrative? [Timing]	0.89	4.00	0.79	3.86
How satisfied were you with the e-quiz conducted in Kahoot!/Socrative? [Score]	0.62	4.00	0.38	4.31
How satisfied were you with the e-quiz conducted in Kahoot!/Socrative? [Interface]	0.67	5.00	0.45	4.59

The additional multiple-choice question was "What is your preferred mode/software to conduct the quiz?" and Figure 1.0 has displayed that 84% prefer to conduct their quiz through the gamified application, "Kahoot!", whereas 10% selected paper-based quiz and 6% chose the "Socrative" gamified application. "Socrative" gamified application is student-paced as in there is no specific timing to complete the e-quiz. Internet glitch does not affect this e-quiz because the student can reload the e-quiz anytime to finish them. The drawback of using "Socrative" is losing a bit of the excitement. The 10% of students have selected paper-based quizzes as their preference. Due to individual learning preferences, these students favor the traditional face-to-face teaching and learning approaches. This can be categorized in the habitual behavior implemented and practiced from a young age. Thus, this is one factor that affects the employment of gamification in ODL as it doesn't guarantee the sense of learning motivation or engagement among the students (Dominguez et al., 2013). The negative finding is in-line with the study conducted by Chen et al. (2019). 6% of students selected the Socrative website because they prefer a simple interface and no quiz time limit per question. Thus, the game design of the gamification application may affect students' perception of gamified e-quiz. Nevertheless, the questionnaire finding has reported a mean value of 4.69 that the students supported e-quiz is better than a paper-based quiz.

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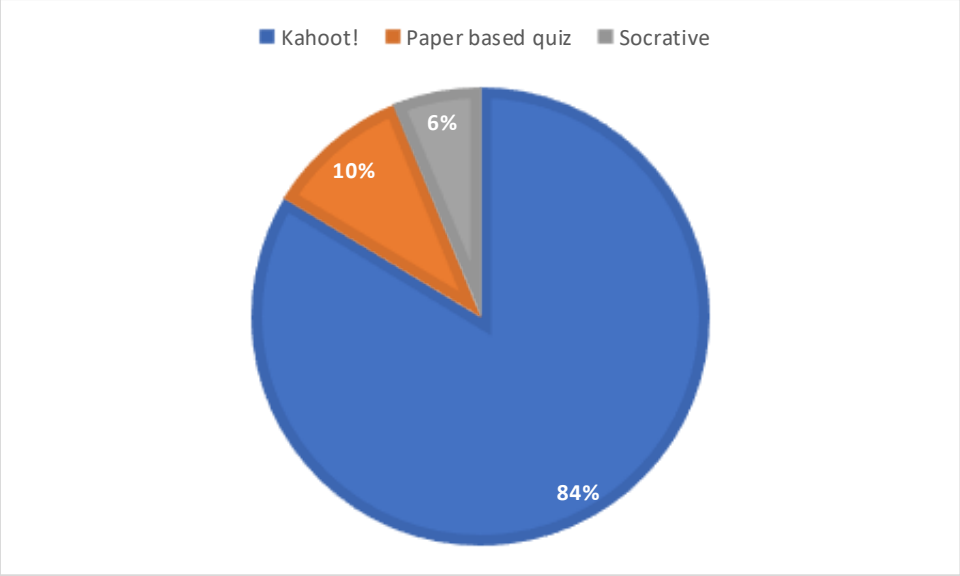

Figure 1: Students' preference for the type of quiz

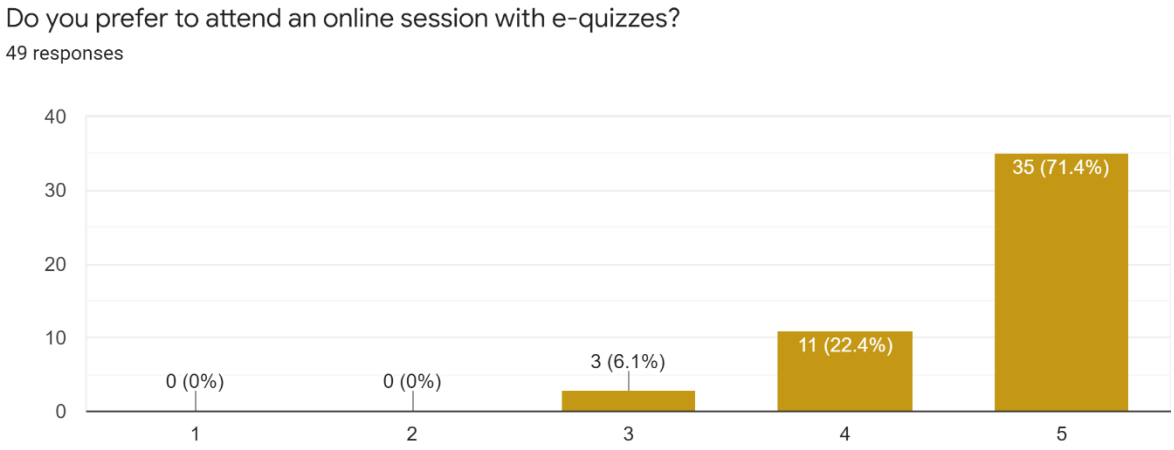

Figure 2: The responses to the first question

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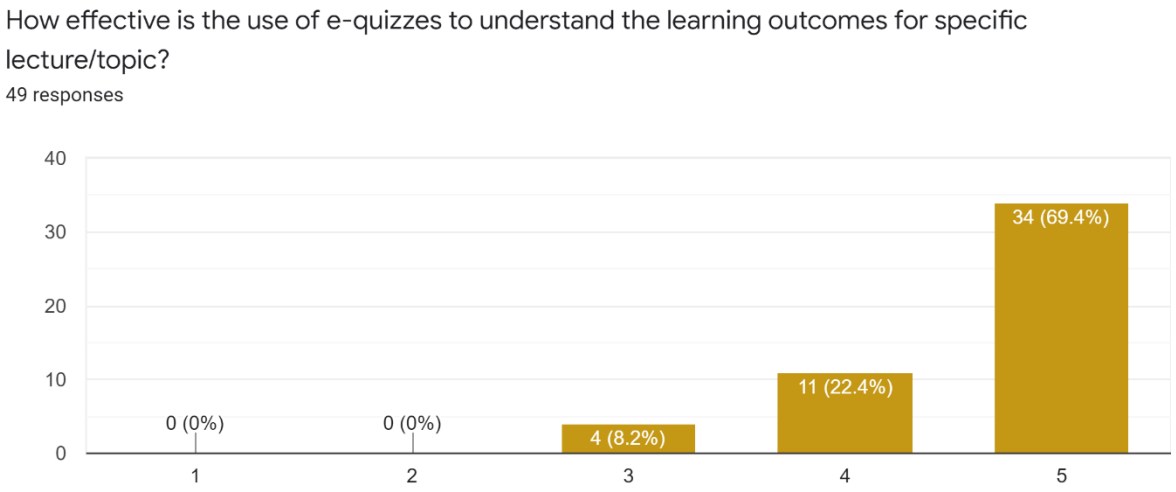

Figure 3: The responses to the second question

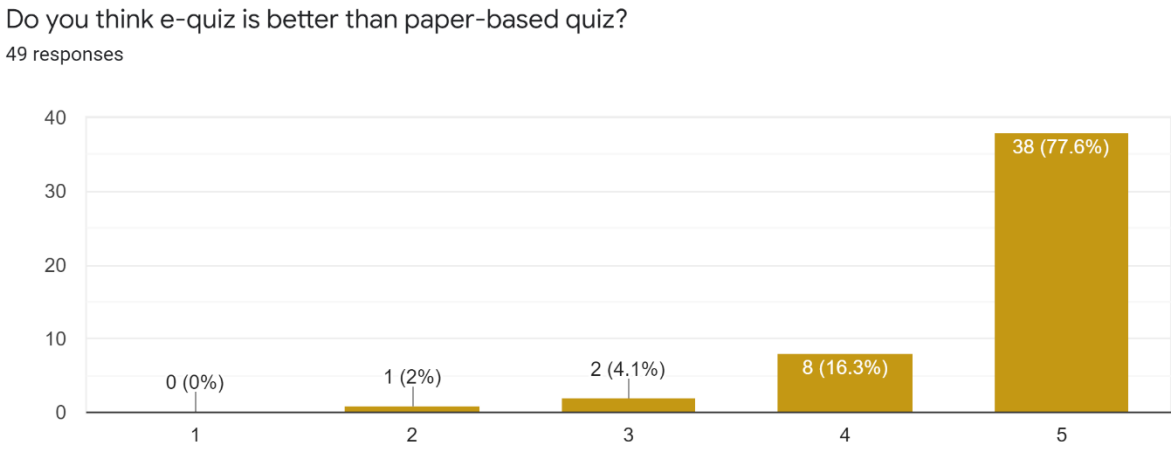

Figure 4: The responses to the third question

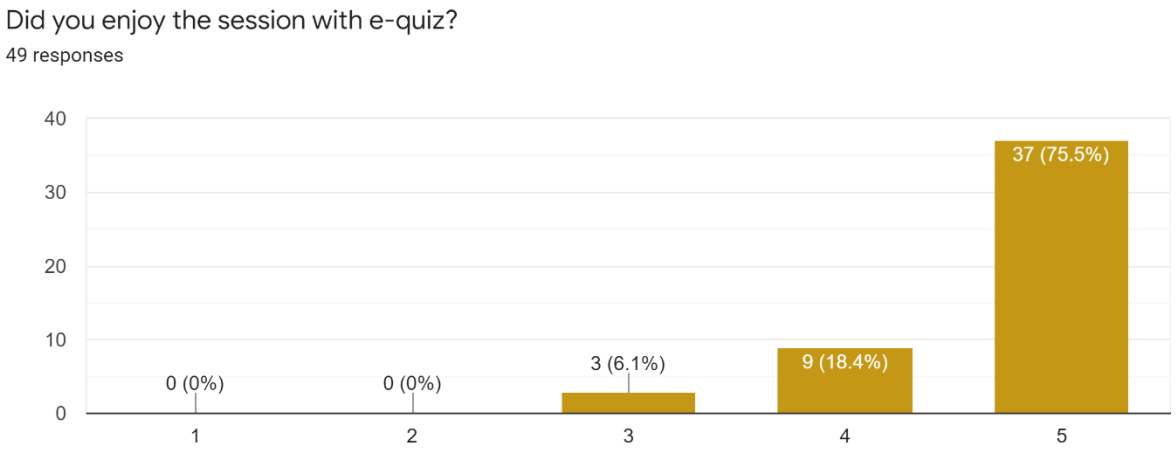

Figure 5: The responses to the fourth question

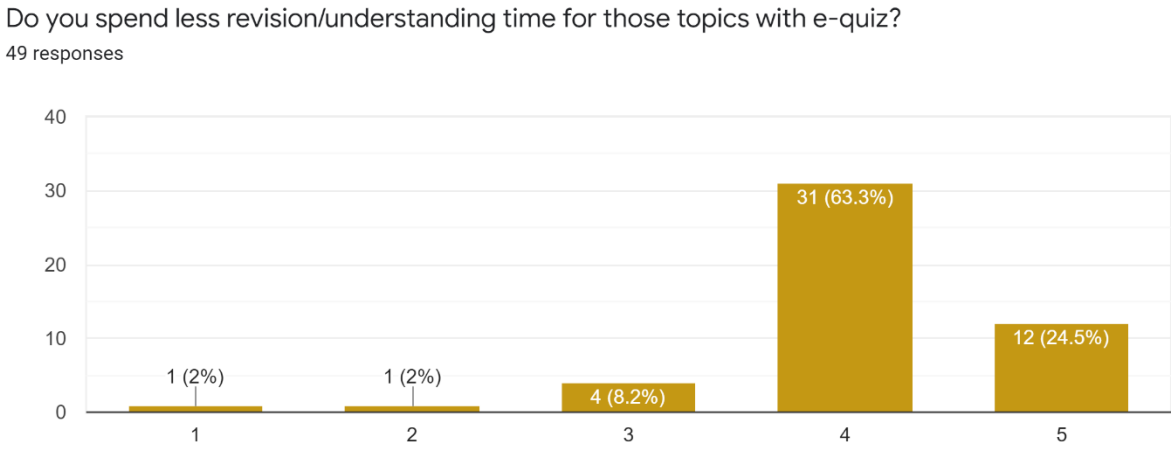

Figure 6: The responses to the fifth question

5. Conclusion

Traditional teaching systems might not be perceived as effective anymore, so researchers are keen to discover alternative learning strategies in this evolving world. Furthermore, most new-era youngsters are no longer interested in physical outdoor activities. They spend more time facing the computer and video games in their free time, so researchers are investigating the integration of gamification content in the teaching and learning process to improve students' intrinsic learning. The gamification application has attracted the students' participation because most would like to attend an online session with an e-quiz. Gamification as an informative quiz assessment, particularly in lectures, has assisted the students in better understanding the learning outcomes for a specific lecture. The majority of the students prefer gamified electronic quizzes to paper-based quizzes. These gamified e-quizzes from different online platforms can assist in delivering lectures, tutorials, or workshops. Also, these gamified e-quizzes can create a virtual atmosphere for answering questions, providing fun, and enabling

instant feedback from educators. A portable device can allow students to study anytime, anywhere by incorporating educational gamification. Overall, the participants prefer Kahoot! Because students are familiar with this application, it can be easily plugged into a lesson.

Co-Author Contribution

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this article. Author1 prepared the literature review, distributed the questionnaire and wrote the article. Author2 proposed the research methodology. Author3 performed the data entry. Author4 carried out the statistical analysis. Author5 interpreted the results. Author6 assisted in proofreading.

Acknowledgments

The authors would like to thank Curtin University Malaysia for their generous financial support under Curtin Malaysia Teaching Innovation Project (CMTIP), contract number: OLT/CMTIP/2020-008. The authors also thank Universiti Teknologi Brunei for realizing the current work.

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SOCIAL SCIENCES & HUMANITIES CONFERENCE 2022 (SSHR 22) 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

Sustainability in Higher Education: Students' Attitudes and Perspectives

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Abstract
Within the recent decades, there is an emerging trend in higher education as curriculum and administration seek to incorporate the goals of sustainability and development. In Malaysia, a lot of campus-based initiatives that seek to forward the goals of sustainable development also took off. However, students' involvement in these initiatives is understudied despite the students being the largest demographic in the university's population. The purpose of this paper is to explore the extent of a public or private university student's knowledge on sustainable development and the United Nations Sustainable Development Goals (UN SDGs). The objective of the study is to analyze the outcome of the perceived knowledge on sustainability towards student behavior. It also tries to examine the manners in which students can contribute towards sustainable development efforts given the challenges and obstacles they currently face. In this research, a qualitative method was employed to evaluate students' attitudes and perspectives on sustainability in a prominent public (Universiti Malaysia Sarawak) and private (Swinburne University of Technology Sarawak) universities in Kuching, Sarawak. In-depth interviews were held with students from both universities. The selected interviewees consist of student leaders who possessed the authority to speak on the issue and on behalf of their peers. Students' knowledge and the ability to transform the knowledge into practice are the focal

eISBN 978-967-2298-96-0

concern of the in-depth interview. The result of the interview shown that students are generally aware of the concept of sustainable development and the contemporary issues related to it. They were also able to articulate the inclusion of the UNSDGs in their campus life such as in their curricular or extracurricular activities. However, there were a few differing opinions on the adequacy of sustainable behaviors and the ongoing efforts done to address sustainability issues.

Keywords: sustainable development, UNSDGs, higher education, student behavior, student leaders

1. Introduction

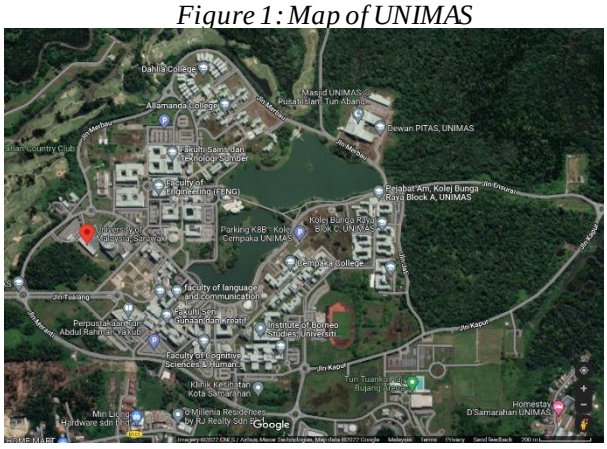
In 2018, a landmark report by the United Nations (UN) Intergovernmental Panel on Climate Change (IPCC) stated that urgent and unprecedented changes are needed to maintain the global temperature between 1.5-2 degree Celsius (Watts, 2018). In the face of an ongoing global crisis, everyone is expected to play active roles by participating in climate actions. Governments are strongly advised to become signatories of the Paris Agreement in order to contribute to efforts maintaining the global temperature at an acceptable level. In the United States, despite conflicting stances on participation in the Paris Agreement, progressive politicians such as Alexandria Ocasio-Cortez managed to introduce the Green New Deal as a grand plan for tackling climate change while simultaneously addressing issues such as employment and socioeconomic issues (Friedman, 2019).

Given the current circumstances faced by society (eg. climate crisis, community-produced waste, the lack of sustainable energy sources etc.), further emphasis has been put in achieving sustainability over the years. Sustainability efforts indicate that society seeks to implement plans that allow for economic prosperity while also leaving room to remain ecologically viable (Ebong, 2002). The sustainable development concept, as further portrayed by the UN Sustainable Development Goals (SDGs) has become the driving force of most sustainability efforts implemented by various parties today. Higher education institutions (HEIs) are also no stranger to the concept.

According to Owens and Halfacre-Hitchcock (2006), universities may be seen as "microcosms" of society and therefore their experiences may inform efforts for change at the societal level. Hence, studying sustainability efforts in HEIs could be the reflectio n of the status quo of sustainability efforts in the society at large. In Malaysia, universities are also actively partaking in sustainability efforts by adopting activities that contribute to the UN Sustainable Development Goals (SDGs).

The research would involve two universities in the East Malaysia, Universiti Malaysia Sarawak (UNIMAS) and Swinburne University of Technology Sarawak (Swinburne Sarawak). The areas covered by the research a Despite the limited focus community, it is sufficient since it is intended to focus on university community especially students to provide an insight into the evolving issue of sustainability in Malaysian HEIs.

Figure 1: Map of UNIMAS



Source: Google Maps

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Figure 2 : Map of Swinburne Sarawak

Source: Google Maps

This research will be exploring the knowledge and attitudes of public university students towards sustainability. A qualitative method approach would be utilized to assess their knowledge of sustainable development and the UN SDGs that are incorporated in their studies and campus life. In-depth interviews involving several student leaders would be held to explore their perspectives on the sustainability efforts they are currently undertaking and how to convert them into practice. The interview will also be meant for the students to voice out their opinions on the challenges they face in adopting sustainability.

1.1 Background

To succeed the Millennium Development Goals (MDGs), the UN launched the SDGs in September 2015. The SDGs were initiated in order to address ongoing issues such as climate change, renewable energy, environmental degradation, socio-economic issues and social justice. There are 17 SDGs which contain 169 targets, many of which are yet to be defined specifically. The SDGs were referent to the MDGs for the international community in order to further forward efforts towards sustainable development from the year 2015 to 2030 (United Nations General Assembly, 2015). Hence, the SDGs are aspirational goals part of an interconnected and integrated network of targets that are designed to guide both the developing and developed nations (Le Blanc, 2015).

In Southeast Asia, addressing the challenge of the climate crisis was made the key social and economic priority due to the interconnectedness economic activities such as trade have with problems that could arise from climate change. Malaysia pledged to cut its emission intensity (per unit of GDP) by up to 40% by 2020 and 45% by 2030 (Bernama, 2016). Hence, the call to adopt sustainability efforts were not only heed by the state but also all facets of society and that includes HEIs.

In line with Agenda 2030, the United Nations Educational, Scientific, and Cultural Organization (UNESCO) coordinated education on sustainability development (ESD). Education was the fourth part of the SDGs and universities play an important role in the realization of the goals. However, ESD can exist beyond the standards and recommendations of the UN and are urged to be phased into conventional learning in order to produce praxis.

Locally, discussions pertaining to the transformation of higher education (HE) through sustainability pedagogy and sustainable development (SD) related content are ongoing. These efforts could manifest itself, for instance, in the way the SDGs are integrated into HE in Malaysia. HEIs also participate in the transformation by incorporating the SDGs into

curriculum, research, operations, and institutional goals. As Malaysia is also committed to the Agenda 2030, it begins to establish the SDGs into multiple layers of development such as education, business practices, and governance. Following that, Malaysian HEIs demonstrate compliance towards the agenda by integrating SDGs into their curricula and campus activities. However, it should be noted that most of the sustainability efforts in HEIs as of now are "top-down" in nature as they are often initiatives implemented by the university's governance.

1.1.1 Problem Statement

Within the recent decades, even prior to the commencement of the Agenda 2030, there is an emerging trend in HE as teaching and research agendas seek to incorporate the goals of sustainability and development (Barlett & Chase, 2004). In Malaysia, a lot of campus-based initiatives ingrained in forwarding sustainable development also took off. It comes as an intended consequence that the awareness and knowledge of sustainable development also increase with this.

As with most campus sustainability efforts, the governance structure of universities present a unique challenge towards the long-term goal of sustainability. Most of the initiatives are described to be a mix of top-down and bottom-up thus rarely identifying specific strategies of organizational change (Brinkhurst et al., 2011). Top-down changes are often successful as they are championed by administrators and are well supported by the governing structures of the university. Bottom-up approaches are led by the "grassroots" and refer to student-led efforts or campaigns. These are unlikely to occur in Malaysia due to the restrictions placed on student-led organizations such as student unions. Hence, most student-led efforts regarding sustainability are limited to awareness-raising campaigns. According to Brinkhurst et al. (2011), a metric to a successful student-led campaign often results in building support for new initiatives and applying pressure for changes in university's policy and operations. These could only be achieved with more political involvement from students as they are often preceded by lobbying, signing petitions and in some cases, protests.

In the HE setting, students must also be made to feel included in sustainability efforts. Most sustainability efforts in universities are top-down in nature and often neglect the important stakeholders such as the staff and students (Brinkhurst et al., 2011). In a campus where the efforts are predominantly approached from top-down, then universities run the risk of alienating a large number of participants they are meant to reach such as students. This will result in low support for sustainable activities or lower participation from them.

In a study by Nusrat Afroz and Zul Ilham (2020), despite the high awareness and knowledge among students about the UN SDGs, there is a discrepancy between practice and knowledge. Student populations that demonstrate high amounts of knowledge in UN SDGs do not have the same level of practice. Less than 40% of the student population engage in sustainable behaviors that are contributing to the climate action goal of the UN (Nusrat Afroz & Zul Ilham, 2020). The imminence of the climate crisis requires a massive change in lifestyles from every member of society. Hence, it is problematic that students do not engage in sustainable behaviors despite knowing the importance of sustainable development.

Consumer behaviors affect the natural environment in unprecedented manners (Stem, 2000). In order to create significant change in the natural environment, sustainable lifestyles must be adopted. However, most impactful sustainable behaviors require a radical shift in the way of life and these changes might not be easily accessible to university students. For instance, cutting meat consumption as a response to the farming and agriculture industries being one of the largest carbon emitters would be difficult for a university student as byproducts of meat are cheaper and affordable. Veganism, for example, is also an inaccessible diet in Malaysia

especially for students as plant-based products such as plant-based meat are very expensive. In order to create a sustainable campus environment, one of the preliminary commitments is to significantly reduce paper usage or going for a paperless lifestyle. However, students might not necessarily be in the financial position to afford alternatives such as a laptop or a tablet. In conclusion, students are put in a position where they could not afford to make radical shifts in their lifestyle in order to adopt a more sustainable way of life. It is important to reconcile the students' knowledge on sustainability with the sustainable practice they can realistically engage in. The barriers they face should also be taken into consideration so campus and national policies can be created to inculcate these behaviors better.

2. Body of paper

2.1 Literature Review

2.1.1 Sustainability & Sustainable Development

One of the earliest definitions of sustainability was within the context a specific class of biological renewable resources such as fisheries and forests. The term was used to define extensively the physical limits of exploitations inflicted on them. Given the context, the term "sustainability" was loosely used to describe the usage of renewable resources in isolation such as not using the resources more than its increase over time thus not reducing the initial stock. This was criticized to be a simplistic view of sustainability as it did not consider external factors and events that could influence the exploitation of resources such as policies, technology, pollution, and social responses to changes in the resource base (Dixon & Fallon, 1989).

The term has expanded since its inception in the 1980s and was referred to as a 'boundary term' where science meets politics and politics meet science (Gieryn, 1999). The interdisciplinary nature or the 'boundary work' of the term alludes to the establishment of epistemic communities of shared understanding of and the common commitment to linking economic and environmental concerns. In the current setting, sustainability is generally defined as the support for a matter and a platform to consider the future that seeks environmental, societal, and economic balance for an improved quality of life (Jeronen, 2013). It is a complex and multidimensional concept that combines efficiency, equity, and intergenerational equity on economic, social, and environmental grounds (Ciegis et al., 2009). A large part of what sustainability is, is resilience and endurance into the long-term future.

Humans and nature are interlinked and form a system; hence the studies of sustainability transcend the borders of just environmentalism. There are three interrelated dimensions recognized in the study of sustainability as illustrated in Figure 1. They are ecological, economic, and social (Robertson, 2017). Beyond environmental problems, the world faces many issues that are interconnected such as poverty, education inequality, health crisis, population problem, and resource mismanagement. It is important to view sustainable solutions as a multi-faceted entity to address these issues.

2.1.2 United Nation Sustainable Development Goals

The UN SDGs are a collection of a total of 17 goals and 169 targets that have been officially endorsed by the UN as part of their Agenda 2030. The 2030 Agenda for Sustainable Development is a plan of action for the 3Ps: people, planet and prosperity (United Nations General Assembly, 2015). All member countries and all stakeholders are to act in collaborative partnership to implement the plan from the UN which also includes different facets of social issues such as eradicating poverty, empowering women, and ensuring individuals the dignity and equality to achieve self-actualization to fulfill their potentials (United Nations General

Assembly, 2015). The UN SDGs will stimulate action over the next 15 years in areas that are of critical importance to humanity and the planet.

The UN SDGs, as illustrated in Figure 3, covers a wide range of issues in society such as poverty, climate change, gender equality, and climate change. It was an extension of the UN MDGs that ended in 2015 (United Nations General Assembly, 2015).

Figure 3: UN SDGs

Source: United Nation

2.1.3 Sustainability in HEIs

Given the multi-faceted approach towards sustainability and the call to action from the UN requiring collaborative approach from all members of society, the burden on achieving sustainability should not be on the shoulders of policy makers and governments alone. HEIs, notably, should take on a leading role in pioneering sustainability in education through research while concurrently educating students in relation to the goals and inspiring meaningful engagement with communities at large (Leal Filho et al., 2017). This could be attributed to the fact that universities may be seen as "microcosms" of society (Owens & Halfacre-Hitchcock, 2006). Therefore, their experiences may inform efforts for change at the societal level.

ESD refers to transforming students, teachers, and the school system with new knowledge, understanding, and resilience (Crosling et al., 2020). The relationship between education and the adoption of sustainable behaviors are complex, however education can shape individuals and mold society's ways of thinking to include resilience and long term support for sustainable development efforts (UNESCO, 2013). ESD is also officially recognized as an intrinsic element of SDG 4 (quality education) and a key enabler of all other SDGs. UNESCO also coordinated the ESD for 2030 framework (refer Figure 4) at the 40th UNESCO Conference in Paris (UNESCO, 2019).

eISBN 978-967-2298-96-0

Figure 4 : ESD For 2030 Framework

Source: UNESCO

Following the action of embracing ESD in universities, campuses had also created a lot of initiatives that could contribute to the UN SDGs. Evidence suggests that universities should aim to contribute to sustainable development beyond what is taught in the classroom.

2.2 Methods

Currently the research is still ongoing and for the purpose of this paper, the results presented would be based on the preliminary data collection that has been done as of May 2022. A total of six student leaders from UNIMAS and Swinburne Sarawak participated in in-depth interviews done by the researcher. The student leaders chosen are either in their undergraduate or postgraduate studies in their respective universities. They are also chosen due to the leadership positions they hold in the university student councils, clubs, and external student associations. The positions held by the interviewees indicate that they have the capacity to be representative of their peers as well as having pre-existing knowledge on the various components of university administrations.

2.3 Results & Discussions

2.3.1 Students' Knowledge on sustainable development, the UN SDGs and its issues

The first part of the interview aimed to identify the extent of student's knowledge on sustainable development and the UN SDGs. There were five items in the interview questions related to achieving the objective.

Following the interviews, a majority of the students were able to understand the gist of sustainable development. For instant, participants have adequate understanding of the concept of sustainable development despite not necessarily having the vocabularies to articulate the academic definitions and connotations of the concept.

The interviewees understanding of the concept of sustainable development can be classified generally into several categories. Based on their answers, they alluded to the concept being largely defined by words such as (but not limited to); (1) balance, (2) long-term development for the future, (3) resilience, (4) being relative to the UN SDGs, and (4) not limited to the environment.

Apart from that, participants also demonstrated awareness and understandings of an array of sustainability issues and happenings. To further understand the extent of students' grasps on the concept of sustainability, a high understanding and awareness of contemporary

issues related to the topic of discussion is paramount. The participants were able to articulate and comprehend sustainability issues such as climate change, green initiatives, circular economy, poverty, education inequality, and gender inequality. The cited issues were also followed up with relevant examples and case studies albeit abridged verbally.

From the interviews, it ought to be concluded that essentially interviewees are aware of the concepts of sustainability and the UN SDGs despite not having extensive knowledge on them. The surface level understandings could be attributed to the preliminary exposure students get from the inclusion of the UN SDGs in university administrations and syllabi.

Both UNIMAS and Swinburne Sarawak are known to apply the UN SDGs into their administrations. This could be observed in the campuses through the existence of promotional materials such as informational posters and the existence of sustainability offices. Student societies related to upholding the UN SDGs are also in existence. The universities also allowed students to organize and partake in activities that are related to sustainability inside and outside of campus such as collaborating with non-governmental organizations (NGOs). Universities also participate in sustainable practices such as adopting a paperless policy in its administration.

Despite the exposure from the university administration however, the level of knowledge varies among students. For instance, students who work directly with the university management ie. the members of student councils, possessed a higher level of knowledge about sustainability in comparison with their peers.

From an academic standpoint, the UN SDGs are integrated into core courses in the syllabi. However, some are only heavily implied and were not taught explicitly to the students. Thus, the only students who are aware of the UN SDGs being integrated into the syllabi are those who have closer ties to the university management and the university senate ie, the student council. This further alienate the student populations who are not privy to the information afforded to the members of the student council.

The asymmetry of information is also exacerbated by the inaccessibility or inexistence of dedicated courses for sustainability. In the case of Swinburne Sarawak, sustainability is offered as a general subject for students hence demonstrating the lack of emphasis towards the subject. In UNIMAS however, participants are not aware of the existence of such subject. The varying level of knowledge about the existence and integration of sustainability in the syllabi was also observed following the interviews.

In conclusion, students demonstrated high level of understanding of the concept of sustainability and its offshoots, the UN SDGs and contemporary issues. However, there is a disparity in understanding in the degree of executions of such concepts in HEIs.

2.3.2 Knowledge Translation: How does the perceived knowledge translate into practice or behaviours?

Following the high level of understanding about sustainability and the urgency of its issues, students were asked about how their knowledge translated into everyday practice. The aim of the second component of the interview was to analyse the outcome of students' perceived knowledge on their behaviours and practice.

Essentially, students tried to practice sustainable behaviours in their campus lives on the daily. Table 1 shows the examples of sustainable behaviours they claimed to practice.

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Table 1: Sustainable behaviours practiced by students

Student(s)	Practiced Sustainable Behaviours
A	i. Not using cars in campus. ii. Walking. iii. Supporting independent businesses over large corporations.
B	i. Not using single-use plastic by bringing their own metal straws and food containers. ii. Going paperless by switching to digital notetaking and using digital textbooks.
C	i. Reducing consumption by no longer buying new clothes or unnecessary items. ii. Refusing to buy from fast fashion companies. iii. Thrifting and buying second-hand items.
D	i. Recycling. ii. Not using single-use plastic by bringing their own metal straws and food containers. iii. Reducing overseas purchase to reduce carbon footprint.
E	i. Buying products known for longevity to prevent from contributing to e-waste. ii. Buying from local businesses.
F	i. Recycling. ii. Not using cars in campus.

Table 1 indicates a high level of awareness and practice among participants. This could be attributed to the general upward trend of the move towards sustainability in general. Furthermore, the general trend also contributed to the level of awareness and knowledge possessed by students on top of the integration of sustainability in universities. For instance, participants were able to name sustainability practices and efforts that are encouraged by the local governments and universities such as "No Plastic Bag Saturday" and the phasing out of polystyrene packaging in campus.

The awareness from the general trend against the backdrop of widespread social media information sharing and the continuous calls to action as response to the climate crisis made students want to adopt a more sustainable lifestyle. Participants also see sustainability partially as a personal responsibility that could be attributed to being a global citizen.

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2.3.3 Challenges and student contributions

The third and final part of the interview was aimed to examine the manners in which students can contribute towards sustainable development efforts given the challenges and obstacles they face. Despite the high level of knowledge and adequate level of practice demonstrated by participants, the students do not feel like they have adequately contributed to sustainable development efforts. The challenges they faced are twofold as shown in Table 2. Following the identification of challenges, participants proposed solutions of their own.

Table 2: Student challenges

Political	i.	University and University Colleges Act 1971 (AUKU)
	ii.	Bureaucracy
Financial	i.	High financial barriers
	ii.	Inaccessibility

The first challenge faced by students are political challenges that manifested in the forms of AUKU and bureaucracy. The existence of AUKU has led to several limitations on student governance. As a result, students are prevented from participating in politics and forming student unions. Hence, monetary allocations for student activities and welfare are not entirely at the hands of student representatives. This led to several difficulties in organizing activities that are political in nature or with higher impacts. Hence, most student activities related to sustainability are relegated to raising awareness as opposed to challenging a hegemony and action-based.

Students are also often self-censoring themselves from voicing out concerns that are deemed politically charged. They realized that sustainability issues are often political and could result from policy failures. For example, the climate crisis is a collective issue that affects everyone and the nature of the crisis is systemic at its roots.

Bureaucracy is also a challenge cited by students due to the limitations it grants most student-led projects. In order to carry out an activity or to establish a new society in campus, red tapes and bureaucracy take up most of the process and making each effort more lengthy and excruciating than the last. The aforementioned bureaucracy coupled with the lack of autonomy granted to student bodies also debilitate student-led sustainability efforts even further.

In order to overcome the political challenges in status quo, students needed to take a more laissez-faire approach in aspects the university has few authorities over. For example, students can still participate in projects outside of the universities with external parties provided they still work within the rules and regulations of the country. The internet as a fairly ungoverned space could also be utilized by students to spread information with their peers. For instance, one of the interviewees involved themselves in creating eye-catching infographics about COVID-19 SOPs to be disseminated via social media.

Universities could also foster a space where students are allowed to organize within the framework allowed by AUKU. The first step in addressing the challenge is by creating a decentralisation model where student bodies would be given more autonomy in their governance. This could include a more inclusive and transparent budget allocation especially for student-led activities from the grassroots.

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The second challenges faced by students are financial in nature. This is the most intuitive challenge faced by students as university students are not as financially mobile as the working populations. Hence, financial barriers are common in preventing them from adoptng a more sustainable lifestyle.

Adopting meaningful lifestyle changes are often expensive and inaccessible. The mitigating solution to tackle this challenge is to buy local and from small businesses. Universities should also create meaningful change in order to encourage students to adopt a more sustainable lifestyle. For example, providing student discounts in campus. Students also acknowledge the importance of a consumer-driven approach to consuming and purchasing products as creating a higher demand for sustainable products would lead to competitive pricing and increased demand fulfilment in the future.

3. Conclusion

Students are indeed knowledgeable about the concepts of sustainability, sustainable development and its contemporary issues. However, the study shows that the level of knowledge they possessed vary greatly and could be observed in the asymmetry of understanding about the existence and integration of sustainability in their syllabi and management. Universities should have effective dissemination strategies about how they incorporate sustainability in their day-to-day affairs.

Student expressed great interests in adopting sustainable behaviours in their daily lives if they are not hindered by numerous systemic barriers. The challenges students faced are systemic in nature and they perceived an ideal sustainable life to have a higher barrier of entry. Hence, in order to address the barrier of entry, most proposed solutions from students involved decentralisation and bottom-up approach.

Acknowledgment

This paper is an output of the research partially funded by the Erasmus+ Programme of the European Union through my appointment as a Graduate Research Assistant for the Malaysian Sustainable University Network (MYSUN).

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SOCIAL SCIENCES & HUMANITIES CONFERENCE 2022 (SSHR 22) 15 JUNE 2022
eISBN 978-967-2298-96-0
KUCHING, SARAWAK, MALAYSIA

Minuman Tradisi *Bahar* Sebagai Amalan Budaya Etnik Dusun Lotud di Sabah

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Abstrak

Amalan budaya tradisi oleh sesebuah kumpulan etnik merupakan satu amalan yang diwarisi secara turun temurun. Budaya merupakan tamadun atau peradaban yang diwarisi oleh sesuatu masyarakat atau bangsa. Budaya berbentuk cerita rakyat, adat, pakaian dan tingkah laku. Bagi etnik Dusun Lotud atau lebih suka digelar *suang lotud* di daerah Tuaran, Sabah mempunyai amalan budaya yang masih diamalkan sehingga kini. Antara amalan budaya etnik Dusun Lotud ialah amalan adat dalam perkahwinan tradisi, pemakaian tradisi, tarian tradisi, kraftangan tradisi, makanan tradisi dan minuman tradisi. Amalan budaya tradisi dapat mencerminkan identiti budaya sesebuah etnik serta memaparkan keunikan dan kearifan masyarakatnya. Kajian ini menjurus kepada amalan tradisi minuman *bahar* dalam kehidupan etnik Dusun Lotud. Minuman *bahar* diperbuat daripada air nyira kelapa yang telah diproses menjadi minuman tradisi mereka. Selain itu, kajian ini juga akan menganalisis kandungan alkohol yang terdapat pada minuman tradisi ini. Kajian ini ditulis melalui kaedah kerja lapangan dan temu bual dengan mengumpul data dan menganalisis kandungan alkohol minuman tradisi *bahar* yang dikaitannya dengan amalan turun temurun etnik Dusun Lotud.

Keywords: Amalan, budaya, minuman, bahar, Dusun Lotud, Alkohol.

1. Pengenalan

Etnik Dusun Lotud atau *Suang*[1] *Lotud* dipercayai berasal dari Daerah Tuaran di Pantai Barat Sabah. Daerah Tuaran terletak lebih kurang 34km dari Kota Kinabalu, Ibu negeri Sabah yang mempunyai keluasan lebih kurang 450 batu persegi dan mempunyai 212 buah kampung[2]. Etnik Dusun Lotud memaparkan kepelbagaian budaya tradisi yang masih diwarisi secara turun temurun. Antara budaya yang diamalkan adalah perkahwinan tradisional, tarian tradisional, pakaian tradisional, makanan dan minuman tradisional serta adat ritual. Adat majlis atau perkahwinan tradisi etnik Dusun Lotud adalah berbeza dengan adat perkahwinan suku kaum yang lain kerana mengamakan pantang larang yang harus dipatuhi oleh pasangan pengantin. Menurut Owen S. K. (1989:11-12), pakaian tradisional etnik Dusun Lotud dinyatakan sebagai pakaian ketuhanan seperti yang digambarkan dalam rangkaian kata-kata ritual[3] atau *rinait*

[1]*Suang* bermaksud bangsa atau kumpulan dalam bahasa Lotud.
[2] Sumber dari www.statistics.gov.my/portal/.../PBT_Sabah.pdf
[3]Kata-kata ritual adalah bermaksud bacaan mentera atau dipanggil sebagai rinait dalam bahasa Lotud.

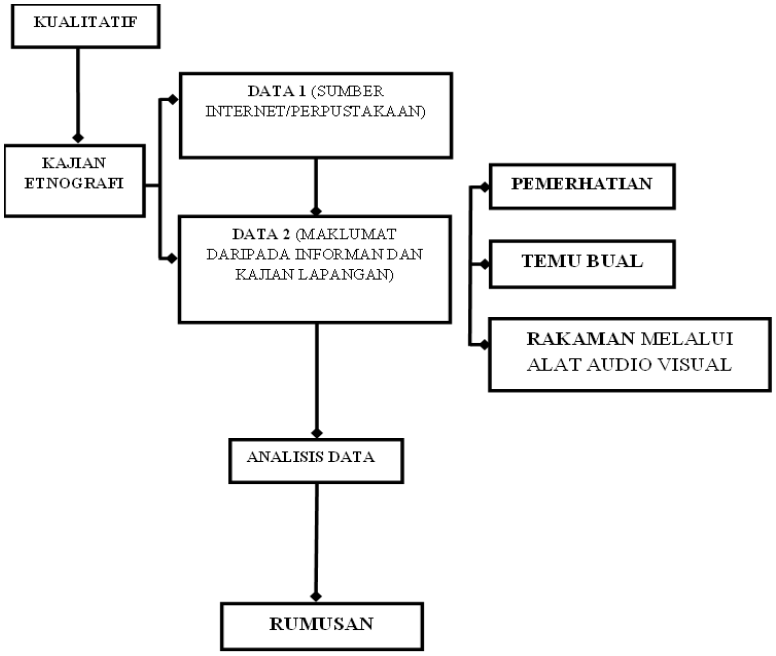
molukas[4] oleh golongan *tantagas*[5]. Para penenun dan pereka pakaian Lotud telah mengeksplotasi dan mengadaptasi *rinait* itu dalam bentuk visual maka terciptalah corak pakaian dan pelbagai ornamen atau perhiasan yang unik.

Menurut Humin & Salbiah (2015), etnik Dusun Lotud membahagikan pakaian kepada tiga jenis mengikut upacara adat. Pertama, adalah pakaian *Momolian* dan *Tantagas*. Kedua, adalah pakaian dalam upacara pemujaan semangat padi atau kuasa ghaib. Ketiga, adalah pakaian penari *sumayau* iaitu, untuk memohon berkat daripada kuasa *supernatural* yang ditransformasikan dalam bentuk persembahan hiburan dan pakaian semasa upacara perkahwinan. Makanan dan minuman tradisional etnik Dusun Lotud dapat dilihat dalam hidangan sesebuah majlis keramaian seperti majlis perkahwinan. *Bahar* atau minuman tradisi yang diperbuat daripada nirah kelapa dan nasi yang dibungkus dengan daun keladi atau *linopot du omon* merupakan antara hidangan tradisi dalam amalan budaya etnik Dusun Tindal.

Kajian ini dijalankan berdasarkan pendekatan etnografi yang bersifat kualitatif melalui penglibatan pengkaji secara terus di lapangan. Kajian seperti ini melibatkan kaedah pemerhatian, temu bual dan rekod data. Kajian khusus ini berfokuskan kepada amalan budaya tradisional minuman *bahar* dalam etnik Dusun Lotud dengan kompilasi dan susunan data-data serta maklumat yang bersumberkan tempat kajian, media massa, internet dan buku rujukan.

Penyelidikan etnografi umumnya menggariskan tiga pertimbangan. Pertama, membuat tinjauan literatur melalui kajian perpustakaan untuk mengenali subjek kajian demi memastikan siapa masyarakat kajian. Kedua, membuat himpunan dan koleksi subjek kajian melalui foto dan audio visual. Kajian ini melibatkan tinjauan dan analisis terhadap objek kajian di lapangan. Antara persoalan utama dibina adalah meliputi siapa pemilik pakaian tersebut dan mengapa ia mempunyai ragam hias dan struktur yang unik. Eksplorasi atau penerokaan selanjutnya dilaksanakan untuk mengenal pasti dari segi variasi, persamaan dan perbezaan elemen kajian.

Rajah 1: Carta Alir Strategi Kajian



Sumber: (diubah suai daripada Salbiah, 2015)

[4]*Rinait Molukas* adalah salah satu bacaan mentera atau jampi bagi kaum Lotud semasa menaiki rumah *bahar*u.
[5]*Tantagas* merupakan panggilan kepada ketua ritual dalam adat masyarakat Lotud.

Rajah 1, menunjukkan carta alir tentang strategi penyelidikan yang menjadi panduan kepada penyelidik dalam penyelidikan ini. Terdapat dua input utama dalam mendapatkan bahan kajian yang dipanggil data 1 dan data 2. Data 1 merujuk kepada sumber sedia ada seperti buku dan internet. Data 2 pula merujuk kepada data *bahar*u yang diperolehi di lapangan melalui 3 kaedah iaitu pemerhatian, temu bual dan rakaman audio visual. Penggabungan kedua-dua data ini membekalkan maklumat-maklumat yang diperlukan untuk dianalisis. Maklumat-maklumat yang dianalisis seterusnya dijangka dapat didokumentasikan sebagai bahan rujukan kepada pengkaji akan datang.

1.1 Asal Usul Minuman Tradisi *Bahar*

Bahar adalah minuman tradisional yang popular dalam kalangan Kadaazan dan Dusun di Sabah. Etnik Dusun Lotud juga mengamalkan minuman tradisi ini sebagai satu warisan budaya yang penting. Minuman tradisi bahar diperbuat daripada kelapa atau nama saintifiknya cocos nucifera juga dikenali sebagai nyiur. Pokok kelapa merupakan tumbuhan pelbagai guna yang cukup terkenal di nusantara yang menyimpan seribu satu macam khasiat, yang antaranya asas kepada pelbagai menu-menu masakan warga dunia.

Gambar 1: Pokok Kelapa dan Proses penghasilan bahar

Sumber: Koleksi Pengkaji

Etnik Dusun Lotud memanggil pokok kelapa dikenali sebagai *piasau* dan kebanyakan pokok ini tumbuh di kawasan rumah kediaman mereka. Asal-usul kelapa masih menjadi tanda dikalangan pengkaji, namun kajian-kajian tidak rasmi mengatakan ianya berasal dari semenanjung Asia Tenggara dan ada yang mendakwa berasal dari barat laut Amerika Selatan. Hasil penemuan arkeologi mengenai rekod fosil ditemui di New Zealand yang menunjukkan pokok kecil serupa kelapa tumbuh di negara tersebut sejak 15 juta tahun yang dahulu. Penemuan fosil di Rajasthan, India pula membuktikan bahawa kelapa telah terlebih dahulu pernah tumbuh di negara tersebut iaitu lebih lama dari New Zealand. Kelapa juga direkodkan subur di Kepulauan Hawai namun keberadaannya kelapa di situ dijelaskan dibangunkan atau ditanam oleh orang Polinesia yang membawanya belayar dari tanah asal mereka di Pasifik

eISBN 978-967-2298-96-0

Selatan. Kelapa begitu sinonim dengan menu masakan, namun amat sedikit yang mengetahui bahawa kelapa menyimpan rahsia tersorok khususnya melalui air tandan yang dikenali sebagai *Bahar*.

1.2 Kaedah Penghasilan Bahar

Air bahar diperolehi daripada sungu atau nyira kelapa yang ditoreh. Pada kebiasaannya, pengusaha minuman bahar akan menorah sungu sebanyak 2 kali sehari iaitu pada waktu pagi dan waktu petang. Nyira kelapa yang ditoreh akan menghasilkan air yang dipanggil wonod. Wonod ditadah dengan alat khas yang dipanggil tukil, iaitu batang bambu atau batang paip. Menurut informan, torehan nyira pada waktu pagi akan menghasilkan lebih banyak wonod mengikut keadaan cuaca. Air wonod akan lebih banyak jika musim sejuk.

Gambar 2: Alat untuk menghasilka bahar

(i) *Tukil*

(ii) *Pongorib*

(iii) *Rosok*

(iv) *Wonod*

Sumber: Koleksi Pengkaji

Alat untuk menorah pula dipanggil *pongorib*, iaitu sejenis pisau berbentuk sabit. *Pongorib* merupakan alat utama untuk menghasilkan *wonod*. Menurut informan, air *wonod* mempunyai rasa yang sangat manis dan tidak memabukkan. Selepas *wonod* dikumpul, proses seterusnya adalah menghasilkan *bahar*. Terdapat dua proses dalam menghasilkan *bahar*, iaitu proses menghasilkan *rosok* dan pencampuran *bahar*. *Rosok* dan *wonod* merupakan bahan utama meghasilkan *bahar*, iaitu *wonod* diperolehi daripada air nyira kelapa dan *rosok* adalah kulit kayu yang mengubah rasa *wonod* daripada manis kepada rasa pahit.

eISBN 978-967-2298-96-0

Gambar 3: Proses pengeringan rosok

Sumber: Koleksi Pengkaji

Rosok dihasilkan daripada kulit kayu daripada kayu bakau yang melalui proses pengeringan yang sempurna. Terdapat dua kaedah penghasilan *rosok*, iaitu kaedah menjemur dan kaedah menyalai. Tempoh penyemuran dilakukan mengikut keadaan cuaca, iaitu satu minggu hingga dua minggu manakala proses penyalaian dilakukan untuk mengelakkan *rosok* menjadi buruk. Menurut informan, *rosok* yang baik akan menghasilkan kualiti *bahar* yang baik. Oleh itu, pengusahan minuman *bahar* sangat mementingkan penjagaan *rosok* melalui kaedah penyalaian.

Proses pencampuran *rosok* pada air *wonod* dilakukan semasa *wonod* masih ditadah, iaitu *rosok* akan dimasukkan ke dalam *tukil* selepas *sugun* ditoreh. Kuantiti *rosok* adalah mengikut nisbah 1:3 daripada kandungan *wonod*. Air *wonod* yang telah dicampur dengan *rosok* akan berubah warna daripada warna keputihan kepada warna kemerahan.

Gambar 4: Imej Bahar

Sumber: Koleksi Pengkaji

Bahar mempunyai tiga jenis rasa iaitu rasa manis, rasa pahit dan rasa asam. Menurut informan, rasa manis didapati semasa *wonod* belum dicampur dengan *rosok*. Rasa pahit adalah *bahar* yang berkualiti baik dan masih segar kerana telah dicampur dengan *rosok* selama 4 hingga 5 jam manakalah rasa asam adalah *bahar* yang telah lama atau *rosok* yang tidak berkualiti baik

sehingga rasa *bahar* tidak sempurna. Walau bagaimanapun, *bahar* yang mempunyai rasa asam boleh dijadikan cuka makanan seperti dicampurkan

1.3 Kandungan Alkohor dalam Bahar

Satu uji kaji kandungan alkohol dalam minuman tradisi *bahar* telah dilaksanakan, iaitu menggunkan alat hidrometer professional. Hidrometer professional adalah alat yang dapat kandungan larutan alkohol dengan tahap ketepatan yang tinggi. Bagi mendapatkan ketepatan kandungan alkohol dalam sesebuah minuman, pengukur alkohol hendaklah disimpan dalam bungkusan asalnya, elakkan daripada digoncang dan terkena bahan mekanikal lain yang boleh menjejaskan integriti dan ketepatannya. Hidrometer professional mempunyai bahan kaca yang sangat rapuh dan mudah pecah. Jika retak, calar atau kecacatan lain akan muncul dan menyebabkan pengukur itu rosak dan perlu diganti.

Gambar 5: Alat Pengukur Kandungan Alkohol

Sumber: Koleksi Pengkaji

Hidrometer professional dapat mengukur larutan dalam suhu 20°C. Pada suhu yang lebih tinggi, hidrometer tidak dapat larut dalam cecair manakalah, pada suhu rendah cecair mudah larut dan sukatan akan lebih tepat. Kegagalan mengukur pada suhu yang tidak sesuai menyebabkan ralat pengukuran sehingga 7%. Ketumpatan cecair juga bergantung pada tekanan atmosfera, angka yang disyorkan ialah 760 mm Hg. Hidrometer professional telah direka bentuk untuk berfungsi dengan cecair yang mengandungi kandungan alkohol dan air. Sebarang kekotoran lain seperti gula, jus, garam dan juga minyak akan mengubah ketumpatan larutan dan membawa kepada hasil pengukuran yang tidak tepat.

Kaedah pengukuran ialah tuangkan cecair yang mengandungi alkohol ke dalam bekas dengan isipadu kecil seperti dalam gelas kaca atau bekas berbentuk silinder dan pastikan alat pengukur alkohol tidak menyentuh dinding bekas cecair. Kemudian perlahan-lahan tenggelamkan pengukur alkohol ke dalam cecair di tengah-tengah bekas. Alat pengukur tidak boleh menyentuh dinding atau bahagian bawah bekas cecair kerana ia mudah pecah. Tunggu sehingga meter alkohol stabil pada tahap yang sama. Jika alat penyukat tidak terapung, bermakna ia rosak atau tidak sesuai. Hasil kandungan alkohol dapat dilihat selepas bacaan berhetih pada anak panah berwarna merah. Analisis kandungan alcohol dalam kajian ini dilakukan sebanyak tiga kali dan hasil bacaan dapat dilihat pada Jadual 1.

Table 1: Keputusan Ujikaji Kandungan Alkohol pada minuman Bahar

Sampel	Tempoh	Keputusan (%)
Sampel A	1 jam	20
Sampel B	1 hari	17
Sampel C	3 hari	10

Sumber: Koleksi Pengkaji

Uji kaji kandungan alkohol dalam minuman *bahar* telah dilakukan berdasarkan tiga sampel iaitu A, B dan C. Sampel A adalah *bahar* yang diuji selepas *rosok* dicampukan. Sampel

B adalah *bahar* yang diuji selepas sehari dicampur dengan *rosok* dan Sampel C adalah *bahar* yang diuji selepas tiga hari dicampur dengan *rosok.*

Gambar 6: Kaedah Uji Kaji kandungan alkohol pada cecair

Sumber: Koleksi Pengkaji

Hasil sukatan terhadap kandungan alkohol pada minuman *bahar* mendapati bahawa 10 – 20% Kandungan alkohol dalam minuman tradisi ini. Hal ini menunjukkan bahawa, minuman tradisi bahar etnik Dusun Lotud boleh memabukkan peminum sekiranya mengambil secara berlebihan. Walau bagaimanapun, minuman tradisi ini wajib dihidangkan setiap kali waktu perayaan seperti majlis perkahwinan dan sambutan pesta kaamatan. Bagi etnik Dusun Lotud, sesebuah majlis akan menjadi suram sekiranya amalan budaya meminum bahar tidak diamalkan.

1.4 Minuman Tradisi *Bahar* Sebagai Amalan Budaya dan Kahsiat Kesihatan

Bahar dihasilkan melalui catuan air tandan kelapa diakui sebagai tonik kesihatan mujarab untuk pelbagai penyakit, dengan merujuk kandungan *bahar* yang kaya dengan sumber *amino* dan *polifenol* yang diakui efektif untuk menstabilkan peredaran darah.

Bahar juga diakuikaya kaya dengan vitamin B dan C, serta mineral yang diperlukan untuk fungsi antioksidan dan penyingkiran radikal bebas. *Bahar* mengaktifkan rembesan jus gastrik, menyokong flora usus, sehingga membantu membuang toksin dari badan. *Bahar* menyimpan sumber semula jadi yang kaya dengan *bioflavonoid,* termasuk *quercetin.* Flavonoid adalah bahan aktif yang berfungsi melawan tumor usus besar, otak, leukemia, barah perut, prostat, ovary serviks dan payudara. Jus *bahar* sangat baik untuk kesihatan, namun pengambilan tanpa peraturan memberi kesan yang buruk khususnya mereka yang menjadikan jus itu sebagai minuman santai. *Bahar* boleh memabukkan seperti minuman beralkohol yang lain. Di Sabah, daerah Kota Belud, Kiulu dan Tuaran antara pengeluar *bahar* berkualiti yang diwarisi daripada nenek moyang mereka sejak berabad lamanya. *Bahar* merupakan minuman alkohol tradisi untuk masyarakat Kadazan dan Dusun.

eISBN 978-967-2298-96-0

Gambar 7: Kaedah Uji Kaji kandungan alkohol pada cecair

Sumber: Koleksi Pengkaji

2. Kesimpulan

Bahar merupakan minuman tradisi dan amalan budaya etnik dusun lotud di sabah. Amalan ini telah diwarisi sejak turun temurun dan telah menjadi warisan yang menjadi kebanggahan masyarakatnya. Proses menyediakan minuman tradisi *bahar* juga mempunyai keunikan dan kaedah tradisi yant tersendiri. Secara tidak langsung amalan meminum bahar menjadi identiti dalam kehidupan masyarakat Lotud. Oleh itu, budaya dalam amalan menghasilkan minuman *bahar* wajar didokumentasikan sebagai warisan generasi seterusnya. Selain itu, minuman tradisi ini perlu diperkenalkan kepada masyarakat luar sebagai usaha pengekalan amalan serta mewujudkan pasaran yang lebih luas terhadap permintaan *bahar*.

Pengakuan

Kertas kerja ini merupakan hasil penyelidikan yang telah dilaksanakan semenjak tahun 2013 namun hanya didolumentasi dan diadaptasi kembali pada tahun 2022 bersama tiga orang informan iaitu;

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eISBN 978-967-2298-96-0

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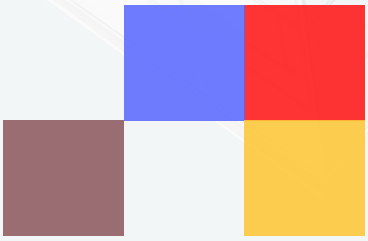

Social Sciences and Humanities Research Conference 2022
(UNIMAS-SSHR 22)
15th June 2022
Pullman Hotel, Kuching, Sarawak, Malaysia
https://www.fssh.unimas.my/index.php/my-unimas/prog-act/sshr22

e ISBN 978-967-2298-96-0
9 7 8 9 6 7 2 2 9 8 9 6 0
Social Sciences & Humanities
& Research Conference 2022