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Forecasting symbiosis in tourism enterprise networks: Monte Carlo simulation of risk and return

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Abstract: This study re-conceptualises the relationship between symbiosis and risk/return as an influence for economic benefit or harm for micro, small and medium enterprises in tourism. A critique of predictive literature identifies Monte Carlo simulation's capacity to use non-parametric data and input of multiple, concurrent variables as best suited to forecasting firms' performance. Statistically significant risk/return variables are established from national monitors. The secondary which is accessed from the New Zealand Business Benchmarking Survey and the Management Resource Centre is used for the simulations. Results show that businesses in different industries were affected by range of factors that resulted in variation in a particular firm's profit. Hospitality enterprises are most vulnerable, accommodation and retail firms

experience greater flux, but the retail component recovers quickly. The research contributes to symbiosis theory, predictive methodology and has implications for the economic recovery of the tourism sector.

Keywords: symbiosis; firm performance; risk and return; forecasting; micro, small and medium enterprise; MSME; tourism; hospitality.

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1 Introduction

The tourism sector is relatively easy to enter because of the small capital outlay and reasonably low skill levels required (Worklocal, 2019). At the same time, the visitor economy is subject to multiple exogenous factors beyond its control (Deloitte and Oxford Economics, 2010). Clusters of allied components of the industry, which provide the needs of residential and day tourists to sleep, eat, shop for souvenirs and access attractions and activities, tend to develop at destinations, but differentiation within the network clusters is hard to achieve (Novelli et al., 2006).

Discourse in the industry tends to stress the benefits of cooperation to differentiate destination identity and position it within a region, nation or between countries. The argument is that symbiotic relationships amongst enterprise networks should be pursued (Cheng et al., 2019) because cooperation creates positive outcomes by minimising risk and maximising return (Hållstedt, 2016). Business connection enables firms to enhance strategic performance (Downe et al., 2012). The symbiotic dynamism amongst and between allied enterprises associated with destination clusters may have positive effects. In order to reduce costs, some service entities can speed up time-to-market by making decisions based on who can deliver the required services at the right price (Urikova et al., 2013). This research into symbiosis within and beyond tourism networks is timely given the unprecedented pause in global tourism produced by COVID-19 which has thrown the challenge of survival of the tourism industry into stark relief. There is now an opportunity to reshape relationships within the industry, societies and global economies, as well as with the natural world (Lew et al., 2020; Assaf and Scuderi, 2020) and overcome the consumptive and extractive traits of tourism (Cave and Dredge, 2020).

This research hypothesises that symbiotic relationships within a sector cluster of allied enterprises will have positive effects on the profit element of return. In addition, in similar circumstances, symbiotic relationships will have a negative effect on the element of risk, particularly in terms of the cost of goods sold and corporate expenses. The rationale is that a critical mass of allied enterprises and a range of enterprise types (accommodation, hospitality and souvenir retail) provide for the fundamental day visits and overnight needs of tourists at a mature tourism destination.

The performance of these tourism businesses fluctuates because of the uncertainty of visitor numbers, seasonal effects and other indeterminate factors. In New Zealand, many businesses in tourism and hospitality tend to earn more money during the high travelling season, December to February, whereas sales are lower from June to August. Seasonal change leads to instability in business performance in terms of sales growth and net profit (Camara, 2004). The situation is similar for souvenir retail shops, which are also affected by seasonal influences as their major income depends directly on the number of visitors, indicating a direct link between the variation of seasons and the number of visitors (Butler, 1994). Because of the uncertainty, it would be helpful for businesses in tourism and hospitality to know the key factors affecting their future net profit. It is also important to discern the likely performance of each industry, so that individual firms can understand their current situation and improve their management, as well as cooperating among themselves so that they are sustained in the long-term.

The research adopts the concept of symbiosis as an analytical lens, coupled with national monitors to establish significant key variables and forecasting techniques drawn from finance methodology to create a robust predictive mechanism. This innovative

approach overcomes weaknesses in prior tourism forecasting analysis and has not been used before in network settings, nor micro, small and medium enterprise (MSME) contexts, or in the components of the tourism sector.

The article begins by literature Section 2, following by research context in Section 3. Section 4 is research methodology. After the results presented in Section 5, Section 6 provides the discussion. The last section is conclusions and contribution.

2 Literature

2.1 Symbiotic relationships in business clusters

The majority of cluster research is directed toward large operations and the manufacturing sector (Yamawaki, 2002), and examines the dynamics of inter-business relationships (Ekanayake, 2017) and the development of new communities, new jobs created and changes to profit margins after the establishment of network clusters. In contrast, this study focuses on interdependencies, the extent and nature of active linkages between small and medium enterprises as tourism sector components, as well as an assessment of ongoing risk and return.

Symbiotic inter-business relationships are "an alliance of resources or programs between two or more independent organizations designed to increase the market potential of each" (Adler, 1966). Cooperation with other companies is increasingly popular to achieve mutually beneficial scenarios for marketing (Dickinson, 2012), linkages between small and large firms (Etemad et al., 2001) and consumption relationships (Pritchard and Funk, 2006). Symbiosis is a key concept within the circular economy wherein value is created by upcycling to another and regenerative tourism (Pollock, 2019). However, its supply chain relies upon political and local community support to bridge technical and socio-cultural needs (Mulrow et al., 2017). Further, in the MSME context resources constraints such as time, staff or capital are important limitations that affect the ability to achieve symbiotic inter-business relationships (Franco and Haase, 2015).

Wright and Dana (2003) suggest that business owners interconnect with other business entities to receive additional, reciprocal benefits derived from inter-transactions and co-activity. For instance, personal social networks and firm performance are positively related amongst entrepreneurs in various industries, including the hotel/hospitality sector (Sparrowe et al., 2001) and supply chains (Ekanayake, 2017). Corporate integration offers the opportunity for entrepreneurs to join activities, share corporate costs, and pool risk, which is reduced through diversification (Banwo et al., 2015). Many companies can save on training and advertising costs with other firms in a symbiotic network (Barnir and Smith, 2012).

However, while cooperation is essential for growth, business model innovation is also an essential strategy for symbiosis since integration of value co-creation and 'co-innovation' within a community of internal and external partners, such as suppliers, competitors and customers can enhance continuous innovation and functional connectivity in firm infrastructures. However, innovation may also create competition within the partner network despite the potential advantage of sharing risk (Brustbauer, 2014). Conceptual parallels can be drawn with the biological notion of endosymbiosis (range of relationship descriptors) as endogenous sub-systems within broader socio-economic forces (Robinson et al., 2019).

It would be helpful however for seasonally affected industries such as tourism to anticipate key factors that affect their future net profit and predict likely performance so that individual firms can understand their current situation, potentially improve their management and perhaps cooperate to remain viable in the long-term.

2.2 The effects of symbiosis on firm performance

Symbiotic relationships have an effect on the components of corporate return, such as the growth of business, the number of tourist visitors, profitability (Brighi and Venturelli, 2016), exit probability via initial public offerings and internal rate of return (IRR) (Xue et al., 2019), sales and market share (Larkin, 2020). Further, symbiotic relationships affect utility sharing (Chertow, 2007), strategic and idea sharing (Googins and Rochlin, 2000), loan terms (Bharath et al., 2011) and new marketing distribution (Sanchez et al., 2007). According to Kijkasiwat et al. (2021), the concept of symbiosis can enhance firm performance in a small town in New Zealand namely Cambridge. In tourism and hospitality industry, signals from elite sport clusters in terms of sport matches, sport halls and facilities or sport training lessons can inform local MSMEs that corporate income can be increased from incoming visitors who visit Cambridge. Therefore, enterprises can get ready for these opportunities. MSME owners awareness of the market potential of events may be a dynamic factor for increasing their enterprises' performances. In order to promote travelling industry, sport competitions can be set. Visitors from other areas visits Cambridge to watch sport matches, as a result, MSMEs in this town have opportunity to get the benefits from these external factors. I-site, for example may act as a hub to inform visitors when they enter Cambridge. Special places, activities, shops, restaurants or hotels can be informed by people or organisation which acts as the centre. Some particular enterprises can also inform visitors when information is needed. For instance, it will be better for travellers visiting Cambridge to watch sports to receive some recommendations from hotel managers about fabulous places for dining. Then, other business can also receive opportunities to get higher income.

Moreover, symbiosis has consequences for the element of risk in terms of the cost of goods sold, advertising costs, transaction costs, resource access (Glauner, 2018), credit rating (Klusak et al., 2020), corporate financial constraints (Meng et al., 2020), as well as cost of negotiations (Camarinha-Matos and Afsarmanesh, 2006). Individual retail companies operating in the same geographical area may be able to use the power of negotiation to ask their wholesale suppliers for reduced delivery costs. Symbiosis can also occurs where there is a positive correlation between industry component relationships, geographical proximity and cost reduction (Chertow, 2000). Better performing business owners can then negotiate from a position of strength to reduce costs and expenses.

Numerous methods are used to forecast the potential performance of firms and economies. For example, Priya et al. (2021) adopt interpretive structure modelling (ISM) to investigate factors affecting the global economy. However, this technique does not enumerate the impact of each variable. Other prior studies have adopted sensitivity analysis to evaluate the potential gains for businesses from interfirm relations and networking. Longinidis and Georgiadis (2011) found that this analysis enables supply chain managers to determine how financial performance changes when fluctuating economic activities are generated by networking between supply chain managers and

their suppliers. Lockamy and McCormack (2010) used sensitivity analysis to examine risk possibilities and potential revenue gained from networking between business owners and suppliers. They explained that a firm's revenue can be affected when its interactivities depend highly on supply partners who have high risk-taking attitudes. Singh and Mitchell (2005) applied sensitivity analysis to investigate how collaboration between several firms enhances corporate sales growth. Their study notes that as a result of increased sales, corporations with incumbent partners enable newcomers to interact with a wider circle of associates.

Uncertainty analysis models the ways that dependent variables might be changed by independent variables in an output model, under certain sets of assumptions (Saltelli et al., 2008). Forecasting techniques can be econometric, time series and artificial intelligence (AI) models, and the analysis of neural networks (Jiao and Chen, 2019; Pérez-Campdesuñer et al., 2018). Sensitivity analysis and scenario analyses are generally used to examine the effect of uncertain factors. However, these methods create some difficulties in calculating the probability of outputs when all inputs are varied at the same time. Indeed, neither sensitivity nor scenario analysis can determine the likelihood of output values which fall between the extreme points (Brealey et al., 2011). Further, although these and discount cash flow could be used to evaluate outcomes relating to cash flow and profitability of firms, they produce only single-point estimate results and could give inaccurate outcomes, particularly in high uncertainty contexts and when using historical data to predict future corporate income. To overcome such shortcomings, Hu and Song (2020) and Pérez-Rodríguez and Santana-Gallego (2020) uses several variables and multiple models to improve the performance of forecasting in the tourism sector, extending fundamental work on computable general equilibrium (CGE) models (Dwyer et al., 2007) and its relevance to destination managers (Dwyer et al., 2003).

The Monte Carlo simulation approach is widely applied in finance (Jackson et al., 2001) as a robust technique to use for estimating income, cost, risk and uncertainty caused by varying inputs in different scenarios. For example, the approach can be used to assist business owners to reduce the variability in potential outcomes from project investment and make decisions about projects during times of uncertainty in costs and income (Forlani et al., 2002). The Monte Carlo approach is methodologically superior to other forecasting techniques since it is capable of calculating the probability of modelled outputs by simultaneously changing all uncertainty factors (Mun, 2006). Further, it can use non-parametric data, which offers the opportunity to better understand possible outcomes or default probabilities impacted by each input A systematic review of literature found little use of Monte Carlo simulation in components of the tourism industry expect for hospitality (Feinstein and Parks, 2002), hotel revenue management (Petříček and Sochůrková, 2015) and prediction of hotel occupancy (Zakhary et al., 2011) and reservations (Halkos and Tsilika, 2015). However, the process has been used to measure carrying capacity of coastal parks (Zhu et al., 2019) and the spatial effects of leisure (Nicholls and Kim, 2019).

From the literature, it is assumed that symbiotic relationships among businesses, particularly those in three industries (coffee lounges, backpackers and hostels, and gift, specialty and novelty shops) can enhance business performance. These assumptions can be stated as:

A1 A symbiotic relationship has a positive effect on the element of return.

A2 A symbiotic relationship has a negative effect on the element of risk, particularly in terms of the cost of goods sold and corporate expenses.

3 Research context

New Zealand is a useful context to explore these issues because of its bounded island environment, business profile of 97% MSMEs, relative isolation from other economies and strong border controls. The tourism sector has overtaken the agricultural sector's importance to the country's economy and social wellbeing. Prior to COVID-19 restrictions on intraregional travel, the tourism sector's direct contribution to national GDP was 5.8%, employing 8.4% of workers (MBIE, 2020).

Tourism sector enterprises tend to earn more money during seasonal travelling seasons increasing the turnover of New Zealand regional retailers (Dudding and Ryan, 2000), but results in to instability in sales growth and differential net profit for souvenir retail, accommodation and food (Héroux and Church, 2014). For instance, from 2009 to 2016, regional visitors spent an increase of 73% in the accommodation component but only 3.04% in food and beverage (MBIE, 2016). However growth in the number of cafes and restaurants contributed 1.7% to GDP (Whitefor et al., 2014).

Tourism enterprise performance fluctuates because of uncertainty of visitor numbers and seasonal effects. For instance, numbers increased by 10% in 2016 and 2017, but in 2018/2019 dropped less than 4%. In the six months to June 2019, 3.88 million visitors had travelled to New Zealand, representing a 2.7% increase from 2018 (Statistics New Zealand, 2019). The accommodation component of the sector had enjoyed an upward trend in guest night bookings since 2014, increasing 3% in 2015, and 12% in 2016 (MBIE, 2016). However, at the time of writing, COVID-19 has caused the global tourism industry to collapse. As in other countries, in New Zealand, a push for domestic tourism to replace international arrivals, albeit with positive, but short-term effects, only highlighted the precarious situation.

New Zealand's largely rural lifestyle and dispersed urban centres offers many potential case examples of regional relationships. One such centre is Cambridge, a rural town in which interfirm and entrepreneurial relations are inextricably interlinked with business to bank relationships (Jack and Anderson, 2002) and coordinating associations at the destination. The i-SiTE destination marketing organisation (DMO) and hotel groups work with the Chamber of Commerce to offer business information, training programmes, workshops and forecasting activities through newsletters, monthly meetings, personal email and other channels. The Chamber of Commerce supports enterprise members with proactive goals and action plans, working with tourism entities such as other trade associations, and clubs and societies provide formal opportunities for business owners to add to their corporate value (Carroll and Teo, 1996) and communicate and share ideas that may contribute to symbiotic relationships.

One could argue that the case of New Zealand is not generalisable. However, the country's economic dependence on tourism in a rural economic base mirrors the vulnerabilities of numerous small nations (Ireland, Wales, Pacific Islands) and rural hinterlands of larger nations (Batista e Silva et al., 2018). Further, the issue of whether networks help or hinder each other is pivotal to industry viability. This case explores an

issue important to all economies, large and small and has importance to community resilience and recovery after economic downturn.

4 Methodology

4.1 Data

When using the Monte Carlo simulation, the range of parameters and probability distributions are critical elements for accurate results (Zakhary et al., 2011). Hence, the two annually generated databases, the New Zealand Business Benchmarking Survey and the Management Resource Centre (MRC) at the University of Waikato from 2013 were used to identify the statistical significance of risk/return variables. As this year is the starting year of promoting tourism industry, New Zealand has seen an increasing number of overseas visitors for the last five years, from 2.61 million in the March 2013 year. For the five years before 2013, there were around 2.5 million visitors a year (Statistics New Zealand, 2018). The most recent MSC report is from 2017, but is no longer owned by Waikato University and inaccessible behind a paywall. These data also show average statistics for each component together with the financial data of the three best performing businesses as individual samples of businesses from each component, divided by the Business Industrial Code, ANZSIC.

4.2 Analysis technique: Monte Carlo simulation

With the Monte Carlo method, the range of parameters and probability distributions are critical elements for obtaining accurate results (French and Gabrielli, 2004; Kwak and Ingall, 2007; Zakhary et al., 2011). After reviewing previous studies and other literature, the input variables were specified. It was found that the concept of symbiosis has some impacts on these determinants. The input parameters for running a Monte Carlo simulation were specified and selected from the financial income statement.

It is presumed that the fluctuating net profit of a business is caused by 11 uncertain factors and these were used as the input variables: income, cost of goods sold, wages, employee and labour expenses, administration expenses, advertising and promotion expenses, interest expenses, occupancy expenses, plant and equipment expenses, phone, fax and communication expenses, vehicle expenses, and other expenses. The output variable is the net profit of each industry.

This study specifies the range of parameters by calculating the differences in financial statistics between the 50th and the 75th percentiles. Then, the study addresses the assumption that a symbiotic relationship among businesses leads to an increase in firm income as well as a decrease in expenses and the cost of goods sold. It is presumed that a symbiotic relationship among businesses offers the opportunity for them to increase their income from 0% to the maximum percentage for each variable in the three industries. These maximum numbers represent the difference between the 50th and 75th percentiles. Conversely, a symbiotic relationship among MSMEs can reduce expenses and the cost of goods sold from 0% to the minimum percentage. These minimum numbers also represent the difference between the 50th and the 75th percentiles. The maximum parameters for each variable were calculated by using the upper limit of those differences: the minimum parameters by using the lower limit of each variable.

Input variables and the range of parameters for scenario modelling, as specified within this research context appear in Tables 1, 2 and 3.

Table 1 Input variables and the range of parameters of coffee lounges

Input variables	*Range of parameters*	*MRC data*	*Min.*	*Max.*	*Mean*
Income	0%–16%	375,034.00	375,034.00	435,039.44	405,036.72
Cost of goods sold	0%–23%	163,664.84	126,021.92	163,664.84	144,843.38
Wage expenses	0%–33%	98,408.92	65,933.98	98,408.92	82,171.45
Administration expenses	0%–27%	7,688.20	5,612.38	7,688.20	6,650.29
Advertising expenses	0%–59%	1,537.64	630.43	1,537.64	1,084.04
Interest expenses	0%–80%	30,002.72	6,000.54	30,002.72	18,001.63
Occupancy expenses	0%–14%	39,753.60	34,188.10	39,753.60	36,970.85
Plant and equipment expenses	0%–20%	10,125.92	8,100.73	10,125.92	9,113.33
Phone and fax expenses	0%–26%	2,175.20	1,609.65	2,175.20	1,892.42
Vehicle	0%–59%	2,475.22	1,014.84	2,475.22	1,745.03
Other expenses	0%–51%	5,588.01	2,738.12	5,588.01	4,163.06

Table 2 Input variables and the range of parameters for backpackers and hostels

Input variables	*Range of parameters*	*MRC data*	*Min.*	*Max.*	*Mean*
Income	0%–123%	189,561.00	189,561.00	422,721.03	306,141.02
Cost of goods sold	0%–80%	13,269.27	2,653.85	13,269.27	7,961.56
Wage expenses	0%–66%	45,361.95	15,423.06	45,361.95	30,392.50
Administration expenses	0%–62%	10,084.65	3,832.17	10,084.65	6,958.41
Advertising expenses	0%–25%	2,653.85	1,990.39	2,653.85	2,322.12
Interest expenses	0%–100%	2,274.73	0	2,274.73	1,137.37
Occupancy expenses	0%–61%	75,559.01	29,468.02	75,559.01	52,513.52
Plant and equipment expenses	0%–23%	6,672.55	5,137.86	6,672.55	5,905.20
Phone and fax expenses	0%–32%	3,563.75	2,423.35	3,563.75	2,993.55
Vehicle expenses	0%–28%	5,743.70	4,135.46	5,743.70	4,939.58
Other expenses	0%–71%	6,956.89	2,017.50	6,956.89	4,487.19

The probability distributions used for running the simulation were selected using the data-driven approach. Historical data from 2006–2014 were used to run the goodness of fit test before providing the probability distributions for running a Monte Carlo simulation.

After specifying all probability distributions, input parameters, and adding correlation coefficients, the simulation was run with 5,000 iterations to generate the probability of net profit. The results were shown in the percentile range. The integer number with upper and lower bounds of net profit varied, depending on each input factor.

Table 3 Input variables and the range of parameters for gift and specialty shops

Input variables	*Range of parameters*	*MRC data*	*Min.*	*Max.*	*Mean*
Income	0%–63%	416,018.00	416,018.00	678,109.34	547,063.67
Cost of goods sold	0%–14%	226,272.19	194,594.08	226,272.19	210,433.14
Wage expenses	0%–95%	48,050.08	2,402.50	48,050.08	25,226.29
Administration expenses	0%–35%	8,486.77	5,516.40	8,486.77	7,001.58
Advertising expenses	0%–90%	2,953.73	295.37	2,953.73	1,624.55
Interest expenses	0%–76%	3,952.17	948.52	3,952.17	2,450.35
Occupancy expenses	0%–24%	42,142.62	32,028.39	42,142.62	37,085.51
Plant and equipment expenses	0%–45%	3,036.93	1,670.31	3,036.93	2,353.62
Phone and fax expenses	0%–28%	2,787.32	2,006.87	2,787.32	2,397.10
Vehicle expenses	0%–91%	2,662.52	239.63	2,662.52	1,451.07
Other expenses	0%–42%	9,152.40	5,308.39	9,152.40	7,230.39

5 Results

5.1 Potential profit of MSMEs

The empirical findings show that the probability of negative net profit in the coffee lounge, backpackers and hostels, and gift and specialty industries was 0%. Table 4 presents precise results.

Table 4 Variation in net profit for three components

Industry: potential net profit	*Min.*	*Mean*	*Max.*	*5%*	*95%*
Coffee lounges	36,009.42	117,157.50	197,887.20	69,343.33	165,358.50
Backpackers and hostels	42,393.30	186,535.00	325,661.50	80,308.02	293,322.80
Gift, specialty shops	91,694.13	249,814.30	414,082.90	131,011.10	368,809.60

According to the histograms for the respective components, Figure 1 coffee lounges, Figure 2 backpackers, and Figure 3 gift shops, the potential net profit of each business differs. Coffee lounges show normal-shaped distribution, in contrast to the potential net profit in the other two components, which was similar to the uniform-shaped distribution. Some authors believe that results in the three components cannot be compared since types of tourism industry components have different natures and characteristics (Degryse et al., 2012). However, considering the shape of the histograms, it seems that businesses in the backpackers and hostels and those in the gift and specialty component are more likely to experience a fluctuating net profit than coffee lounges.

Figure 1 Potential net profit: coffee lounges (see online version for colours)

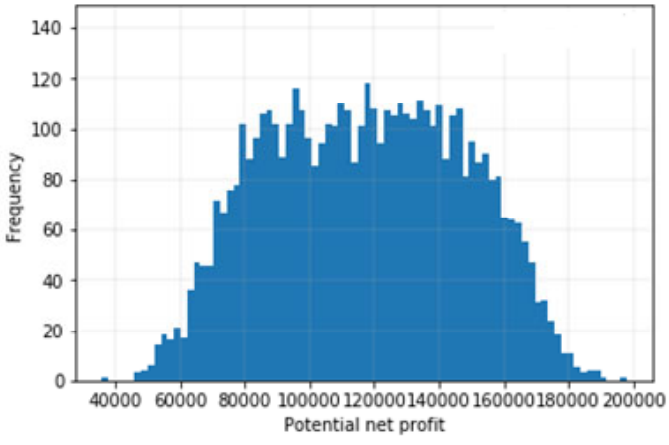
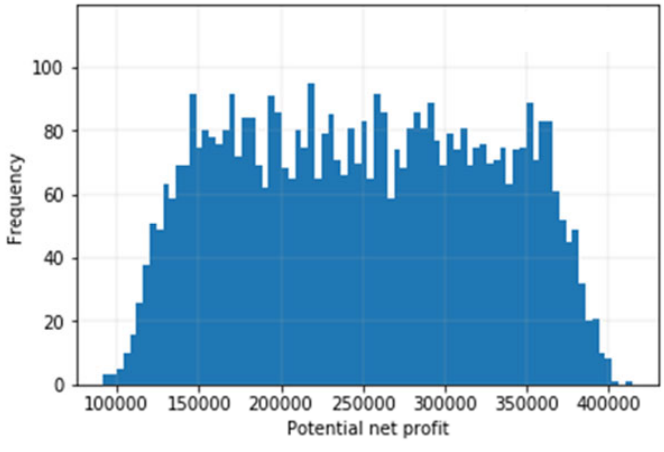


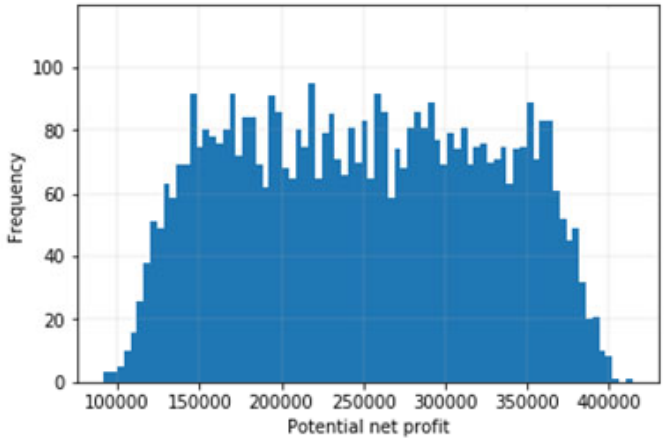
Figure 2 Potential net profit: backpackers and hostels (see online version for colours)



For modelling purposes, regarding potential gains from a symbiotic relationship, the results indicate that the flat-shaped distribution will generate more gain than the normal-shaped distribution. The shape of the histograms suggests that people are more likely to spend money at backpackers and hostels, gift and speciality shops at all ranges of product and service prices. Therefore, it can be assumed that these components are more likely to earn a wider range of net profit than coffee lounges.

From the histograms, for those at the low end of net profit, the number of businesses in the backpacker and hostels and gift and speciality components were higher than in the coffee lounges. High customer demand and flexibility in purchasing may offer an opportunity for businesses to earn income (Smaïl and Makaoui, 2020), and for those in the backpackers and hostels, and gift and specialty shops to make a profit (Swanson, 2004).

Figure 3 Potential net profit: gift and specialty shops (see online version for colours)



Seasonal demand has always been a critical issue for the tourism industry (Ateljevic, 2007), as fluctuations in purchasing power can cause variations in corporate income and net profit (Deaton, 1989). A small discount from backpackers, hostels, gift shops, or souvenir stores may motivate people to spend money on their products and services. Some may prefer economical rooms, for example rooms with shared bathrooms or rooms with six beds rather than a single bedroom. As a result, backpackers and hostels can make a profit at any range of the room rate. The figures in the histograms above give an indication of the likely performance for each component. The shape of the histogram suggests possible firm performance in the future and signals each industrial indicator.

In contrast, at the low end of net profit, only a small number of businesses are in the coffee lounge component compared to the low end of net profit for the other two components. According to the probability distribution of the coffee lounge component, a smaller number of businesses have a very low or very high net profit compared to those in the other two. As the two tails of the histogram in Figure 1 are longer than those in Figures 2 and 3, it can be concluded that businesses in the coffee lounge component tend to face greater challenges in earning high net profits.

Further, it can be assumed that if the price of coffee and other beverages sold in coffee stores increases, then customers may not be willing to purchase it. As a result, coffee lounges may earn less at a certain range of product price, a finding that is indicated by the two long-tailed histograms. A decreasing number of customers may result in decreasing net profit. However, the number of customers and corporate earnings are not the only important factors affecting firm performance. Earning more income from having more customers but seeing a decrease in net profit may not be a satisfactory result for business owners and may arise from the high cost of goods sold and excessive expenses. For owners to have a clear and specific understanding of themselves and other businesses, it is important to look at the industrial percentile. The percentile differences presented in Table 5 informs the potential position of businesses in each component.

Table 5 shows that for the overall figures for the components concerned, the differences in the low percentile range (between 1st and 5th percentiles) are higher than the differences in the high percentile range (between 95th and 99th percentiles). Moving the position of a business to the middle range for the whole component (from 25th to

50th percentile) seems to be easiest for businesses in the coffee lounge component (only 27% change) while this seems to be the most difficult for those in the backpackers and hostels component (46% change).

Table 5 A comparison of percentiles between three components

Industry	*Coffee lounges*		*Backpackers and hostels*		*Gift, specialty shops*	
Percentile	*Net profit*	*Difference*	*Net profit*	*Difference*	*Net profit*	*Difference*
1.00%	56,618.1		62,321.7		114,577.8	
2.50%	63,939.1	13%	72,170.0	16%	122,050.9	7%
5.00%	69,343.3	8%	80,308.0	11%	131,011.1	7%
10.00%	76,809.8	11%	93,719.4	17%	146,075.3	11%
20.00%	87,225.1	14%	116,479.6	24%	170,889.0	17%
25.00%	92,456.4	6%	127,788.8	10%	183,148.9	7%
50.00%	117,428.3	27%	187,024.0	46%	249,656.9	36%
75.00%	141,247.1	20%	244,398.5	31%	314,630.4	26%
80.00%	146,300.0	4%	256,400.9	5%	328,274.2	4%
90.00%	158,004.3	8%	280,420.1	9%	355,641.1	8%
95.00%	165,358.5	5%	293,322.7	5%	368,809.5	4%
97.50%	170,995.7	3%	301,309.0	3%	379,153.9	3%
99.00%	176,418.9	3%	309,365.4	3%	387,486.5	2%

The differences in the low percentile range (between 1st and 5th percentiles) of the gift and specialty component are lower compared to those in the other two components. Thus, moving a business to a higher position may be easiest for those in the gift and specialty component. It is also easier for businesses in the high percentile range (between 95th and 99th percentiles) to raise themselves to the position of the higher performing firms. This may be because the differences in the high percentile range (between 95th and 99th percentile) are the lowest among the three components.

5.2 Uncertainty factors associated with profit of MSMEs

These factors are relevant to variations in income and expenses, as a result of constantly fluctuating net profit. In the three component industries, various factors affect the elements of risk and return. Regarding the intensity of input factors, Figures 4, 5 and 6 show the key determinants that cause variation in potential net profit.

Figures 4, 5 and 6 show that uncertain income had the biggest impact on the net profit of businesses operating in the three components. For the backpackers and hostels, the second key factor causing fluctuation in business performance was occupancy expenses, followed by wage expenses. The least significant determinant causing the smallest variation in net profit was vehicle expenses.

In the coffee lounge component, the cost of goods sold, and wage expenses were also critical factors which may decrease net profit in the future, whereas plant and equipment expenses were the least important factor affecting variations in net profit. Wage expenses and the cost of goods sold were the second and third most important factors causing uncertainty, while advertising expenses were the least important in gift specialty shops. It

is essential to identify the key factors causing net profit instability, so that individual business owners can join forces with other businesses in order to survive in the long-term. It is worth paying attention to these determinants, because they can then be used as a litmus test to enhance overall corporate performance.

Figure 4 Net profit variation factors: coffee lounges (see online version for colours)

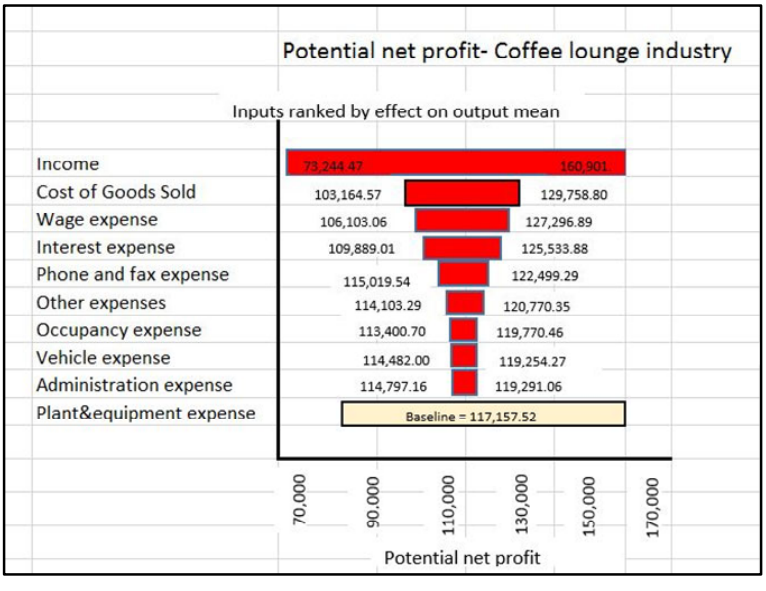


Figure 5 Net profit variation factors: backpackers and hostels (see online version for colours)

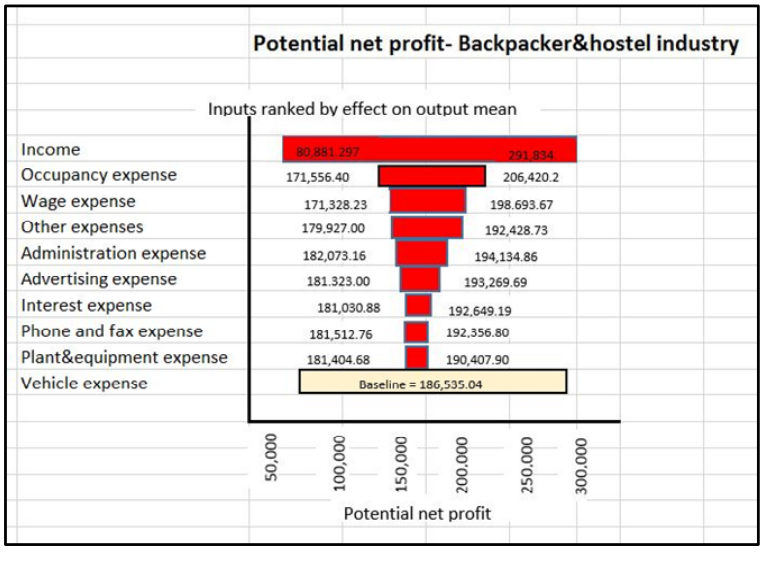
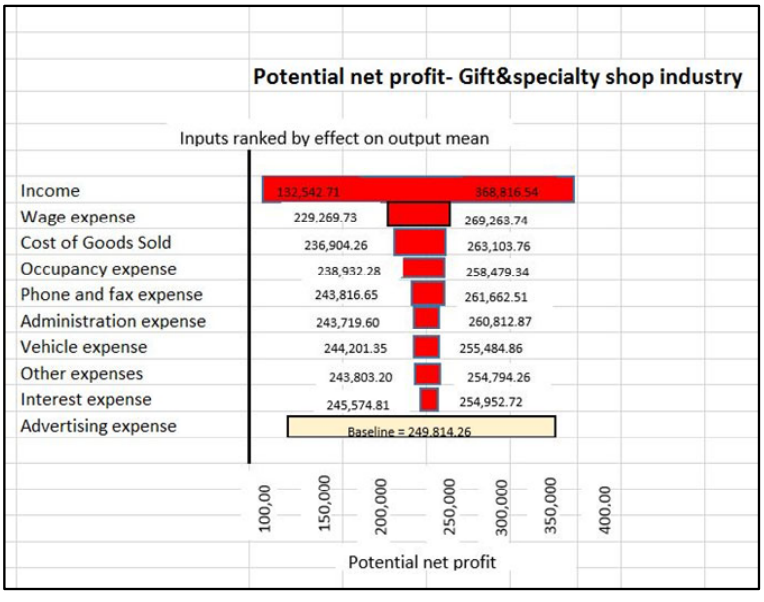


Figure 6 Net profit variation factors: gift and specialty shops (see online version for colours)



The ANOVA results (Table 6) show that only income was statistically highly significant at the 1% level. The simulation output, specifically net profit, was considered the dependent variable for the ANOVA test. Although the means of some business performance variables were not significantly different, the potential net profits simulated from the application of the Monte Carlo method varied when using different types of distribution, and the *p*-value emphasised these differences. Various types of probability distribution give statistically different values, thus carrying out fieldwork provides an opportunity to verify and simulate the various drivers of business performance (Rosselló-Nadal and He, 2020).

Table 6 The means of business performance variables calculated from different types of probability distribution

Variables		*Best fit distribution*	*Uniform distribution*	*Triangular distribution*	*F-test statistics*	*P-value*
Income	Uniform	428,812.33	405,131.82	408,976.78	1414.7925***	0.0000
COGS	Triangular	146,156.93	138,835.20	148,513.49	1.07770	0.9999
Wage	Uniform	88,431.78	90,700.24	88,527.99	4.74700	0.9999
Interest	Uniform	14,387.85	23,597.95	18,266.66	1.08580	0.9999
Phone and fax	Triangular	1,825.07	1,900.03	1,877.41	3.10350	0.9999
Other expenses	Triangular	3,639.97	5,200.84	4,251.85	0.00000	0.9999
Occupancy	Triangular	38,406.65	36,835.84	35,866.00	0.00000	0.9999
Vehicle	Uniform	1,490.17	1,976.09	1,316.33	0.22630	0.6342
Admin	Uniform	7,148.62	6,618.91	6,469.75	9.95520	0.9999
Plant and equipment	Uniform	8,984.11	8,170.64	9,580.41	0.00010	0.9998
Advertising	Uniform	1,163.08	1,104.09	1,044.36	0.00100	0.9989

6 Discussion

The Monte Carlo analysis shows that net profit changes when the parameters vary. The predictive model investigated the potential return resulting from symbiotic relationships, and at what level of symbiosis the returns start to turn down. Results show that MSMEs can diversify returns by connecting with different entities since networking promotes trading opportunities and resulting impacts depend on how well firms develop and maintain relationships over time (Eberhard and Craig, 2013). Indeed, strong cooperative relationships among MSMEs influence their capacity for international diversification (Zimmerman et al., 2009) and ability to expand market distribution, through shared resources and supportive collective activities (Jack, 2005). Further, strong relationships between MSMEs and banks can reduce a firm's credit constraints, and provide intermediation services (Mancusi et al., 2018) as credit trust worthiness reduces the cost of risk among firms (Mmadu, 2013). In fact, relationships with multiple banks can reduce liquidity risks and ensure more stable credit for MSMEs (Detragiache et al., 2000).

A symbiotic relationship has a negative effect on the element of risk, particularly in terms of the cost of goods sold and corporate expenses. This research has shown that MSMEs are the least capable of forming external networks. However, they can hedge against risks and offset the limitations of size by membership of professional association with Chambers of Commerce and DMOs, whose broad-based membership provides access to professional services, such as lawyers, financial planners, accountants, business advisers, etc. (Greenwood et al., 2002).

Business activities contain uncertainties in relation to both systematic and unsystematic risks (Hallikas et al., 2004). Support from networking organisations enables MSMEs to reduce unsystematic risks from internal factors, but systematic risks generated from external factors such as economic downturns, are still critically important. Consequently, in order to manage and diversify risks, companies should envisage 'action, reaction, re-reaction' to its own and other's networking and its respective outcomes (Ford et al., 2002).

7 Conclusions and contribution

Under conditions of uncertainty such as the COVID-19 downturn, integration and interdependence between sector players and their capacity to predict future performance, becomes more important than ever. This study has estimated the effect of symbiotic relationships on firm performance, particularly on the elements of risk and return by building a robust financial model for financial forecasting, determining the probabilities of survival if the idea of symbiosis is adopted.

According to the Monte Carlo simulation predictions, there was no possibility for businesses in the three industries to finish with a negative net profit. Income is the most important factor driving variations in net profit. The cost of goods sold, occupancy expenses, and wage expenses also have a major effect on firm performance, with impact on the tourist budget share of the economy (Gómez-Déniz et al., 2020). Exogenous fluctuations in plant and equipment expenses were the least important factor in the coffee lounge component, whereas vehicle and advertising expenses had the least effect on the potential net profit of backpackers and hostels, and gift and specialty shops, respectively.

The findings of this study should encourage those who are in the tourism and hospitality industry and MSMEs owners in other industries to focus on factors which minimise costs and expenses, to increase the overall firm performance and manage internal risk. They should also ensure corporate and individual membership of networking organisations to hedge against external risk.

The research contributes to theory by re-conceptualising the relationship between symbiosis and risk/return. The study identifies factors that produce variation in performance, as well as coupling the symbiosis concept with Monte Carlo simulation. The research also makes a methodological contribution that advances predictive analysis for MSME networks and demonstrates the methodology in new sector settings.

Related entities such as networking organisations, industry associations and DMO's, and government policy makers should consider how to improve and support MSMEs in this and other sectors by using Monte Carlo simulations of potential profit of firms. The resulting understanding of network dynamics can be used to plan business strategies and support the growth of the economy. The simulations are also powerful tools with which to reimagine COVID-19 readjustment strategies and economic alternatives.

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