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Analysis on The Understanding of Environmental Management Practices among Contractors in Malaysia using Rasch Measurement Model

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ABSTRACT

The rapid development of construction industry in Malaysia has caused a significant impact on the environment and has resulted in increased demand for implementing environmental management practices. This study aimed to analyze the level of understanding on environmental management practices among contractors in Malaysia. A total of 47 contractors from all grades in Malaysia participated in this study. This study also used a 5-point Likert scale for the data collection process. Items in the questionnaire were analyzed using the Rasch Measurement Model to test the validity and reliability of the research instruments. The results showed that the item reliability value was 0.57 and the individual reliability value was 0.89. The value of the item separation index is 1.16 while the value of the individual separation index obtained is 2.78. Overall, person measure for construct of understanding level on environmental management practices ranged from +7.77 logit to -1.30 logit. For construct challenge faced by the contractor, the maximum value for person measure is +6.35 logit and the minimum measurement value is -0.97 logit. For the last construct which is the impact of environmental management practices on the environment, the value of person measure is +8.27 logit to -1.62 logit. Through item suitability analysis, there are some items that need to be dropped or harmonized as they not meet the requirements in one of the Outfit MNSQ and Outfit ZSTD ranges. The Rasch Measurement Model has identified that most contractors in Malaysia still have a moderate level of understanding on environmental management practices. The findings obtained at the end of this study are significant so that these environmental management practices remain practiced by contractors to maintain sustainable development in future.

Keywords: The level of understanding; environmental management practices; Rasch Measurement Model; contractors; validity; and reliability

INTRODUCTION

The rapid construction trend has made the construction industry in Malaysia as one of the most important industries in driving the country's development. The growth of construction industry has made a huge impact on the environment. The increasing demand from stakeholders has put additional pressures on many contractors to implement environmental management practices in their organizations to reduce the impact on theenvironment. Sara Hajmohammad et al. (2013) defined the environmental management practices as the level of resources invested in activities and knowhow development that led to pollution reduction at the source. It includes the implementation of environmental management systems such as ISO14001, application of environmentally friendly programs and green practices as the 3R (reduce,reuse, and recycle) .In general, environmental management practices in construction companies are divided into three main activities, namely

energy efficiency, waste management and involvement in implementing environmental practices (Izyan Yahaya & Nazirah Zainul Abidin 2020). Environmental management practices at the project level need to be adapted and integrated according to the organizational system to ensure that these practices are widely implemented in the construction industry. Today, environmental management practices are part of efforts to raise awareness towards sustainable development. Influential individuals in the construction industry should be aware of the importance of protecting the environment by implementing environmental practices especially among contractors. Recognizing the importance of sustainable development, construction practitioners around the world strive to adopt environmental management practices. These environmental management practices are also able to minimize the impact on environment and promote sustainable development to ensure that Malaysia construction industry is on par with other developed countries. Therefore, this research is focused on identifying the level of understanding of contractors on environmental management practices. The objectives of the research are to determine the level of understanding of contractors, challenges as well as impacts in implementing environmental management practices.

CONSTRUCTION INDUSTRY IN MALAYSIA

The construction industry is the oldest industry that has always played an important role in generating Malaysia's development. In Malaysia, all construction projects awarded to local or foreign contractors must be registered with the Construction Industry Development Board (CIDB).

TABLE 1. Projects that have been awarded from 2018-2021

Year	Projects awarded
2018	8549
2019	10,006
2020	7639
2021	0

Source: CONVINCE CIDB (2021)

Based on statistics from the Construction Industry Development Board (CIDB 2021) above, the number of projects awarded in 2018 showed a positive increase until 2019. However, the construction industry experienced a reduction in the number of projects in 2020 as a result from COVID19. Although Malaysia is facing some impact from the pandemic, the construction industry is still continuing to rebuild the economy in the country.

ENVIRONMENTAL MANAGEMENT PRACTICES

Environmental management practices can be defined as the level of resources invested in activities and know-how development that leads to the reduction of pollution at its source. It includes efforts to implement environmental management systems such as ISO 14001, reduce waste, or recycle materials (Sara Hajmohammad et al. 2013). According to Gangnon et al. (2012), environmental management practices also refer to practices that are not harmful or cause minimal damage to the environment. In addition, Montabon et al. (2007) also defined environmental management practices in their paper as the techniques, guidelines and methods used by organizations to monitor and control the influence of their actions on the natural environment.

UNDERSTANDING ENVIRONMENTAL MANAGEMENT PRACTICES IN MALAYSIA

In Malaysia, the implementation and understanding of environmental management practices is still at a moderate level and still far from achieving sustainable development as required by the government. Lack of exposure to environmental management practices in the construction industry can have an impact on the environment such as soil erosion and sedimentation, pollution and so on (Nur Khairina 2020). Environmental management practices and strategies have the ability to control technological change as well as the ability to make continuous improvements. Such practices not only reduce the negative impact on the environment and source consumption but also able to promote environmental process and sustainable product innovation. Besides, an understanding of environmental management practices needs to be emphasized as the construction industry contributes to high carbon emissions (CO2) as a result from burning of raw materials during the processing of building materials. The increase in carbon dioxide due to natural factors and human activities will cause the greenhouse effect (GHG) which results in global warming (Jabatan Meteorologi Malaysia 2021). Environmental management practices need to be improved among contractors because it is able to achieve the government's aspirations towards low carbon cities by 2022, zero-carbon cities by 2030 and carbon-neutral cities by 2050. A deep understanding on this practice will able to develop the construction industry, especially in terms of construction methods and work productivity to be on par with the construction sector from developing countries. Therefore, it is important for the contractors to have a good understanding and awareness to help protect the environment.

FACTORS THAT AFFECT THE ENVIRONMENTAL MANAGEMENT PRACTICES

According to the data analysis, the main issues according to the quality in the Malaysian construction industry are:

1. Implementation of Environmental Management System ISO14001.

   An Environmental Management System (EMS) is a set of processes and practices that enable an organization to reduce its environmental impact and improve operational efficiency (Casio 1998). ISO14001 is a frequently used system in an organisation. According to Fernando (2021), ISO 14001 is a set of standards by the International Organization for Standardization (ISO). The purpose is to clarify the best practices for organizations in order to reduce environmental impact by adopting an effective environmental management system (EMS). According to research conducted by the CIDB (2018), one of the factors driving the implementation of ISO 14001 by construction companies is because ISO 14001 meets the needs of clients or government agencies to minimize the impact of construction activities to the environment. There are no operating standards or technologies set but through the implementation of ISO 14001 globally, it is indirectly able to improve the quality of the environment. In addition, the implementation of ISO 14001 can improve the company's image while minimizing operating costs in the long run because all activities performed will be well monitored, especially for activities that have the potential to affect the environment. Organizations that implement the ISO 14001 are in high demand from clients as the system produces environmentally friendly outcomes. Organizations implementing ISO 14001 demonstrate that their organizations comply with current and future legal requirements. The controls introduced by systems as well as internal and external audit's programs will increase the organization's compliance to be more concerned about the environment.

2. Lack Implementation of Environmentally Friendly Program

   Tremendous efforts have been made to ensure that the construction industry does not affect environmental sustainability. Thus, the projects have been inculcated with elements of sustainability since the early stages of construction projects. Systematic waste management is an example of an environmentally friendly program at the construction site. It can be achieved by providing an open area to facilitate waste managed by the contractor (Wee, Halim & Mohamad 2006). Next, housekeeping practices on construction sites are also essential to develop the image of the construction industry by providing a safe working environment. Roth S (2005) stated that construction projects will benefit if housekeeping practices are prioritized at construction sites. Besides, housekeeping practices on construction sites are important to ensure a safe work environment (Federated 2007). Unmanaged construction waste will cause workers to be prone to accidents such as tripping or slipping. Thus, housekeeping practices can reduce waste on construction sites and can provide a safe working environment. Environmentally friendly programs such as 3R (Reuse, Reduce and Recycle) should be applied and utilized as much as possible because it can minimize the waste generated from the construction activities. 3R programs not only reduces the waste generated but can also reduce the cost of transporting, disposing, and recycling waste (Esin et al. 2007). Sustainable development must comply with erosion and sediment control (ESCP) especially in providing resource control i.e., quantity control, water quality as well as erosion and sediment plans. The contractor must comply with the ESCP's guidelines with emphasis on components such as sediment ponds and erosion dams to prevent accidents from occurring at construction sites.

3. Application of green practices by contractors

   According to Albino et al. (2009), 'green' refers to a combination of several aspects, such as the integration, recognition, and application of environmental practices in terms of planning, to reduce the impact on the environment. Green practices among contractors are an important aspect of the construction sector. There are several past studies stating that construction sites that implement green practices enable projects to reduce the negative impact of construction projects on the environment and at the same time improve economic performance (Chang et al. 2018). Green practices also have been shown to provide advantages by minimizing costs and providing many benefits to economic performance (Chen et al. 2016). Construction cost reduction can be implemented through improvements in construction processes to reduce waste generated and used building materials efficiently. Hence, the use of green building materials, minimizing construction waste generation, efficient use of energy and water are practices that need to be done by contractors in order to reduce impact on the environment. Challenges of

environmental management practices Lack of enforcement and support from the government also limits the implementation of environmental management practices. S.D. Dzokoto (2014) stated that the effectiveness of these environmental management practices occurred if stakeholders set legislation that requires continuous cooperation and policies that help to enforce sustainability in all aspects of development. The success of this practice is closely linked to the commitment of the government and the formation of legislation. Because of the many benefits that result from sustainable construction, collaborative efforts by the government are needed so that this practice can be emulated and implemented in every construction project. Lack of sustainable or green materials also inhibit the implementation of environmental management practices. Environmental management practices in the construction industry are also less practiced due to the difficulty of implementing green technology. According to Abidin et al. (2013), the knowledge of local construction practitioners on green technology is still at a low level.

CHALLENGES OF ENVIRONMENTAL MANAGEMENT PRACTICES

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IMPACT OF IMPLEMENTATION ON ENVIRONMENTAL MANAGEMENT PRACTICES TOWARDS ENVIRONMENT

There are many positive impacts resulting from the implementation of environmental management practices. Firstly, cost savings due to the reduction of interest fines to contractors because of compliance with environmental legislation. Huge amount of greenhouse gases (GHG) emitted are from activities such as production, installation, maintenance, and end -of -life disposal of building materials. Therefore, the implementation of environmental management practice can reduce the greenhouse gas emissions and energy consumption. The implementation of environmental management practices can also reduce waste generation at construction sites since it produces a lot of waste. Therefore, it requires a systematic system to manage the waste and should be based on the 3R concept. Environmental management practices also able to minimize pollution to the environment because activities on construction sites are a major contributor to noise, water, and air pollution.

CARBON EMISSIONS

The construction industry is one of the largest contributors to carbon emissions in the world as a result of the rapid urbanization process. Building operations are also responsible for nearly one-third of the total amount of carbon gas released. The sources of carbon emissions in construction sector are the production of building materials followed by energy consumptions from construction machineries/ equipment. Most buildings use a lot of energy generated from the combustion of fuels that cause the emission of carbon dioxide gas. These emissions are due to the burning of fossil fuels to change appliances, heating, and cooling systems as well as other energy consumers. Studies by previous researchers have also shown that energy consumption and carbon emissions in the construction sector are also influenced by building type, structure type, product type and fuel source. Carbon emissions are also depended by machinery used at construction sites. All these machinery and equipment require energy and fuel to function such as diesel or electricity. The construction phase has a certain stage where transportation is very important to speed up the construction

process. For example, machinery is needed to transport and transfer building materials from one location to another. Therefore, selection of proper transportation is important to reduce time usage and avoid higher carbon emissions. In addition, cement is one of the most important and most widely used building materials. Drastic cement production has resulted in high carbon emissions leading to pollution. According to Fauzi (2012), the production of cement used in the construction industry releases a total of 7% of global carbon dioxide and exploits natural resources Therefore, the quantity and selection of appropriate building materials is an aspect that must be emphasized so that carbon emissions can be reduced.

METHODOLOGY

A quantitative study was chosen as the design for the study where the objective and goal are to determine the level of understanding of environmental management practices, especially among contractors. The method used is survey form. Quantitative methods were performed using questionnaires. The questionnaires distributed to the respondents through Google Form are structured and closed -ended questions. Through this method, the element of bias will not occur because the results of the study are based on the data that has been collected. The Google Form provided has been distributed through shared links via Facebook, Twitter, WhatsApp, and LinkedIn.

The sampling method used in this study is probability sampling which is random sampling. Random sampling consists of simple random sampling, systematic random sampling, stratified random sampling and cluster random sampling. Simple random sampling was chosen for this research. The sample of this study consists of construction companies that drives construction projects in Malaysia. The industry was chosen because of its huge impact on the environment. The study involved contractors from all grades which is from grade 1 (G1) to grade 7 (G7) and it is because of their ability from to implement environmental management practices.

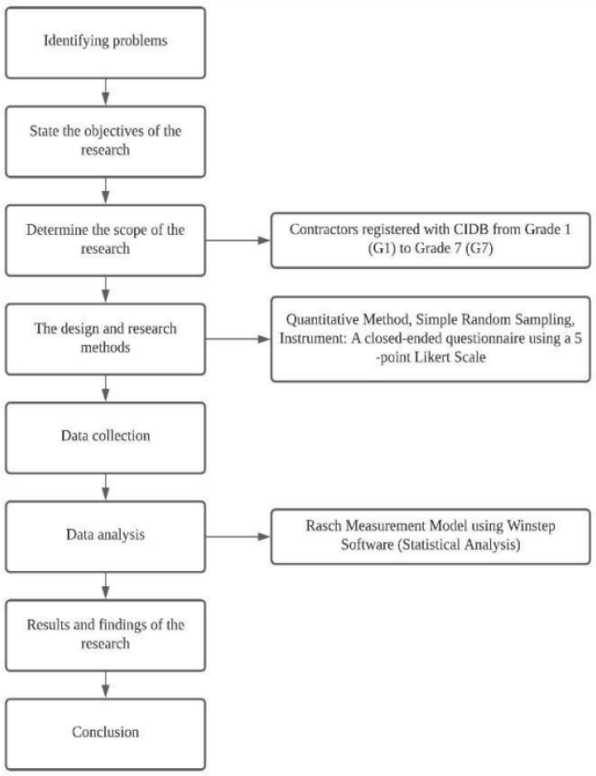

FIGURE 1. Flow chart

RASCH MEASUREMENT MODEL

Sampling size for the study can also be determined using the Rasch Measurement Model as shown in the table below (Linacre 1994). This study used item calibration with ± 1 logit and a confidence level of 95%. This is because measurements based on item calibrations with standard deviations up to 0.5 logit are suitable for research because they are free of bias elements (Haryanti et al. 2017). Therefore, the appropriate minimum sample size for this study is 30.

TABLE 2. Sampling Size and Logit for Item Calibration

Item Calibrations Stable Within	Confidence	Minimum Sample Size Range	Size for Most Purposes
± 1 logit	**95 %**	**16-36**	**30**
± 1 logit	99 %	27-61	50
± ½ logit	95 %	64-144	100
± ½ logit	99 %	108-243	150

Source: Linacre 1994

This questionnaire contains four parts that need to be answered by the respondents. Part A: Background of the Respondent, Part B: Understanding on Environmental Management Practices, Part C: Challenges on Environmental Management Practices, Part D: Impact of Environmental Management Practices. This survey used a 5 -point Likert scale which consists of a scale of strongly agree, agree, not sure, disagree and strongly disagree. This Likert scale is used to identify the level of understanding, impact and challenges faced by respondents.

TABLE 3. Questionnaire items

Part	Item	Number of items
A	**Background of the Respondent**	
	Demography	3
	Organizational Level)	1
	Duration of company involved in construction industry	1
	Grade of Contractor	1
	Respondent's Position	1
B	**Understanding on environmental management practices**	
	Implementation of Environmental Management System ISO14001	8
	Implementation of Environmentally Friendly Programs	3
	Application of Green Practices by Contractors	3
C	**Challenges on environmental management practices**	
	Implementation of Environmental Management System ISO14001	8
	Implementation of Environmentally Friendly Programs	3
	Application of Green Practices by Contractors	3
D	**Impacts of environmental management practices**	
	Implementation of Environmental Management System ISO14001	8
	Implementation of Environmentally Friendly Programs	3
	Application of Green Practices by Contractors	3
	Total	49

Closed-ended questions are used because they provide more specific information and make it easier for respondents to choose the suitable answers. In addition, the questions generated are also guided by the objectives of the study and adapted to answer the research questions.

PILOT STUDY

A pilot study was conducted to identify the suitability of the items in the questionnaire as well as to ensure the validity and reliability of the instruments for this study. The validity and reliability of the items in the questionnaire form were measured with the Rasch Measurement Model using Winstep software version 3.72.3. The questionnaire was distributed and involved a total of 10 companies. Item validity analysis is the construct validity, and it uses the main component analysis (Principal Component Analysis) or known as PCA. The purpose of PCA is to check the assumption that the measured construct should be unidimensional in nature based on the value of raw variance explained by measures (Aidah 2017). In addition, the features that need to be emphasized to study the unidimensions for PCA are the degree of interference of the measured item or the value of unexplained variance in 1st contrast. According to (Sumintono & Widhiarso 2015), the value of raw variance explained by measures should be at least 20%. The value is in the good category if the value exceeds 40% and excellent if the value received exceeds 60%. Meanwhile, the value of unexplained variance in 1st contrast should not exceed 15% (Karim 2018).

RESULTS AND DISCUSSION

RELIABILITY

ITEM RELIABILITY AND SEPARATION

Statistical analysis based on the Rasch Measurement Model was used to determine the item reliability in the study instrument by referring to the value of the reliability index and item separation. Findings from this analysis indicate that the item reliability value is 0.57. This clearly indicates that the item is at an acceptable level because the confidence value is in the range of 0.6 to 0.7 after rounding if using the Cronbach's Alpha score. The reliability of the item is still at a low level if the value obtained is compared with the value on the instrument quality criterion evaluation scale. The item separation index indicates the separation for the level of item difficulty. According to Linacre (2004), a good and acceptable index separation value should be above 2.0 but the value obtained is 1.16 and it is considered weak and needs to be improved. Therefore, the items in this construct need to be reviewed as it may not measure

what should be measured on the construct (Kamis et al. 2012). Furthermore, according to Boone et al. (2013) low reliability also means that the samples obtained are not sufficient to locate items accurately on latent variables. The low item separation index value also illustrates that the number of individual samples is not large enough to support the level of item difficulty in the instrument (Juliana & Zolkepeli 2016).

TABLE 4. Item Reliability

SUMMARY OF 42 MEASURED ITEM

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	40.8	10.0	.00	.56	.97	-.1	1.08	.0
S.D.	3.1	.0	.94	.07	.66	1.2	1.00	1.4
MAX.	45.0	10.0	2.02	.65	3.60	3.8	5.43	5.4
MIN.	32.0	10.0	-1.48	.40	.24	-1.8	.22	-1.9
REAL RMSE	.61	TRUE SD	.71	**SEPARATION 1.16**	**ITEM**	**RELIABILITY**		.57
MODEL RMSE	.57	TRUE SD	.75	SEPARATION 1.32	ITEM	RELIABILITY		.63
S.E. OF ITEM MEAN = .15								

PERSON RELIABILITY AND SEPARATION

Person reliability is used to measure the reliability of research instruments. Based on Table 5, the value of the person reliability index is 0.89 and according to Sekaran & Bougie (2003) this value is a good value. Next, the value for the individual separation index shown is 2.78. The individual separation index obtained was able to estimate the ability of the instrument to differentiate individuals into three groups of constructs that were measured and were at a good level.

TABLE 5. Person Reliability

INPUT: 10 PERSON 42 ITEM REPORTED: 10 PERSON 42 ITEM 5 CATS WINSTEPS 3.72.3

SUMMARY OF 10 MEASURED PERSON

	TOTAL SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	INFIT ZSTD	OUTFIT MNSQ	OUTFIT ZSTD
MEAN	171.2	42.0	2.12	.27	1.18	.3	1.08	-.1
S.D.	12.4	.0	1.01	.04	.84	3.0	.66	2.3
MAX.	197.0	42.0	4.43	.35	3.40	7.6	2.65	4.3
MIN.	155.0	42.0	.99	.23	.28	-3.8	.24	-4.2
REAL RMSE	.34	TRUE SD	.95	**SEPARATION 2.78**	**PERSON**	**RELIABILITY**		.89
MODEL RMSE	.27	TRUE SD	.97	SEPARATION 3.52	PERSON	RELIABILITY		.93
S.E. OF PERSON MEAN = .34								

PERSON RAW SCORE-TO-MEASURE CORRELATION = .99

CRONBACH ALPHA (KR-20) PERSON RAW SCORE "TEST" RELIABILITY = .91

VALIDITY

UNIDIMENSIONALITY

In evaluating unidimensionality, important elements to consider are the value of raw variance explained by measures and the value of variance unexplained in the first contrast. The minimum value for raw variance is 40% but according to Conrad et al. (2009), they argue that raw variance values more than 30% are still acceptable and considered for moderate dimensional uniformity of measurement. Next, the unexplained value of variance in the first contrast should not exceed 15% but the value obtained should exceed 15%. Thus, the value is still acceptable even if there is slight interference in the construct measurement.

TABLE 6. Standardized Residual Variance

INPUT: 10 PERSON 42 ITEM REPORTED: 10 PERSON 42 ITEM 5 CATS WINSTEPS 3.72.3

Table of STANDARDIZED RESIDUAL variance (in Eigenvalue units)

	-- Empirical --		Modeled
Total raw variance in observations =	62.6	100.0%	100.0%
Raw variance explained by measures =	20.6	**32.9%**	35.9%
Raw variance explained by persons =	6.6	10.6%	11.6%
Raw Variance explained by items =	13.9	22.3%	24.3%
Raw unexplained variance (total) =	42.0	67.1% 100.0%	64.1%
Unexplned variance in 1st contrast =	10.4	**16.6%** 24.7%	
Unexplned variance in 2nd contrast =	8.0	12.7% 18.9%	
Unexplned variance in 3rd contrast =	6.7	10.7% 16.0%	
Unexplned variance in 4th contrast =	5.2	8.4% 12.5%	
Unexplned variance in 5th contrast =	4.3	6.9% 10.2%	

POLARITY AND ITEM MEASURE

In Rasch modelling, the items in the questionnaire form should show good compatibility. The item is considered fit if the values of Point Measure Correlation, Outfit Mean Square and Outfit zStandard are within the specified. For item values that are outside the range of the Item Compatibility Index as shown in Table 7, they should be modified or dropped so as not to affect the item. However, they have also argued that if an item meets one of the set criteria, then the item can be retained.

TABLE 7. Item measure acceptable range

	Acceptable Ranges
Point Measure Correlation (PTMEA-CORR)	0.40 – 0.85
Outfit Mean Square (MNSQ)	0.5 – 1.5
Outfit z-Standard (ZSTD)	-2.00 – 2.00

Source : Boone, Staver & Yale (2014)

According to Fuaad (2018), the correlation value of the measurement point is very small which is less than 0.4, it means that most respondents are not able to answer the item. For items with MNSQ and ZSTD values that exceed the set range, it describes the level of poor ability of respondents in answering difficult items. Next, if the value of MNSQ -2.00 in turn indicates that the respondent is weak but has difficulty in answering simple items. Therefore, inappropriate respondents will be excluded so that the validity of the instrument can be improved (Lamoureux et al. 2008).

OBJECTIVE 1: THE LEVEL OF UNDERSTANDING OF CONTRACTORS ON ENVIRONMENTAL MANAGEMENT PRACTICES

PERSON MEASURE

The maximum value for individual measurement is +7.77 logit while the minimum value is at -1.30logit. Moreover, maximum logit indicates that the individual has high level of understanding while a minimum logit indicates the individual has low level of understanding. A total of 4

respondents from contractor companies who have a high understanding of environmental management practices because they have maximum marks. Based on the observations, it can be concluded that these companies have long been involved in the construction industry and often handle large-scale projects. Therefore, an understanding of environmental management practices is important and is a key in their organization to ensure smoothness in every project undertaken.

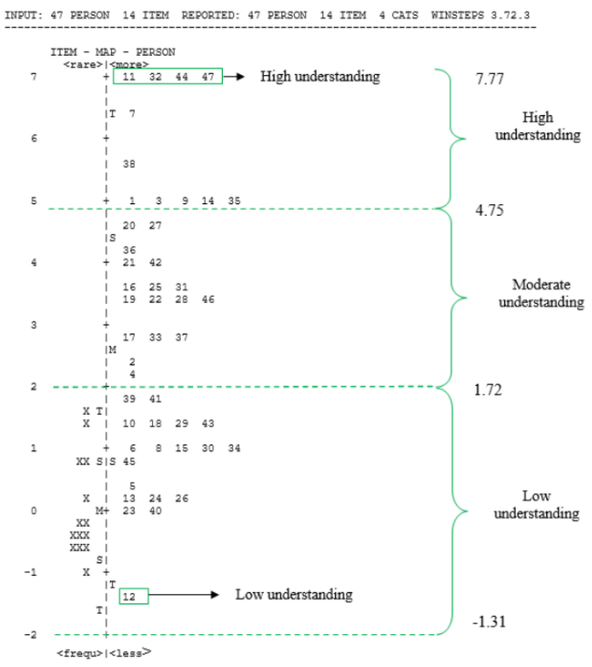

FIGURE 2. Person map for level of understanding of contractors.

PERSON MEASURE (CONSTRUCT)

The overall mean value obtained for ISO14001 construct is +2.85 logit. Through the comparison with person map in Figure 2, it can be proven that the contractor has a moderate level of understanding and still has not reached a comprehensive understanding of ISO14001. The mean value for environmentally friendly program showed the highest value compared to other constructs at logit +4.33, but all contractors were categorized at a moderate level of understanding. Next, the mean value for green practices is at +3.49 logit and it can be concluded that the contractor also has a moderate level of understanding about green practices.

TABLE 8. Person measure for level of understanding of contractors

Construct	Mean Value	Explaination
ISO14001	+2.85	Moderate
Environmentally friendly program	+4.33	Moderate
Green practices	+3.49	Moderate

OBJECTIVE 2: CHALLENGES ON ENVIRONMENTAL MANAGEMENT PRACTICES

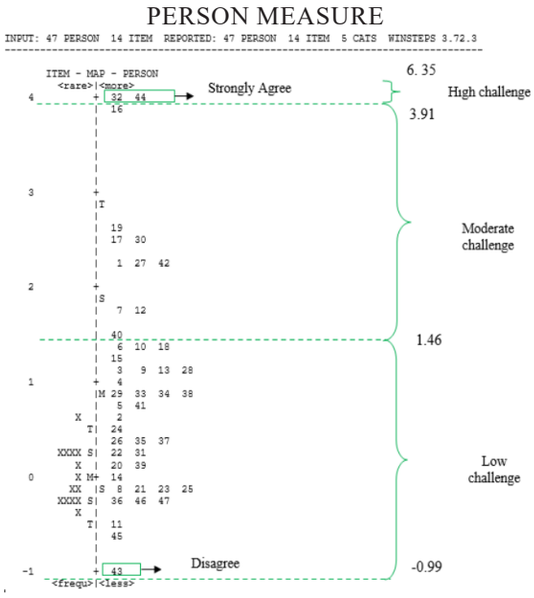

FIGURE 3. Person map for challenges on environmental management practices

The maximum measurement value for individual measurements is +6.35 logit while the minimum measurement value is -0.97 logit. Therefore, the total length of the measurement is +7.32 logit. Furthermore, a high logit value indicates that individuals face a very challenging situation when applying environmental management practices while a low measure of -0.97 logit indicates the opposite situation. There were 2 respondents from contractor companies facing very challenging situations, 9 of them were challenging while the rest faced less challenges when implementing environmental management practices. The overall mean value for the individual was at logit +1.10. As a conclusion, the challenges faced by contractors are at a low level and less risky when applying environmental management practices.

PERSON MEASURE (CONSTRUCT)

TABLE 9. Person measure for challenges on environmental management practices

Construct	Mean Value	Explaination
ISO14001	+1.38	Low
Environmentally friendly program	+0.79	Low
Green practices	+3.80	Moderate

The implementation of the ISO14001 Environmental Management System is part of environmental management practices and it requires the preparation of thorough and complex documents. Respondents with maximum logit shows that they strongly agreed that the implementation of ISO14001 is very challenging and difficult to implement. Overall, the mean value for ISO14001 is +1.38 logit and it can be concluded that all contractors face less challenges to implement this construct. The environmentally friendly program is difficult to be implemented into a small-scale project from lower tier contractors because it will delay the completion of the project and increased the costs. Furthermore, the increase in the number of contractors from the lower class also makes it difficult for the government to provide financial incentives for the contractors to implement environmentally friendly programs. The mean value is +0.79 logit, and it shows that the contractors face less challenges and difficulties to implement environmentally friendly programs. Lastly, the mean value for green practice's construct is at logit +3.80 and it shows that contractors face moderate challenges to implement green practices in their organizations. It is because lack of expertise on green technology and practices from organizations and the cost of implementing green practices is higher compared to conventional methods. Hence, these practices being less empowered on construction sites.

CONCLUSION

Quality is important in the construction industry to ensure the high quality of end product or construction projects. However, the implementation of quality and QLASSIC in the Malaysian construction industry needs a corporation by all the stakeholders and construction practitioners to ensure the success of the projects and meets the client's satisfaction. The findings show the main issues in quality of Malaysian construction industry are the stakeholders and construction practitioners doesn't play the roles toward quality, lack of quality awareness and QLASSIC awareness by stakeholders and clients, the incompetence of contractors, consultants, and stakeholders and no appropriate quality training among construction practitioners. The results also indicate the way forward for the Construction Industry Development Board Malaysia to solve the quality issues in the Malaysian construction industry. Thus, further study is suggested to ensure the strategic action to increase the quality of Malaysian construction industry from the view of all the stakeholders, construction practitioners, and academician.

OBJECTIVE 3: IMPACTS OF ENVIRONMENTAL MANAGEMENT PRACTICES

PERSON MEASURE

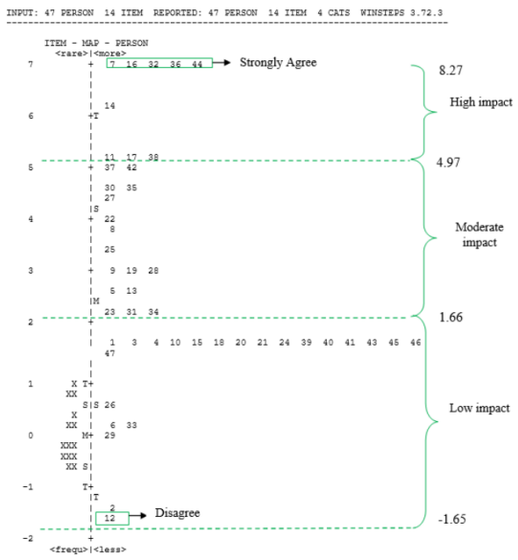

FIGURE 4. Person map for impacts of environmental management practices

The maximum measurement value for person measure is +8.27 logit while the minimum measurement value is -1.62 logit. The maximum logit shows that individuals strongly agree that environmental management practices have a great impact on the environment while respondents who disagreed indicate the minimum logit. Respondents with maximum logit support that the implementation of environmental management practices can reduce the impact on the environment. The overall mean value is at logit +3.04. It is concluded that contractor agrees that environmental management practices have only a moderate impact on the environment

TABLE 10. Person measure for impacts of environmental management practices

Construct	Mean Value	Explaination
ISO14001	+4.23	Moderate
Environmentally friendly program	+7.63	High
Green practices	+1.92	Moderate

ISO14001 implementers, such as contractors, can provide a safe, healthy, and non-polluted environment. This is due to the ISO14001 system which considers the impact on the environment for each phase from the first stage of construction until completion stage. The mean value for ISO14001 construct is +4.23 logit and it shows that the implementation of the environmental management system that is ISO14001 only has a moderate impact on the environment. Mean value for the environmentally friendly program construct was at logit +7.63. Through a comparison using the person map, the contractors strongly agree that the environmentally friendly program is able to provide high impact as well as reduce environmental pollution. Environmentally friendly programs such as the implementation of ESCP, namely the provision of drainage control and removal of runoff surfaces can reduce erosion and sedimentation caused by construction activities. Waste management practices can minimize waste generation at construction sites as well as reduce greenhouse gas emissions and carbon emissions globally (Agumuthu 2010). Green practices help to conserve and minimize negative impacts on the environment. In addition, these practices protect ecosystems, improve air and water quality as well as protect natural resources. For green practice's construct, the mean value is at logit +1.92 and it stated that the implementation of green practices has a moderate impact on the environment.

CONCLUSION

Analysis using the Rasch Measurement Model identifies that the level of understanding of contractors in Malaysia on environmental management practices is still at a moderate level. This is because the construction industry is given less exposure and serious emphasis on environmental care. The challenges faced by contractors are still at a low level. Cooperation from all parties, especially enforcement agencies such as CIDB and government are important so that environmental management practices can be implemented comprehensively and consistently. Environmental management practices from the contractor's perspective are also said to have a moderate impact on the organization and the environment. This is because the implementation of this practice is unusual although it has potential in reducing the negative impacts produced by the construction industry. The findings obtained at the end of this study are significant so that these environmental management practices are practiced and extended to contractors in order to produce sustainable construction. Ultimately, environmental management practices are important and should be at the core of all contractors to pursue environmental sustainability.

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DECLARATION OF COMPETING INTEREST

None

REFERENCES

Abidin, N. Z., Yusof, N. & Othman, A. A. E. 2013. Enablers and challenges of a sustainable housing industry in Malaysia. *Construction Innovation.* 13(1): 10–25. doi:10.1108/14714171311296039

Boone, W. J., Staver, J. & Yale, M. S. 2014. Rasch analysis in the human sciences. The Netherlands: Springer. doi:10.1007/978-94- 007-6857-4

CIDB. 2018. Impact Study On ISO 14001 Implementation To G7 Contractors With Annual Turnover RM200 Million And Above 36. Retrieved from https://www.cidb.gov.my/sites/default/files/2 020-12/8. CIDB-Tech.-Pub.-No.186ImpactStudy-on-Implementation-ISO-14001.pdf

Federated. 2007. Housekeeping during Construction Operations (Malaysia: ISO Services Properties). SOCSO *Annual Report Social Security Organization 2000*.

Fernando, J. 2021. ISO 14001. *Sustainable Investing.*

Izyan Yahaya & Nazirah Zainul Abidin. 2020. The implementation of environmental practices by Malaysian contractors. *International Journal of Integrated Engineering* 12(4): 310–318.

Jabatan Meteorologi Malaysia. 2021. *Perubahan Iklim & Kesan Rumah Hijau*. Kuala Lumpur.

Karim, E. 2018. Kesahan dan Kebolehpercayaan Ujian Kemahiran Proses Sains untuk Murid Sekolah Rendah Berdasarkan Model Pengukuran Rasch (Validity and Reliability of Science Process Skills Test for Primary School Pupils based on Rasch Measurement Model). *Jurnal Pendidikan Malaysia.* 43(03). doi:10.17576/jpen-2018-43.03-01

Mohd Affandi, H., Khairil Hizar, M. K., Amiruddin, M. H., Mohd Firdaus, M. K. & Fadzil, H. 2017. Establishing the Malaysian contractors' soft skills requirements for construction management graduates: Applying the Rasch measurement model. *Journal of Technical Education and Training.* 9(1): 61–72.

Nur Khairina. 2020. Pelaksanaan Sistem Pengurusan Alam Sekitar (EMS) dalam Projek Pembinaan Infrastruktur 14001.

S.D. Dzokoto, J. D. 2014. Barriers to sustainable construction in the Ghanaian construction industry: Consultants Perspectives. *Journal of Sustainable Development* .7(1): 223–234.

Sara Hajmohammad, Vachon, S., Klassen, R. D. & Gavronski, I. 2013. Lean management and supply management: Their role in green practices and performance. *Journal of Cleaner Production* 39: 312–320. doi:10.1016/j.jclepro.2012.07.028