Research Article

Construction of Mathematical Start-Up Business Index Formulation for Swiftlet Ranching Industry in Malaysia

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Abstract: An important agricultural product exported by Malaysia is swiftlet nests. Due to its high demand, many entrepreneurs venture into this industry. Hence, the bioactive ingredients and dietary values are significant in supporting the manufacture of medicines in edible bird's nest (EBN). However, there are a lot of entrepreneurs who were unable to fulfil the request for EBN production and failed in this industry. To prevent failure in the birds' nest swiftlet ranching industry, a mathematical modelling formulation should be developed. Thus, the purpose of the research is to construct a general formulation of the start-up business index equation for the swiftlet ranching industry in Malaysia. Experts interviewed found that there were eight factors in starting a business that mattered. Based on the findings, the weightage of the start-up business factors has been used in constructing the general formulation of the start-up business index function of the swiftlet ranching industry in Malaysia. Hence, we will develop the system of start-up business factors in the swiftlet bird nest ranching industry using the general formulation of the start-up business index equation.

Keywords: general formulation, start-up business index equation, swiftlet ranching industry, health food product

1. Introduction

Nowadays, a wide range of edible bird nest (EBN)-based products are used in health and cosmetic including drink and food products, supplements, and food additives [1], which encourages the development of the edible-nest swiftlet industry [2-3]. As a result, EBN becomes increasingly familiar in the pharmaceutical industry and becomes one of the fastest-growing businesses since the pharmaceutical industry makes higher profits with wider margins than other industries. The margins on these products are much higher than what research and development would cost [4]. Additionally, the bird's nest industry attracts investors due to its high market value and low maintenance costs. This exotic product is known as the "Caviar of the East" and is one of the most expensive animal products. A kilogramme of EBN can range in value from $ 1,000.00 to $ 10,000.00, depending on the grade, shape, type, and origin [5]. Dai et al. [6] also contended that the price of EBN is affected by its form, feather quality, size, and other factors. Therefore, the

researcher stated that the most important part is the process after harvesting EBN, which determines the cleanliness of EBN. This is a crucial part because it determines the price of EBN [2, 6].

Thus, bird nest harvesting is seen as a prosperous industry in many Southeast Asian nations. As Asia has become fascinated with the value of EBN, the industry has exploded. After Indonesia and Thailand, Malaysia has become the third country to export EBN [2]. As a result, EBN-based products are becoming more demanding in the Asian market, and many entrepreneurs are participating in this industry. Despite huge demand for EBN and government support, 70% of Malaysian swiftlet houses fail to generate EBN properly, even though the number of swiftlet homes is increasing annually [7]. Many of them were failures due to several challenges that the industry faced during the decades, including verifying EBN authenticity, ensuring quality, and preventing swiftlet populations from declining. In addition, the biggest issue in this industry is that 80% of entrepreneurs involved in it fail because they do not know the cost of starting a business.

Therefore, it is crucial for start-ups in the EBN swiftlet ranching industry to determine and measure their level of readiness before entering this industry. Besides, it is important for start-ups in this industry to determine their chance of success to reduce the probability of failure. Today, index numbers are prevalent in a wide range of industries. Indices measure changes in variables or groups of variables. For example, the government uses index numbers to formulate price policies and measure money's purchasing power. Furthermore, indices also serve as forecasts for business and economic activity. Thus, this study aims to develop a mathematical formulation to measure their level of success in EBN start-up businesses using a composite index formulation. This index is very helpful for new entrepreneurs in the EBN swiftlet industry since swiftlet farming is a high-risk business [3].

2. Literature review

Mathematical modelling is the practise of using mathematics to solve real-world problems. Mathematics can describe real-world situations. However, the solution must be in such a way that it helps with the given problem. In modelling, there are factors other than mathematics to consider when it comes to problem-solving [8]. In this study, the application of index numbers will be used as a basic formulation to develop an effective formulation index for measuring the success of start-up EBN businesses. Furthermore, it is necessary to address the factors contributing to failure in the EBN swiftlet ranching industry.

2.1 *Application of index number*

The function of an index will determine which new method is used to assess an entrepreneur's potential to create a firm based on their knowledge, connectedness, network, sustainability, digital competence, agility, and innovativeness. Index statistics' main purpose is to make potentially difficult calculations simpler. Numerous output variables could be easily examined using this index. Economic experts frequently utilise the index approach to determine things like pricing, output, incomes, labour force participation, and more [9]. An essential economic indicator is, for instance, the consumer price index.

When used in finance, it typically alludes to a statistical measurement of movement in a securities market. Financial market stock and bond market indices are constructed from a fake portfolio of securities that represent a certain market or segment of it. Two such applications for an index number are the Jakarta Islamic Index (JII) and the Jakarta Composite Index (JCI). Robiyanto [10] asserts that JII was created with the intention of advising investors who sought to invest in stocks traded on the Indonesian Exchange by putting a strong emphasis on Sharia rules. JCI, on the other hand, is an indication of stock price movement that is listed on the Indonesia Stock Exchange [10]. Standard benchmarks for the U.S. stock and bond markets are the S&P 500 Index and the Bloomberg US Aggregate Bond Index, respectively.

In addition, the index is evaluated for business development. Customer satisfaction, the Halal Sensitivity Index, and the International Index of Environmental Sustainable Development are a few examples of indexes [9]. For instance, Customer Satisfaction Index (CSI) has numerous versions of systems or models depending on each country because it has progressively come to be accepted by governments and businesses all over the world as a reliable tool to assess the output quality of a country or business [11]. The German Barometer, the Swiss Index of Customer Satisfaction (SWICS),

the Norwegian Customer Satisfaction Barometer (NCSB), the Swedish Customer Satisfaction Barometer (SCSB), the American Customer Satisfaction Index (ACSI), the Malaysian Customer Satisfaction Index (MCSI), and the Korean Customer Satisfaction Index (KCSI) are a few examples of CSIs that are conducted at the national level. The index can be used in a variety of ways because its use is versatile.

2.2 *Factors of failure in EBN swiftlet ranching industry*

In the EBN swiftlet ranching sector, a variety of circumstances might lead to business failure. One of the key reasons many of them fail in this industry is a lack of expertise and direction. Most likely, they entrust the design and maintenance of their buildings to their consultants or contractors [12]. As a result, consultants who have previously managed swiftlets can easily dupe them. They may not have the knowledge or interest to participate in this industry; in some circumstances, they just have money to invest in it. They completely trust the consultant with their business, abstaining from involvement.

Swiftlet reproduction in the wild presents a difficult challenge. The birds need extra care when creating a larger nest and growing more quickly because they are so extremely sensitive to humans [13]. Due to the difficulty of swiftlet breeding, business owners in this sector should pay attention to EBN farming instruments. In Sarawak, Malaysia, more than 1,500 swiftlet farms have been constructed, although they need ongoing supervision. As a result, equipment like audio systems, humidifiers, clocks, thermometers, and humidity testers is essential to their existence. Wireless sensor networks can also be used to monitor and manage EBN swiftlets [14].

The subject of noise pollution is also brought up in this EBN swiftlet. Numerous problems, including communities erected in residential areas and the usual city bustle, make it difficult for swiftlets to cultivate [15]. Due to this problem with birds trying to disrupt their daily routines through their looks and sounds, several locals have complained. They note that a lot of swiftlet breeders let tweeters run around without the neighbourhood's permission [16], which draws swiftlets. These issues could have an effect on the owner of a company in this industry.

The government started developing appropriate legislative norms and regulations to inform and develop Malaysia's swiftlet sector once it became more aware of the drawbacks and negative effects of swiftlet farming on society and the environment. Furthermore, the major worry in the EBN swiftlet ranching industry is that about 80% of business owners fail because they are unaware of the start-up costs. Rahman et al. [17] contend that entrepreneurship and business owners are inextricably tied to the start-up concept. In addition, it involves putting new firm structure combinations in place, including new services, goods, suppliers of raw materials, production processes, markets, and management techniques.

3. Methodology

This study used the qualitative method by interviewing experts in the EBN ranching industry. As Rabiee [18] said, the number of people participating should be between six and eight to obtain a range of viewpoints. However, the optimal number of participants for an interview session should be between eight to indicate a broader potential for discussing such topics. Thus, this study interviewed eight participants, which are six entrepreneurs in the EBN industry, a veterinarian, and an academician. By observing the responses of participants during interview sessions, the researcher identified the factors that contribute to a successful start-up business in EBN. It would have been different if we had conducted the observation in the laboratory [19].

The data from the interview will be used to construct mathematical modelling formulations for components in the start-up business index. After obtaining the elements of starting a business through expert interviews, each factor is given a weighting based on the interview. In mathematics, these weights are crucial for calculating the composite index. Each component in the development of the start-up business index had to be built into the questionnaire items. The basic formulation of index number and composite index used in this study is shown in the equation below:

Index number,

$$I = \frac{Q_1}{Q_0} \times 100, \text{ where}$$

$Q_0 = $ Quantity at base time

$Q_1 = $ Quantity at given time

Composite index,

$$I^- = \sum (I_i W_i) / \sum W_n, \text{ where}$$

$i = 1, 2, 3, 4, 5, \ldots, 8$ and $n = 1, 2, 3, 4, 5, \ldots, 8$

$I = $ Index number

$W = $ Weightage

Each component in the development of the start-up business index had to be built into the questionnaire items. The items have a 1-10 response scale (Likert scale). The amount of success in starting a business for the swiftlet ranching industry is calculated using an index that gives high marks. Finally, a high index score indicates a greater willingness to participate in the swiftlet ranching industry.

4. Findings and discussion

The development of a general formulation for the start-up business index function of the swiftlet ranching industry in Malaysia has two portions, according to the findings and discussion. Section 4.1 is to find the weightage of the start-up business factors, and the results in Table 1. Table 2 is the questionnaires of start-up business factors for independent variables with weightage and formulation.

4.1 *Weightage of factors influencing start-up businesses in the EBN ranching industry*

By using the qualitative method, the interview of the eight experts in the EBN ranching industry is shown in Table 1. The experts are six entrepreneurs, one from a vet and one from an academician in the EBN ranching industry.

Table 1. Percentage and weightage of factors affecting start-up businesses in the EBN ranching industry

Number	Factors	Number of the participants	Percentage	Weightage	New weightage after less than 50%
1.	Knowledge of management	7	87.5%	9	8
2.	Capital	7	87.5%	8	7
3.	Strategy location of edible bird house	6	75%	7	6
4.	Threats of swiftlet	6	75%	6	5
5.	The role of building design and maintenance	6	75%	5	4
6.	Government support	5	62.5%	4	3
7.	Strategic marketing	5	62.5%	3	2
8.	Skilled employees	7	87.5%	2	1
9.	Innovation	2	25%	Less than 50% = remove from the factors of start-up business	Nil

Table 1 shows that seven participants rated management knowledge as the most significant factor for starting a

business in the EBN ranching industry, followed by capital. Then, the third rank is the strategic location of an edible bird house, with six participants agreeing on that. The following business factor is the threat of swiftlet, which six participants selected as the fourth factor in business start-ups. Six participants picked the role of building design and maintenance as the fifth essential start-up business factor. Government support is followed by the selection of five participants, followed by strategic marketing. Seven participants agreed that the eighth-ranked business start-up has a skilled employee. The final factor in business start-up is innovation, which two participants chose.

Thus, it is discovered that nine factors are involved in business start-ups in the tasty bird nest ranching industry. However, the innovation component was excluded in this study because only two individuals chose it, indicating that the number was less than 50%. The innovation factor does not affect their ability to produce more bird nests [20]. By constructing a questionnaire of independent variables, section two uses the quantitative method. The constructs of start-up business factors are independent variables. The questionnaire had been pre-tested by experts in methodology and members of the swiftlet ranching industry. The questionnaire uses a Likert Scale with a scale of 1 (strongly disagreed) to 10 (strongly agreed).

4.2 *Questionnaires of start-up business factors for independent variables with weightage and formulation*

In Table 2, we show questionnaires of start-up business factors with weightages from Table 1, and the result is the Likert scale index number with respect to capital, knowledge of management, strategy location of an edible bird house, threats of swiftlets, the role of building design and maintenance, marketing strategy, government support, and skilled employees, respectively.

Table 2. Questionnaires of start-up business factors for independent variables with weightage and formulation

Factors	Statements	Source	Weightage	Formulation
Knowledge management	Knowledge is an everyday business process within the company.	[21]	8	$\sum_{i=1}^{6} ai$
	The use of knowledge increases the effectiveness of decision-making processes.	[21]		
	Knowledge has become the main element that is important for the development, operation and improvement of overall companies' performance.	[21]		
	Knowledge is one of value to the organisation tend to be embodied in individuals difficult to substitute.	[22]		
	Knowledge management has important implications for innovation.	[22]		
	Knowledge becomes an important factor of production, besides resources of capital, workforce, land, and nature.	[22]		
Capital	One of the intangible assets a firm can use to boost its competitiveness and business performance is capital.	[23]	7	$\sum_{i=1}^{5} bi$
	The competitive advantage of small and medium-sized businesses was positively influenced by capitals.	[23]		
	High levels of innovation and creativity are made possible by capital.	[23]		
	Capital has been admitted a fundamental resource that requires development of an organization.	[24]		
	Capital is an important contribution of small and medium-sized enterprises (SMEs) to the growth of the nation's resources.	[24]		

Table 2. *Continued*

Strategy location of edible bird house	I believe it is very important for swiftlets house built in areas with attractive plant resources insects or swiftlets food.	[25]	6	$\sum\limits_{i=1}^{5} ci$
	I trust the saturated location becomes the focus and is the place collection of major swiftlet farming.	[25]		
	I am confident that weather is a fundamental factor that allows the swiftlets to be built and earn a return decent result.	[25]		
	Good location plays an important role in determining the success of EBN production.	[25]		
	The swiftlet farming must be in a location that has abundant food sources as well as meeting the habitat characteristics required by swiftlets.	[25]		
Threats of swiftlets	Entrepreneurs must face the challenge of providing habitats that are appropriate for swiftlets' temperature.	[25]	5	$\sum\limits_{i=1}^{5} di$
	The EBNs will deteriorate and become contaminated if they are not kept clean enough or in sanitary settings.	[25]		
	It is important to pay attention to farming's adversaries, including owls, bats, snakes, and structure upkeep.	[25]		
	There are threats from technical issues like water pipe leaks and building leaks, which are also issues because they relate to the upkeep of EBN farming.	[25]		
	It is important to be vigilant and monitor EBN to notice any unusual changes that occur.	[25]		
The role of building design and maintenance	I know about manual monitoring and controlling of equipment in the farms will frighten the swiftlets away.	[26]	4	$\sum\limits_{i=1}^{5} ei$
	I am confident that using wireless sensor networks to monitor swiftlet farms will have significant potential advantages for both the scientific community and society at large.	[26]		
	I know that wireless transmission and data placed on various greenhouses can transmit temperature and values humidity in the greenhouse to the central node easily.	[26]		
	I am aware of the significance of the email block design (e-notification) that was created to alert the system owner via email services of any modifications to the system.	[27]		
	I am aware that the swiftlet's sensitivity and the remote location of the site necessitate the capability of monitoring and managing sensor networks remotely via internet connectivity.	[26]		
Government support	Companies' capital bases can be strengthened by the government offering incentives such favourable tariff and tax discounts.	[28]	3	$\sum\limits_{i=1}^{5} fi$
	Programmes development by government-developed programmes are a key mechanism needed to vigorously support the growth of SMEs.	[28]		
	Funding through schemes and programmes established directly by the government are intended fundamentally to enhance and foster the growth of small business.	[28]		
	The government's national programmes improve small businesses' access to domestic and foreign markets as well as domestic and foreign consumers of their products.	[28]		
	Government financial support may be able to increase cash flows, which would immediately ease any financial limitations.	[28]		
Marketing strategy	An organization must attempt to maintain its competitive advantage for long enough and prevent it from imitation, duplication or elimination by competitors.	[29]	2	$\sum\limits_{i=1}^{4} gi$
	An organization must identify how to provide customer's desired values (products), attract and satisfy them through marketing intelligence.	[29]		

Table 2. *Continued*

	An organization must be able to encourage satisfied customers to return through marketing relationship.	[29]		
	In order to gain benefits from long-term loyalty and satisfaction of customers, company should focus on establishing and maintaining a long-term relationship with their customers.	[29]		
Skilled employees	The company that has skilled workers are capable of increasing diversity skills that are newly learned in the workplace.	[30]	1	$\sum_{i=1}^{4} hi$
	The need for skilled and talented workers seen as important because most industries have shifted to operations an environment that requires knowledge to work.	[31]		
	A firm can achieve a competitive advantage when they have employees that are valuable and well organized.	[32]		
	Business performance achievement is strictly related to the quality of employees.	[32]		

4.3 *General mathematics function of start-up business index for EBN swiftlet ranching industry*

The basic mathematics formulation of index number and composite index are used to construct the general mathematics function of start-up business index for the EBN swiftlet ranching industry.

Assuming that, $\sum W_i = W_i$ [33] the composite index of the general function of start-up business index for the EBN swiftlet ranching industry is as follows:

$$
\begin{aligned}
I^- &= \sum (I_i W_i) / \sum W_n \\
&= [W_1 \sum (\text{Knowledge of management})i + W_2 \sum (\text{Capital})i + W_3 \sum (\text{strategy location of edible} \\
&\quad \text{bird house})i + W_4 \sum (\text{Threats of swiftlets})i + W_5 \sum (\text{The role of building design and maintenance}) \\
&\quad i + W_6 \sum (\text{Government support})i + W_7 \sum (\text{Marketing strategy})i + W_8 \sum (\text{Skilled employees})i] \\
&\quad [W_1 + W_2 + W_3 + W_4 + W_5 + W_6 + W_7 + W_8] \\
&= [8 \sum_{i=1}^{6} ai + 7 \sum_{i=1}^{5} bi + 6 \sum_{i=1}^{5} ci + 5 \sum_{i=1}^{5} di + 4 \sum_{i=1}^{5} ei + 3 \sum_{i=1}^{5} fi + 2 \sum_{i=1}^{4} gi + 1 \sum_{i=1}^{4} hi] / \\
&\quad [8 + 7 + 6 + 5 + 4 + 3 + 2 + 1] \\
&= [8 \sum_{i=1}^{6} ai + 7 \sum_{i=1}^{5} bi + 6 \sum_{i=1}^{5} ci + 5 \sum_{i=1}^{5} di + 4 \sum_{i=1}^{5} ei + 3 \sum_{i=1}^{5} fi + 2 \sum_{i=1}^{4} gi + 1 \sum_{i=1}^{4} hi] / \\
&\quad [36]
\end{aligned}
$$

5. Conclusion

The result in Table 1 is the weighting of each factor for start-up businesses in the EBN ranching industry. Table 2 demonstrates the development of a mathematical index of start-up business factors for the EBN swiftlet ranching industry. The entrepreneurs must insist on using ranching techniques for their EBN swiftlet farming in order to run a profitable business. By using the formulation, we will also be able to determine how far they are able to delve into the subject. For the forthcoming study, a new formulation should be developed to evaluate participants' preparedness in the bird nest swiftlet ranching industry by developing a mathematical model formulation that identifies those variables that can be used to determine the most effective ways to become a successful entrepreneur in the EBN industry.

Finally, it is suggested that Malaysians use it moving forward across the whole country. Entrepreneurs can assess their ability to remain in this sector of the economy that will contribute more to the manufacturing of swiftlets by following the formula. This study's findings, based on relevant market data, can ensure the sustainability of the EBN industry in this country. The literature review in this study proved that consumption of EBN has been shown to bring multiple health benefits, including anti-virus, antioxidant, and anti-inflammatory properties. It is also helpful in improving cardiometabolic diseases and bone degeneration. Because EBN is beneficial to health, there are numerous

EBN-related products available on the market today [34].

In consequence, future customers will be able to benefit from the nourishment produced by bird nest creation, and many will continue to live healthy lifestyles. This start-up business index will prevent many entrepreneurs in the swiftlet ranching industry from losing too much money. As a result, this finding may be useful in the pharmaceutical industry for the development of bird-nest swiftlet products. Despite the fact that the system has been constructed, risk management in risk transfer remains crucial to entrepreneurs, and they must pay attention to it [35-42]. Risk transfer is crucial in business for double-checking and balancing before you lose too much. Transferring risk is one way to cope with it, and in the future, it will be required for people who wish to start their own business.

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Conflict of interest

There is no conflict of interest for this study.

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