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THE RESILIENCE OF TIN INDUSTRY ON THE ECONOMIC, ENVIRONMENT AND SOCIETY IN MALAYSIA

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Abstract: *The past decades have seen that the tin industry has to face a challenging scenario for its operation especially in decreasing ore grades, deeper deposits, and harder rock mass (Sánchez & Hartlieb, 2020). Notwithstanding to that, the mining activity that decrease the environmental stability, causes pollution, reduced water quality and change of biodiversity (Nurtjahya, Franklin, & Agustina, 2017) has urged the industry to be more environmentally friendly in their operation. In addition, the global economic crisis due to COVID-19 pandemic has added the tougher situation for tin industries. Like it or not, the tin industry needs to combat the challenges in order to remain in the business. In other word, we need a resilient tin industry that can recover from the adverse experience and move forward not only for success but also to contribute for a better nation. A possible solution to become a resilient industry is by adoption of digital technology to increase the operation efficiency, adoption of green technology to reduce the negative environmental impact, managing adequate financial resources to overcome the economic crisis and encouraging product innovation to enhance customer satisfaction.*

Keywords: *Resilience of tin industry, Digital technology, Financial resources, Green technology, Product innovation*

Introduction

Tin mining industry was once a major contributor to the national economy. In 1979, Malaysia was producing almost 63,000 tonnes, accounting for 31 percent of world output. It was the world's leading producer and employed more than 40,000 people. In recent decades, the tin industry has been confronted with a challenging scenario for its operation particularly in declining mineral contents, deeper deposits and harder rock masses (Sánchez and Hartlieb 2020). Nevertheless, mining activity which reduces environmental stability, causes pollution, reduces water quality and alters biodiversity (Nurtjahya, Franklin, & Agustina, 2017) has urged

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industry to be more environmentally friendly in their operations. Furthermore, the global economic crisis caused by the COVID-19 pandemic has aggravated the situation of the tin industries. Like it or not, the tin industry needs to combat the challenges in order to remain in the business. This means we need a resilient tin industry that can recover from the adversarial experience and move forward not only to succeed but also to contribute to the betterment of the nation. However, it should be noted that unseen events like the COVID-19 outbreak can significantly affect the performance of the overall GDP as well as the contributing sectors. With the prolonged lockdown, there was a major decrease in the Malaysian economy, as it contracted to 17.1% in Q2'2020 due to the fall in construction GDP to 44.5%. Hence, it is clear that the suspension of the construction industry is a major threat to the stability of the economy. At the end of Q3'2020, the economy saw a smaller decline of 2.7% in the overall GDP of all the sectors. In general, the effects of COVID-19 were not present in Q4'2019. The values are shown in Table 1.

Table 1: Sector-wise quarterly gross domestic product (GDP) of Malaysia.

Sector	GDP			
	Q4'2019	Q1'2020	Q2'2020	Q3'2020
Construction	1.0%	−7.9%	−44.5%	12.4%
Services	6.1%	3.1%	−16.2%	−4.0%
Manufacturing	3.0%	1.5%	−18.3%	3.3%
Agriculture	−5.7%	−8.7%	1.0%	−0.7%
Mining	−2.5%	−2.0%	−20.0%	−6.8%

Note: Department of Statistics Malaysia. Malaysia Economic Performance Fourth Quarter 2019 and2020

The objectives of the research are as follows:
1. To identify the factors that contributes to tin industry resilience.
2. To determine the effect of resilient tin industry on economic, environment and society.
3. To develop a resilient tin industry model.

Literature Review

Resilience Theory

Resilience Theory is the underlying theory in explaining the relationship between the variables in the framework for this research. Resilience is defined as the ability to bounce back from adversity, frustration, and misfortune and is essential for the effective leader (Ledesma, 2014). Resilience theory has its roots in the study of adversity and an interest in how adverse life experiences impact harmfully on people (Van Breda, 2018).

Adequate financial resource

Financial resource is an asset used to settle liabilities and an obvious resource that companies must have available to achieve strategies (Stacey, 2011). Stacey noted that financial resources enabled organizations to acquire other forms of resources that organizations use for operations that justify the company's existence. Adequate financing has a significant effect on the survival and success of small business and without which the small business would not succeed (Gill &Biger, 2012). Yallapragada and Bhuiyan (2011) examined the key factors in the success of small business and noted that the factors that determine small business success include adequate financial resources.

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Adoption of digital technology

Digital technologies are transforming industry, products, processes and operations (Bolat, Kooli & Wright, 2016). The workplace has changed at a dizzying rate, driven by rapid strides in technology. In the digitized world, management professionals have seen their role changing as not only drivers of a business process but also being in charge of the automation efficiency and output (Schildt, 2017). The adoption of automated systems that can connect the information from one department to another department will help to reduce the manual documentation and repetitions of the same tasks. The workspace that design with the internet of things will increase the service efficiency and reduce the congestion in the workplace. Based on this argument, the following hypothesis has been developed:

Adoption of green technology

Green technology is the development and application of products, equipment and systems used to conserve the natural environment and resources, which promotes the use of renewable resources, minimises and reduces the negative impact of human activities (Izvekova, Roy, & Murgul, 2016). Adoption of green technology in tin industry can reduce energy and water consumption, maintenance costs and employee health costs as well as improvement in quality of life. In addition, reuse of recyclable materials can contribute to energy and cost savings in a organization (Jainudin et al., 2017). With the installation of energy -efficient light bulbs, maximum natural light in the office and application of rainwater storage, it is expected the company will reduce the energy and water consumption in the office. The usage of green technology will create renewable energy such solar and wind power. In addition, the natural open space will make tin industry employee feel better.

Product Innovation

Product innovation can be defined as a “process that includes the technical design, R&D, manufacturing, management and commercial activities involved in the marketing of a new (or improved) product”(Alegre & Chiva, 2008).Innovative product becomes a crucial point in the industry where through innovative product, customers gain benefits from the sides of either the new feature, design or function. A product is said to be innovative when the customers gain various benefits from the new design, function and feature (Khin, Ahmad &Ramayah, 2010). Janssen, Stoopendaal and Putters (2015) classify innovation into two words, novelty and newness.

Resilient Tin Industry

Malaysia is heavily reliant on rubber and tin exports in the early years of independence and used the revenue earnings from these sectors to increase agricultural productivity and reduce poverty. Tin and rubber revenues were used to subsidize and incentivize the development of the palm oil sector and to set up the Palm Oil Research Institute of Malaysia (PORIM) to increase yield rates (Sach, & Maennling, 2015). Today, Malaysia only produces less than 1.5% of total world tin production. Malaysia needs a resilience tin industry that able to recover from difficult situation and to remain competitive in global arena. Resilience tin companies enable them to cope effectively with unexpected events, bounce back from crises, and even foster future success (Duchek, 2020). Resilience is both a function of planning for and preparing for future crisis (planned resilience), and adapting to challenges and difficulties (Barasa, Mbau, & Gilson, 2018). It expected that adequate financial resources, digital technology, green technology and product innovation will be the contributed factors to be resilience and subsequently the tin industry resilience will contribute to economic growth, sustainable environment and prosperous society.

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Economic Growth

Economic growth refers to an increase in aggregate production in an economy. If there is an economic recession, healthcare workers are affected by a combination of job insecurity, decreased purchasing power and reduced labour market opportunities (David Stuckler, Sanjay Basu, Marc Suhrcke, Adam Coutts, Martin McKee (2009). It has also been suggested that these economic recessions are often amplified by the reduction of welfare support and salary cuts by the restrictive policies governments typically apply to the largest spending sectors (including commonly health) in the attempt to balance budgets and reduce deficits. on health workers include salary cuts and job losses, compounding migration intentions (Humphries, Crowe, McDermott, et al., 2017), decreased motivation (Williams, Thomas, S, (2017), unwanted organisational changes (Kerasidou, Kingori P (2019) and an increase in the tendency to engage in concurring profit-generating activities, often at the expense of the quality of service (Giuliano Russo, Inês Rego, Julian Perelman, Pedro Pita Barros (2016). A resilient workplace will increase the productivity which eventually will contribute to economic growth. Better understanding on resilience of workplace allows for policy development that can minimize the negative impacts on economic change has on people and bolsters the sustainability of the change process (Adger, 2000). Based on the discussion, the following hypothesis has been developed.

Sustainable environment

Environmentally sustainable health care facilities are those that improve, maintain or restore health, while minimizing negative impacts on the environment and leveraging opportunities to restore and improve it (World Health Organization, 2017). Building climate resilience and environmental sustainability are best addressed together for achieving synergies and resource efficiency.

Prosperous Society

The physical environment at work plays a vital role in employees' productivity. Management must take an active part in defining the physical environment in which the health workers carry out their daily task to make it conducive. This can be achieved by improving on the physical workplace and facilities, delegating responsibilities, increasing accountability, and encouraging teamwork. This will promote trust and loyalty among the workers and encourage better teamwork among them. The social life and environment in any health facility has an important role to play in the workers' performance and productivity. When the employees physically and emotionally have the desire to work, then their performance outcomes shall be increased (Boles, Pelletier, Lynch, 2004). Absenteeism can be reduced by having a proper workplace environment; which can in turn increase employee performance and productivity. Chandrasekhar stated that the connection or relationship between the work, workplace, and tools of work had become the most important aspect in their work itself (Chandrasekar, 2011). A cheerful and happy health worker will encourage and guide the patients, and make them comfortable around the facility. There is concern that focusing on the resilience of workplace to cope with adversity and precarious circumstances diverts attention from the collective responsibility of society to protect individuals (Gill & Orgad 2018).

Proposed Conceptual Framework

The proposed conceptual framework below was developed based on resilience theory. The enabler factors for tin industry resilience are adequate financial resources, adoption of digital technology, adoption of green technology and product innovation. Subsequently, the tin

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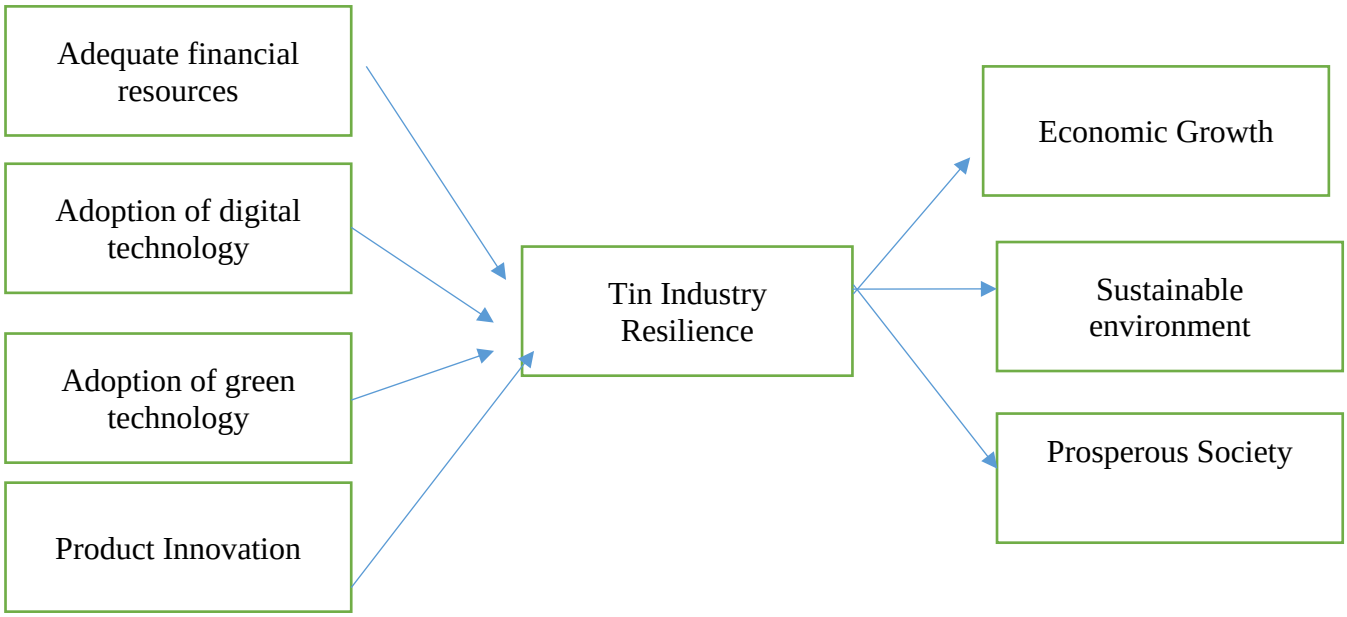
industry resilience is expected to contribute to sustainable community which is from the perspective of economic growth, sustainable environment and prosperous society.

Figure 1: Proposed Conceptual Framework



H1: Adequate financial resources will have a positive significant impact on tin industry resilience
H2: Adoption of digital technology will have a positive significant impact on tin industry resilience
H3: Green technology will have a positive significant impact on tin industry resilience
H4: Product Innovation will have a positive significant impact on tin industry resilience
H5: Tin industry resilience will have a positive impact on economic growth.
H6: Tin industry resilience will have a positive impact on sustainable environment.
H7: Tin industry resilience will have a positive impact on prosperous society.

Research Methodology

A quantitative data collection by distributing the questionnaire will be performed in order to achieve research objective 1 and 2. The target population for this study is the staffs that involve in accounting/finance, production and technology in tin industry companies in Perak and Selangor. Perak and Selangor were selected as these two states are rich which tin field. Since there is no sampling frame, a convenient sampling technique will be applied. With this regard, the respondents will be approached based on their availability and convenience to answer the questionnaire. The sample size will be based on suggestion by Hinkin (1998) whereby the appropriate sample size based on the item-response-ratio is ranged from 1:4 to 1:10. It is expected that number of items from each of the variables to be 5 items. Therefore, the total number of items will be 40. This will lead to a sample size range of 40 to 400. Another justification in determining the sample size is based on the suggestion for conduction partial least square structural model (PLS-SEM) analysis that used minimum sample size estimation method in PLS-SEM is the "10-times rule" method (Hair et al., 2011), which builds on the assumption that the sample size should be greater than 10 times the maximum number of inner or outer model links pointing at any latent variable in the model. Based on the suggestion, the number of sample size for this study will be 70. Therefore, the sample size for this study will be 70 as it will apply the PLS SEM data analysis. Taken into consideration that there might be

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invalid response, a total of 100 questionnaires will be distributed. The questionnaire will be designed based on adequate financial resources, digital technology, green technology, resilient tin industry, economic growth, sustainable environment and prosperous society. The collected data will be analysed using the Partial Least Square Structural Equation Model (PLS SEM). PLS SEM is an essential tool to assess the connections between multiple variables in the chains and analyses instantaneously in a model. Below is the expected equation model:

$$TIR = \beta + \beta FR + \beta DT + \beta GT + \beta PI + \varepsilon \quad (1)$$
$$EG = \beta + \beta TIR + \varepsilon \quad (2)$$
$$SE = \beta + \beta TIR + \varepsilon \quad (3)$$
$$PS = \beta + \beta TIR + \varepsilon \quad (4)$$

Where, β=Constant, TIR=Tin Industry Resilience, FR=Financial Resources, DT=Digital Technology, GT = Green Technology, PI = Product Innovation, EG = Economic Growth, SE = Sustainable Environment, PS = Prosperous Society, Ɛ=Error term.

A measurement model will be evaluated using indicator loading, internal consistency reliability and convergent validity. Indicator loading with value above 0.70 is generally recommended, otherwise the item will be removed from the model. Internal consistency reliability will be assessed using Composite Reliability (CR), Cronbach' alpha and rho_A. CR values between 0.70 and 0.90 are ranged as "satisfactory to good" (Hair, Risher, Sarstedt, & Ringle, 2019). Convergent validity will be assessed using Average Variance Extracted (AVE). Subsequent step is to determine the collinearity using Variance Inflation Factor (VIF). The suggested VIF is below 3 (Hair et al., 2019). Next, a Heterotrait Monotrait ratio (HTMT) will be performed to evaluate the discriminant validity. The values are below 0.85 indicates the establishment of discriminant validity. This is to ensure that the latent constructs used for measuring the causal relationship between the variables are different from each other. Finally, in depth analysis of R-square and Q-square will be performed to determine the path coefficient. These outcomes will be applied in determining whether the hypotheses will be accepted or not.

In order to achieve research objective 3, a Fuzzy Delphi Method (FDM) will be conducted. The following FDM procedures will be performed in this proposed study. The first step is extracting a resilient tin industry model based on literature reviews. The list will be categories into three stages which are anticipation, coping and adaptation. The second step is to design the questionnaire using a linguistic variable. Thereafter, the questionnaires will be sent to the experts such as green building officers, digital technology experts and experts in tin industry . The selection of experts is very crucial as their opinion will lead to the success of FDM application. In addition, it was suggested by Tsai, et., al (2020) that FDM required samples of 10 to 15 participants. In this study, it is expected to have 15 participants comprising 5 experts from academia, 5 from government and 5 experts from the industry. Next step is conducting the fuzzification where the measurement scale in the questionnaire transformed into a triangular fuzzy scale as shown in Table 1.

Table 1: Likert scale, linguistic change enables and fuzzy scale.

Likert scale	Linguistic Change	EnableFuzzy Scale
1	Least important	(0.00, 0.00, 0.25)
2	Moderately important	(0.00, 0.25, 0.50)
3	Strongly important	(0.25, 0.50, 0.75)
4	Very strongly important	(0.50, 0.75, 1.00)
5	Extremely important	(0.75, 1.00,1.00)

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In this triangular fuzzy scale, the maximum and minimum value of experts' opinions are considered as two station points while the geometric mean represents the participants' score of triangular fuzzy scale in order to achieve statistical unbiased results. It also prevents the effect of extreme values (Mahdiyar, Mohandes, Durdyev, Tabatabaee, & Ismail, 2020). The next step is to compute the aggregation of the experts' opinion and defuzzification to obtain the crisp value as the importance indicators for a tin industry resilience. The indicators will then be selected based on the threshold. The computation for the threshold is presented below:

Ei (a) = (li, mi, ui), i = 1,2,3 …. .n (1)

A(a) = (lA, mA, uA), = (min li , GMmi,, max ui) = 1,2,3,… (2)

Whereby Ei (a) = refers to the triangular fuzzy numbers from experts' opinion (i), m, n refer to minimum value of fuzzy number, geometric mean, and maximum value.

DA (a) =(lA + 4 x mA, uA)/ 6

T= Σs a = 1DA (a)/ S

where DA is the defuzzified number of aggregated experts' opinion for the resilience indicator and T is the threshold value. If DA (a). ≥ T, the indicators are selected, if Da(a) ≤, the indicators should be rejected. In order to identify and quantify the indicators, the Interpretive Structural Modeling (ISM) will be applied. The findings will enable us to develop the tin industry resilience model which is research objective 3.

Conclusion

The mining sector will face uncertainties in the future; particularly in respect of world demand and price. The setbacks faced by the tin industry call for structural adjustments and rationalisation with the objective of maintaining its cost efficiency. The mining sector has been heavily dependent on a few minerals, thereby subjecting it to very high risks in time of low demand and high price and depleting reserves. But with adequate financial resources, adoption of digital technology, green technology and product innovation will eventually have a positive impact on the tin industry resilience. Efforts will be actively pursuit by the government to reduce these risks and diversify the sector away from the traditional minerals.

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