Research article

Modelling and assessing new SME digital business status for visualising virtual economics and sustainability economic indicators: Empirical evidence from poultry business

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ABSTRACT

SMEs are generally recognised as financial contributors to regional economic development. Despite the enormous contributions of digital SMEs to sustainable economic growth and regional development have not yet been reported. This paper assesses and models SME businesses to gain a digital business status and model. These days, visualising economic growth is challenging and powerful to identify business performance and realise sustainable regional development. This research analyses empirical data obtained from a poultry business to form a standard model for implementing a new SME digital business model and status. This standard model is a guideline to measure the other SME businesses and productions. Localisation of the SDGs was analysed using thematic analysis. Mathematical computation is used to visualise virtual economic growth geographically. Hence, our digital business model and status demonstrated business performance, management, and economic growth.

1. Introduction

Small to medium enterprises (SMEs) are an important economic contributor to the county and play a key role in the sustainable development of the region [1]. However, traditional SMEs perform under the theoretical framework of the business life cycle and beneath the theory of firm monopolies [2–5]. These fields of economic theory demonstrate the challenge of developing sustainable growth of a single SME industry that extends cross-province economics to further international trade. Detecting the position of regional planning and management strategies in transforming the SME business into a digital business status and model could improve regional economics. Economic growth in regional management is unquantifiable. Thus, a computational study can overcome this obstacle. Currently, computational study has had a huge impact on medicine, engineering, business, and social science [6–10]. Computational results draw patterns and models to solve research questions and visualise unknown variables to deepen research understanding and

generate new ideas. Presently, researchers have applied decision tree learning to analyse product service systems of SME businesses using the circular economy [11]. Another example is the identification of high-tech manufacturing used in SMEs for sustainable technology development. Researchers used computational methods to quantitatively evaluate the company's database. Their research activities form a direction to achieve digital transformation [12].

At present, localisation of Sustainable Development Goals (SDG) in SME businesses is compulsory. This sustainability indicator captures the progress of SMEs towards the SDGs [13–15]. Studies related to the localisation of SDGs in business aimed to track business contributions to SDGs [15–17].

Former researchers examined businesses and identified their localisations of the SDGs using an electronic literature database. Their research aims to examine the benefits, issues and challenges in warehousing businesses related to the 17 SDGs [17]. Moreover, prior analyses of the localisation of the SDGs have focused on the global level, such as assessing countries' sustainable development levels [13]. These investigations scrutinised secondary data obtained from the Government Statistics Office. However, previous results lack direct validation of the empirical evidence against the targets and indicators listed in the 17 SDGs. The current state of the literature studying SMEs focuses on sustainable economic growth using computational methods. As far as we know, no systematic studies have been performed hitherto that establish new SME digital business status and model to evaluate performance and management to create economic growth and sustainable regional development. SME business management is crucial to establishing sustainable regional economics. Thus, founding an SME network structure by a master business and its business peers in the same industry will significantly help carry out regional development and economics. This research analyses preliminary data collected from a case study of the poultry business of both the master business and its business peers. This research aims to validate our hypothesis of how SMEs can become digital businesses to improve the local economy. Virtual economic growth is visualised geographically using computational study, and thematic analysis was used to analyse SDG localisation. Therefore, our research contributes to monopoly and economic theory, business life cycles, and computational practices. Many SME poultry businesses in Northern Thailand have been examined. Almost all poultry SMEs did not digitise their businesses. Only a select group of poultry SMEs moving forward with cross-province economic expansion are active in the digital economy model. Digital business status and models can be described as virtual economic growth and sustainable economic indicators. This digital SME model is a key economic player driving sustainable regional economic development. The current research can serve as a roadmap to help other SMEs model and evaluate digital business positions that increase sustainability in economic growth and regional development.

2. Materials and methods

In this investigation, surveys and field visits were conducted for data collection. The telephone survey was used because it saves time and costs. It was an efficient way and quick approach to gaining a large amount of data from a huge population [18–21]. Table 1 shows the open-ended questionnaires for a semi-structured telephone interview with a master business. The transcript results were documented manually on paper and recorded in mp3 file format. Researchers (TC and YC) travelled to the interviewees' locations for verification of transcript results. Fig. 1 shows the seven steps in the simulation model of this research.

A questionnaire is a survey instrument. Our survey instrument was designed and implemented based on our previous research to generate data for social measurement [18]. It was built based on four criteria: accuracy, reliability, repeatability, and generalisability. Survey bias was removed by avoiding yes and no questions and providing participants with clear instructions and research details before the survey took place. Fig. 2 shows a graphical diagram of the survey instrument to simulate data generation and analysis. This survey instrument can be applied to other settings. Computational and thematic analysis methods were chosen for data analysis. This is because both analytical methods use appropriate mathematical programming and coding themes to create new and unique results for visualising and understanding data.

Table 1
The open-ended questionnaires for a semi-structured telephone interview with a master business.

No.	Questions
1.	What business have you been doing and how many years have you been doing it?
2.	How would people know that it was your business?
3.	What are the essentials that are required to run your SME chicken processing business?
4.	Quality ranking of chicken meat processing business.
5.	Where are the main trade markets? Who are the buyers?
6.	How many workers are at present? What machines and computer systems are used?
7.	What do you think Digital Business is?
8.	What are the relationships between profit and cost?
9.	What do you want to develop to increase your sales?
10.	What is needed if you want to make your SME become a Digital Business?
11.	Profits based on customer satisfaction opinions. How will customers profit from the product?
12.	Assuming it is a digital business that you are running. How will it benefit your SME business?
13.	Let's say you are running a Digital Business, and it was completely successful. What are the relationships between profit and cost?
14.	Give one name of fruit as a representative for the interview; an interviewee creates a pseudonym.

Modelling Technique	
Step	**Procedure**
1	Define a study location of economic flow, for example, SME poultry business.
2	Detect economic flows in a study location and then compare it with other industries.
3	Create a research question regarding the interests.
4	Find the economic patterns and variables.
5	Select a data collection approach and then collect data.
6	Perform a data analysis and then visualise the findings and results.
7	Draw a conclusion, solution, and/or guideline.

Fig. 1. A generic modelling algorithm.

2.1. Data collection and SME

Data were collected using the semi-structured telephone interview with a master business as a case study from April 27 to May 14, 2021. A case study was a successful poultry business in San Sai, Chiang Mai, Thailand, and its study area is shown in Fig. 3. The 3 researchers (TC, YC, and CJ) interviewed the father and son business owners for almost 3 h to create a digital business model. Table 2 shows the test data for fitting a digital business model. Then, researchers assessed 10 SMEs to determine the level of success of their digital business status. Consent has been given before the interview takes place. An important characteristic of the sample in this study is the maturity of their digital businesses and economic expansion through the provinces.

Additionally, raw data from 12 telephone interviewees contains statistics and verbal information. Then, the numbers and codes were extracted from the raw data manually written on paper. Codes and numbers were elaborated concerning digital business status and model and annual revenue for thematic analysis and computational approach. Finally, the analysis results were confirmed correctly by the interviewees.

In this work, the SME definition represents a local business with employment is not more than 5 employees, a business located in a remote area; it is not in a business district, and annual revenue is not more than 5 million Baht (equivalent to 112,209.55 Pound sterling or 142,178.75 United States Dollars in July 2023). Thus, all businesses in the present study completed these conditions.

2.2. Data classification and critical evaluation strategies

Empirical data are composed of a master business and its 10 business peers. Master business data were used to build a digital business model, and 10 business peers were used for digital business model fitting. The survey data are classified based on digitisation and how a master business growth is measured. A critical evaluation assessed the big picture of how to visualise virtual economic growth originating from a master business. First is understanding the current situation on how to manage the business in the modern day, and second is identifying the promising results to help other businesses grow financially or form other businesses expand markets and consumptions. The finale is a plan and process to measure a digital business status and model marked potential business peers to grow similarly to a master business.

2.3. Digital business model

In this context, a digital business model was built from master business data, which simply means a change of local SME into an online social network for financing, advertising, promoting, selling, communicating, and tracking logistics. Moreover, a local SME has a completed electronic online platform for business and management. A thematic analysis of the transcript results from a master business draws the principles for modelling digital business including product sales, media, and information technology (IT), product storage system, freight forwarding system, and online platform to sell products; A digital business status comprised of widely recognised nationwide, leadership in the current business, research on the company's products, product development, and quality storage associated with logistics.
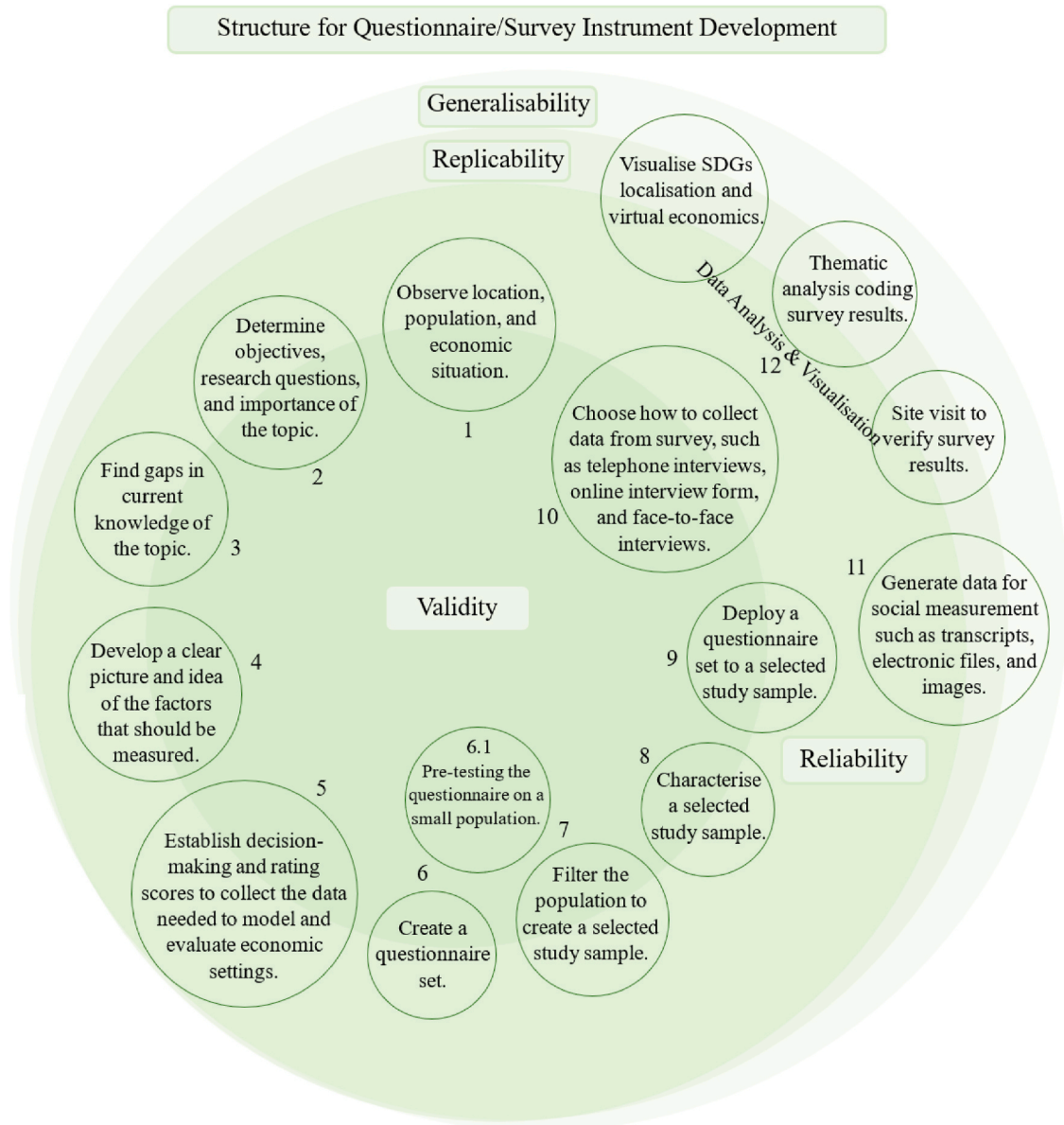
Fig. 2. Survey instrument development.

2.4. SDG localisation calculation

In this present research, a calculation of an SDG localisation based on the United Nations' 17 sustainable development goals lists [22] and SDG accelerator for businesses [23]. SDG localisation was used for thematic analysis. Realising SDGs are key to doing good business. Sustainable global developments are implemented in 193 countries around the globe [23]. SDGs can give value to businesses and create more business opportunities. Therefore, localising the SDGs enables local communities to support the performance and monitoring of local sustainable development actions and support the achievement of the SDGs at the national level.

2.5. Virtual economics measurement

In this context, virtual economics is a pictorial captured economic situation in a certain study area of our digital business model originating from a master business financially expanded to its business peers. Virtual economics were quantified and modelled based on two conditions: a mature digital business and economic expansion across provinces. This is because both conditions reflect intelligent economics in the industry. Moreover, the proposed digital SME model covers economic expansion in different regions. It allows results to be measured reasonably to present a realistic picture of the economy in terms of virtual economics.

Fig. 3. A map shows a study area and the origin of virtual economics.

Table 2
Business peers are the test data to test with digital business status and model.

No.	Postcode	Local Area	District	Province	Pseudonym	Connection Type	Interviewer
1.	50210	Pa Phai	San Sai (1)	Chiang Mai	Gros Michel Banana	Received education and bought chicks from a master business.	YC
2.	50300	San Phisuea	Muang (2)	Chiang Mai	Monthong Durian	Received education and bought chicks from a master business.	YC
3.	50150	Ban Chang	Mae Taeng (3)	Chiang Mai	Mangosteen (1)	Received education from a master business.	YC
4.	50150	Sop Poeng	Mae Taeng	Chiang Mai	Santol	Received education and bought chicks from a master business.	CJ
5.	50150	Sop Poeng	Mae Taeng	Chiang Mai	Durian (1)	Received education and bought chicks from a master business.	CJ
6.	50150	Inthakhin	Mae Taeng	Chiang Mai	Banana	Received education and bought chicks from a master business.	CJ
7.	51000	Ton Tong	Muang (4)	Lamphun	Longan	A master business provided support and education to form the business.	TC
8.	54170	Wang Luang	Nong Muang Khai (5)	Phrae	Pisang Awak Banana	Produced chicken for and received education from a master business.	TC
9.	64000	Yang Sai	Muang (6)	Sukhothai	Durian (2)	Produced chicken for and received education from a master business.	TC
10.	52210	Soem Sai	Soem Ngam (7)	Lampang	Mangosteen (2)	Produced chicken for and received education from a master business.	TC

Table 3
Statistical data of current and future revenue for mathematical computation.

Digital Business Assessment		Master Business	Business Peers									
		Cantaloupe	Gros Michel Banana	Monthong Durian	Mangosteen (1)	Santol	Durian (1)	Banana	Longan	Pisang Awak Banana	Durian (2)	Mangosteen (2)
Annual Revenue (Million THB)	Current economy	1.50	0.05	0.10	0.03	0.30	0.19	0.20	0.93	0.28	0.16	0.32
	Future economy	1.51	0.66	0.61	0.64	0.71	0.70	0.61	1.19	0.69	0.77	0.73

The mathematical model of virtual economics was developed based on an analysed transcript result. Table 3 shows annual revenue. Consequently, the two stages of the economy are given as current and future revenue generated from the assessed statistics of a master business and its ten business peers, as shown in Table 3. Then, a least square method is used for data fitting to clarify and visualise a virtual economic situation.

Assume that this single economy only has a poultry business: a master business and its ten business peers, future economic growth relies on business peers, their supply of labour is fixed under SME conditions, the productivity of labour is fixed, and all business peers received education and supported in doing businesses from a master business. Thus, from this model assumption and a given economic data, an economy can be defined as a function f, such that $f(x)$ gives a total economy of entire poultry businesses at each business x. Since every poultry business is given a specific value. The economic graph in each stage can be determined as *approximation* to estimate the values of function f.

Let $f(x, a1, a2, ..., am)$ is a family of the functions of a specific form that relies on the parameters $a1, a2, ..., am$. So, there are many chances and possibilities of these parameters being members of function f. Thus, the best possible of such a function is a sum of the squares of deviations of f allowing $y_j, j = 0, 1, 2, ... n$ is the observed values. A simple equation of this economy is shown in Equation (1).

$$f(x, a, b) = ax + b \tag{1}$$

where parameters (a, b) are in a straight-line calculation, and consider abstract dataset:

$$
\begin{array}{c|c|c|c}
x_0 & x_1 & ... & x_n \\
y_0 & y_1 & ... & y_n
\end{array}
$$

A square of deviation at each point of x_j is $(y_j - f(x_j, a, b))^2$, and from equation (1) the new form of x_j is $(y_j - (ax_j + b))^2$. A minimisation value of a and b of the following sum is $g(a, b) = \sum_{j=0}^{n}(y_j^2 - 2ay_jx_j - 2by_j + 2abx_j + a^2x_j^2 + b^2)$, and the minimum of a function is found by applied the two partial derivatives of $\frac{\partial g}{\partial a}$ and $\frac{\partial g}{\partial b}$ is:

$$-2\left(\sum_{j=0}^{n} y_jx_j - a\sum_{j=0}^{n} x_j^2 - b\sum_{j=0}^{n} x_j\right)$$

$$-2\left(\sum_{j=0}^{n} y_j - a\sum_{j=0}^{n} x_j - b(n+1)\right)$$

Then, the yields of a linear algebraic system can be obtained by equalised these two equations to zero, which can easily solve the unknown a and b.

$$\sum_{j=0}^{n} y_jx_j = a\sum_{j=0}^{n} x_j^2 + b\sum_{j=0}^{n} x_j$$

$$\sum_{j=0}^{n} y_j = a\sum_{j=0}^{n} x_j = b(n+1)$$

For a superior data *approximation*, parabolic calculation can be estimated this economy better by using Equation (2).

Table 4
Assessing SME digital business status.

Digital Business Status	1st Rank Motivation	2nd Rank Initialisation	3rd Rank Contemporary	4th Rank Impression	5th Rank Completion
Research on the company's products	Interested in doing research	Started doing research	Gained research output	Disseminated research output	Products are supported by research
Leadership in the current business	Give information on products	Give the knowledge to develop products	Give assistance to enhance and sell products	Become a buyer for business peers	Become a buyer and product distributor nationwide
Widely recognised nationwide	Well-known by local citizens	Well-known by business peers	Interviewed and broadcasted on TV nationwide	Owned product content on media/YouTube channel	The same businesses accepted as the no.1 priority
Product development	Working on late technology	Interested in using modern technology	Started using modern technology and digitalisation	Research supported using modern technology and digitalisation	Disseminated new techniques, modern technology, and digitalisation
Quality storage associated with logistics	Interested in quality control during transport	Started using a temperature control system for product quality	Improved/developed temperature control system for product quality during transport	Temperature control system generated product quality at the destination close to the production date	Temperature control system-generated product quality at the destination is the same as the production date

Table 5
Developing SME digital business model.

Digital Business Model	1st Rank Motivation	2nd Rank Initialisation	3rd Rank Contemporary	4th Rank Impression	5th Rank Completion
Product sales	Focus on selling products in community areas (5 kg/day)	Expand sales of products in nearby communities (5–20 kg/day)	Expand product sales to the low-end market (20–50 kg/day)	Expand product sales to the primary central market (50–80 kg/day)	Selling products in multiple channels expands to various markets (>80 kg/day) or daily orders
Media and information technology	Interested in advertising on the Internet	Started using social networks, e.g., Facebook, Twitter, and Instagram.	Opened short video media channels, e.g., YouTube and TikTok.	Started a very own social network, e.g., a website.	Actively used at least one social network system on a regular basis
Product storage system	Interested in frozen storage systems	Frozen products (5–10 kg) are stored in pre-frozen packaging (ice crates)	Owned/leased a cold storage system that can support products (>50 kg)	Owned/leased a cold storage system that can support products (>100 kg)	Owned/leased a cold storage system that can support products (>1000 kg)
Freight forwarding system	Self-transport, packing products into ice crates (small volume, short distance transport)	Started/developed a transport system to support increasing sales by using self-transport/private transport	Owned a transport system for shipping goods packed into ice crates in small quantities covering short-distance delivery	Owned a transport system for shipping frozen goods in large quantities covering short-distance transport	Owned a transport system for shipping frozen goods in large quantities covering short-and long-distance transport
Online platform to sell products	Interested in selling online	Start planning an online sales system	Use an online sales system	Improve sales channels in line with market demands	Have at least one online sales system

Table 6
Assessing SME to digital business status and model resulted from 10 business peers.

Digital Business Assessment		Master Business	Business Peers									
		Cantaloupe	Gros Michel Banana	Monthong Durian	Mangosteen (1)	Santol	Durian (1)	Banana	Longan	Pisang Awak Banana	Durian (2)	Mangosteen (2)
Digital Business Status	Research on the company's products	1,2,3,4,5	–	1	–	1	5	–	1	1,2	1	1
	Leadership in the current business	1,2,3,4,5	–	1	1	5	2	4	1,2,3	1,2,3	1,2,3	1,2
	Widely recognised nationwide	1,2,3,4,5	1	2	1	5	2	2	1,2,4	1,2	1	1,2
	Product development	1,2,3,4,5	1	–	–	3	1	3	1,2,3	1,2,3	1,2	1,2
	Quality storage associated with logistics	1,2,3,4,5	1	–	–	3	2	2	1,2,3,4,5	1	1	1
Digital Business Model	Product sales	1,2,3,4,5	1	1	1	5	5	5	1,2,3,4,5	2	–	1
	Media and information technology	1,2,3,4,5	–	2	–	1	–	1	1,2,4	1,2	1,2	1,2
	Product storage system	1,2,3,4,5	–	–	–	5	–	1	1,2,3	–	–	1
	Freight forwarding system	1,2,3,4,5	–	–	–	1	2	1	1,2,3,4,5	1,2	–	1
	Online platform to sell products	1,2,3,4,5	1	1,2	–	1	–	1	1,2,3,4,5	1	1	1,2,3,4,5

$$f(x, a, b, c) = ax^2 + bx + c \qquad (2)$$

Hence, solving the unknowns a, b and c by repeating the same calculation techniques for equation (1) [24]. The coding was implemented in Matlab (MathWorks Inc., Massachusetts, United States) for mathematical computation [25].

3. Results

Data analysis of a poultry business case study has been completed to model and assess SME digital business. The results of our study proved to support the title and research questions/hypotheses that the study sets out to investigate. It is an in-depth analysis of SMEs transforming their businesses into digital SME models. This analysis demonstrates a strong relationship between economic growth and sustainable county development after businesses become digital businesses, and a year in business has no significant effect on digital businesses to expand the economy.

3.1. Digital business status

The qualitative data were analysed and clarified the digital business status of a master business. This poultry business trades and produces healthy chicken meats, free-range chickens, organic products, and a native bird breed (Pradu Hang Dam chicken) of Chiang Mai, Thailand. The empirical results show progress in ranking how SMEs can achieve digital business status. Table 4 shows SME digital business status.
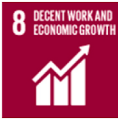
3.2. Digital business model

There were links between digital business status and digital business model. A digital business model patterns media and IT, online social networks, logistics, and product sales, whilst digital business status patterns leadership, research, product development, and national standing. Thus, the digital business model and digital business status advance economic growth and sustainable county development, respectively. Table 5 shows progress in scoring SMEs towards digital business models.

3.3. Assessing SMEs into digital business

A test dataset from a group of 10 poultry businesses was used for training to validate the digital business status in Table 4 and the digital business model in Table 5. The execution results in Table 6 reveal business performance and progress in growing the local economy and achieving the SDGs. Fig. 5 shows 10 SMEs that assessed their digital business status and model. Thus, the digital business

Table 7
Assessing digital business status and model depicted an SDG localisation.

| SDGs	Description	Justification
1 NO POVERTY	End poverty in all its forms everywhere	Father and son poultry business owners provided education to their business peers to do a poultry farm and create a digital business.
3 GOOD HEALTH AND WELL-BEING	Ensure healthy lives and promote well-being for all at all ages.	The public consumes chicken meats produced from healthy chickens and no antibiotics are used on chickens.
8 DECENT WORK AND ECONOMIC GROWTH	Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.	Father and son poultry business owners provided support to continue improving business for their business peers.
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.	A poultry farm produced products supported by research to ensure sustainable innovation and economic growth.
13 CLIMATE ACTION	Take urgent action to combat climate change and its impacts.	Business process management and production in a poultry farm contributed less carbon dioxide and greenhouse gas.
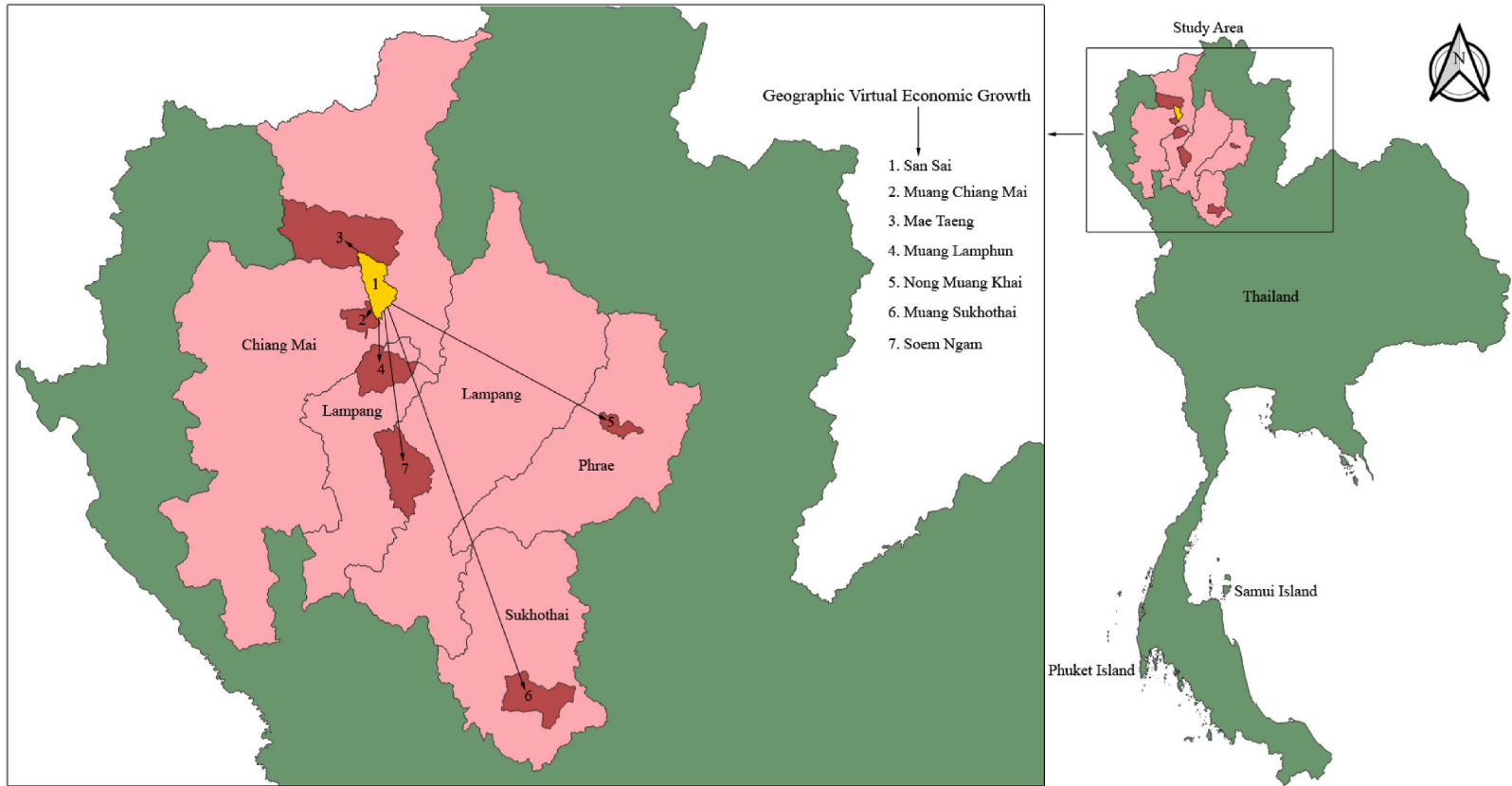
Fig. 4. Geographical visualisation of virtual economic growth originated in the San Sai district and expanded to other provinces.

status (Table 4) and model (Table 5) can be used to match the performance of other SMEs to achieve SME digital business.

3.4. SDG localisation

Sustainable development was successfully measured using the 17 SDGs recommended by the United Nations. Empirical evidence was analysed using the targets and indicators identified in the 17 SDGs. Thematic analysis was used to identify patterns in transcript results. Table 7 shows the implemented results of SDG localisation.

3.5. Visualising virtual economics

Virtual economics demonstrates in Fig. 4 paired with the district column in Table 2. Pictorial economic growth originated from a master business expanding businesses to its 10 business peers. Fig. 5 mathematically illustrates virtual economics graphs of the entire poultry businesses incorporated with pictorial economic growth in Fig. 4. Virtual economics are drawn in the forms of straight-line and parabola in algebra. Two stages of virtual economics are the current economy and the predicted future economy.

4. Discussion

Recent research used a computational method to address research questions through a survey on a case study of a poultry business. This study has found out how SMEs become digital businesses to improve the local economy. Our analysed results confirmed this hypothesis, and geographically visualised economic growth in terms of the virtual economics over the study region (see Figs. 4 and 5). In summary, the results of our analysis answered the research questions linking the digital transformation of SMEs using our digital business status and model. Our findings proved that SMEs continue to digitise their businesses to expand their economies across provinces.

It must be noted that in practice, SMEs doing digital business promisingly improved the county's economy, and proceeded to gain sustainable county development. Table 4 confirms that SMEs achieving digital business status must achieve all five ranks: motivation, initialisation, contemporary, impression, and completion; a digital business status indicates all five sets are leadership in the current business, widely recognised nationwide, research on the company's products, product development, and quality storage associated with logistics. Consequently, the model fitting on ten SMEs showed their competitiveness to a certain level and they advanced to digital business status.

In the same way, Table 5 confirms SMEs complete a digital business model must reach all five ranks previously mentioned, and all five sets are product transactions, media and IT, product storage system, freight forwarding system, and online platform to sell products. As a result, the model fitting on ten SMEs evidenced their productivity at some level and they progressed towards a digital business model. Hence, promising results are reported in Table 6 verified the model fitting results using Tables 4 and 5 with ten SME business peers. Only one SME business, Longan located in Muang Lamphun district (see Table 6) outperformed, and nearly completed a digital business status and model. This SME only misses research and development to improve company products. Another important factor that affects SMEs doing digital business is SDG localisation. Table 7 uncovers SME businesses localised five SDGs including decent work and economic growth, no poverty, climate action, industry innovation and infrastructure, and good health and well-being.

More recently, our results revealed an assessment of digital business status and model is promising and shows signs that SME business is going to be a successful economic producer and sustainable county developer. In contrast, many studies have reported different perspectives focused on a digital business model considering the revenue impacted by government restrictions on media [26]. Digital business model innovation combines four variables: context, sensing, resources, and orientation [27]. Digital supply chain resilience driven business capabilities [28]. An important implication of our study derives from our findings on knowledge sharing/open innovation provided by the master business to its business peers. The master business fosters its business peers to acquire a digital business model and status. Our findings suggest in fact that SMEs should become digital businesses to improve local economics.

Interestingly, former researchers pointed out that the development of SME digital finance can significantly reduce tax non-compliance of SME businesses [29]. Their studies are in line with our findings and confirm that SME businesses significantly improved their finances by digitising their businesses. Our research is a guideline for digital business practice on how to improve SME business management and performance for SDG localisation and economic growth that persists during recessions [30].

This research developed a theoretical context for a digital business model and status to measure economic growth in the regional management of SME businesses. Since a business life cycle and monopoly theories affect SME performances. It is a challenge to develop sustainable growth of local SME businesses. Thus, our results confirmed that the local SMEs became digital business models and statuses avoiding the business life cycle, as well as acting like a single firm monopoly. Our empirical findings revealed a single SME industry (poultry business) can perform like a monopoly firm that has the potential to overcome the business life cycle. Fig. 4 proves that the economic enlargement started from a master business at point 1 in San Sai and spread its products over northern Thailand to overcome the declining stage of its business. To a certain extent, business peers achieved all levels of digital business status and model (see Tables 4 and 5) can become master businesses. For example, at point 6 (Fig. 4) is No. 9 Sukhothai province, Durian (2) (see Tables 2 and 6) disseminates products and expands the economy to build business partnerships through central and southern Thailand. Consequently, our work filled the gap to improve local economies and create sustainable regional development.

Nevertheless, the recent research has some limitations. First, government policies and restrictions have been excluded from our study since SME businesses already performed under government roles. Second, the digital business status and model have been built from a poultry business case study. However, our model is valuable and can guide the digital business measurement of other businesses
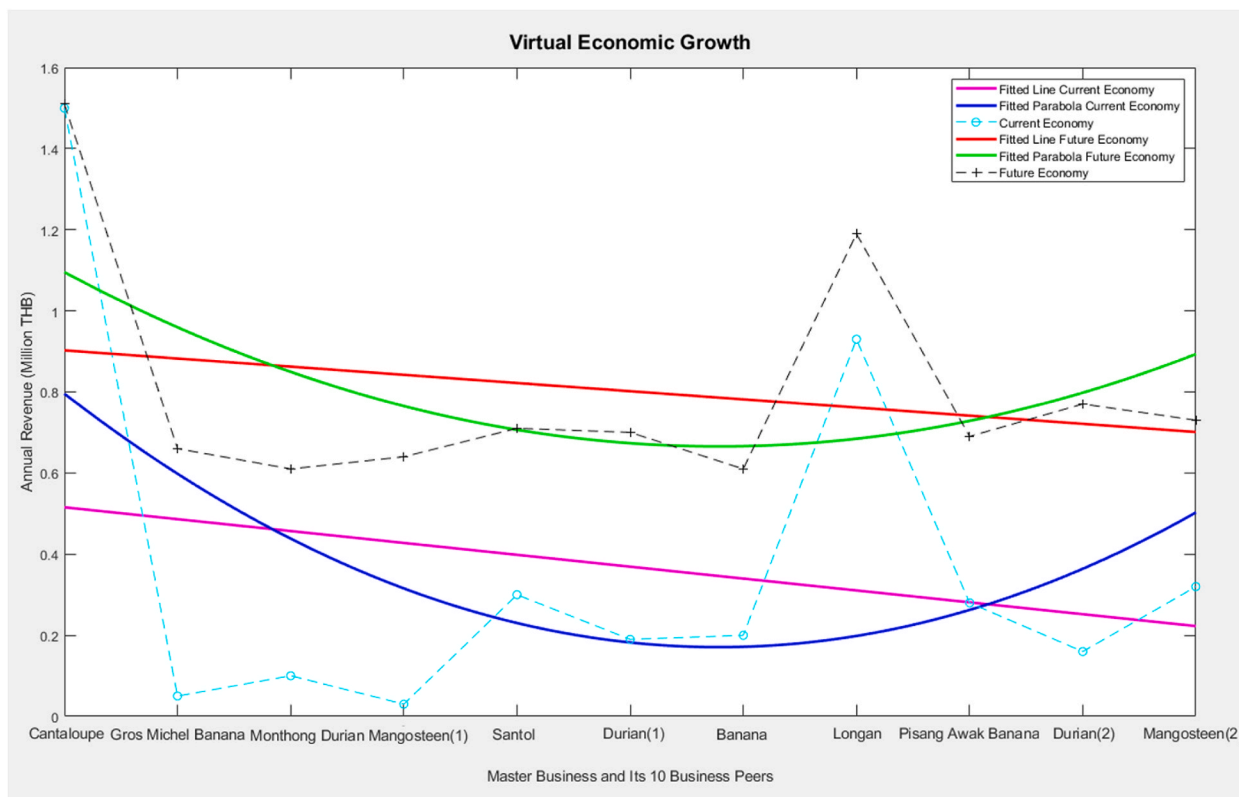
Fig. 5. Mathematical computation proved virtual economic growth in all provinces liaised in Fig. 4, Tables 2 and 6

and industries. Third, only one year of revenue was obtained from the study population, which was used in virtual economics demonstrations and calculations. However, revenue data is enough for our mathematical computation to visualise virtual economics.

5. Conclusion

This research assessed and modelled SME business to digital business status and model. Empirical evidence was gained from a semi-structured telephone interview with a master poultry business group to create a digital business status and model for evaluating its ten business peers. Additionally, SDG localisation was assessed. A mathematical model has been developed to visualise virtual economic growth geographically networking between a master business and its 10 business peers (see Figs. 4 and 5). The analysed results showed that SME businesses completed a digital business status and model expanded local economics and continued sustainable regional development. The five SDGs localised in our research are decent work and economic growth, no poverty, good health and well-being, industry innovation and infrastructure, and climate action. Our work demonstrated SME business management contributed to economic theories, monopoly framework and avoiding business life cycle. This work is restricted to a management study of the poultry business. The results from Fig. 4 clearly show how to overcome a decline stage in the business life cycle. Products and knowledge within the company are continuously expanded to customers and the same business group. This allows the proposed digital SME model to progress towards sustainable economic development. Our work was built on a limited sample size. Because it was found that there was only one poultry SME that had fully developed a digital business. However, our work shows the general nature of the case where SMEs in the poultry industry need to digitise their businesses. The basics of the digital SME model and its important features are discovered for general use by other businesses. This can be replicated in other regions or elsewhere in the world so that SMEs can transform their businesses into digital SMEs. To summarise, our digital business status and model can be used as a guideline to assess SMEs to characterise their business performance and economic growth. There is sufficient evidence to implicate not only the business life cycle framework but the decline phase of a product as well. Therefore, future research should explore avenue management of other SME businesses and industries, such as export/import companies and food industries, as well as comprise government restrictions and policies causing a loss in revenue.

Data availability

The authors do not have permission to share data.

CRediT authorship contribution statement

Thanapong Chaichana: Writing – review & editing, Writing – original draft, Visualization, Validation, Software, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Graham Reeve:** Writing – review & editing, Writing – original draft, Validation, Software, Methodology, Investigation, Formal analysis, Conceptualization. **Chalalai Jaisan:** Data curation, Conceptualization. **Yasinee Chakrabandhu:** Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:The authors declare no conflict of interest, no personal relationships, and no financial interests that have influenced the research reported in this paper.

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