An Innovative Virtual Kitchen Partnership-as-a-Service to Improve Efficiency of Healthy and Hygienic Meal Delivery Service Management in Culinary Industry

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Abstract

During COVID-19 pandemic, many food service providers and online delivery providers have changed and partnered into new business model known as virtual kitchen partnership-as-a service providers (VKPaaS) on cloud computing with focus on demand for healthy and hygienic meals with fastest delivery service to customers in health-related isolation environment. However, due to increasing problems of inaccurate delivery services, the VKPaaS attempts to improve its search engine with AI-based technologies in cloud computing and algorithms to determine the proper healthy and hygienic meals with fastest, accurate and economical delivery service from the nearest location to customers. The objective of this study is to study factors affecting new COVID generation customers decision to choose and purchase healthy and hygienic meals that have potential impact on management on efficiency of VKPaaS delivery service in health-related isolation environment. The quantitative survey and qualitative in-depth interview methods were used to collect and analyze data from 554 subjects and 18 food service providers in Thailand, China and USA during 3 months in 2020. The findings suggested a new VKPaaS efficient delivery management model for improvement and advancement of VKPaaS delivery service to new COVID generation customers with five vital variables of performance expectancy, effort expectancy, social influence, perceived trust and price that had significant impact on customers decision to choose and purchase healthy and hygienic meals from online VKPaaS providers. Recommendations for further research include state-of-the art areas of crowdsourcing, artistically design for contactless meals, robotic-mobile vehicles for live visualization service, and compliances in new emerging health-related isolation economy.

Keywords: Virtual kitchen, Isolation economy, Efficiency management, Culinary industry, Healthcare industry

I. INTRODUCTION

During global COVID-19 pandemic, many food service providers (FDP) such as restaurants, street food vendors and homemade kitchens had changed and partnered with online delivery provider (ODP) into new business models known as virtual kitchen partnership to deliver healthy and hygienic meals to locked down customers in isolated residences. The new emerging virtual kitchens partnership included independent-one shot (IO); cloud kitchen using hub and spoke (CK); ghost kitchen (GK); virtual restaurant (VR); aggregator ODP with no driver fleet; consolidator with bulk drop system; aggregator ODP with owned fleet; and aggregator with dark kitchen. Each new business model differs in services, physical requirements, kitchen facility, driver fleet and ownership of database, as shown in table 1. However, the ghost kitchen and virtual restaurant have been hasty and effortlessly adopted to provide delivery only services to take advantages of new demand, overcome shortage of revenue and quickly reduce operating cost problems than other business models [1].

Table 1: Virtual kitchen partnership business models [1]

Business Model	Code	Description	Kitchen Facility	Driver-Fleet	Database Owner
1. Independent-One Shot	IOS	Physical restaurant with delivery	Owned	Owned	Owned
2. Cloud Kitchen-Hub & Spoke	CK	Half-finished cold meals from hub to branches for reheat	Hub/branches	Owned	Owned
3. Ghost Kitchen	GK	Delivery only	Rent	ODP	Owned
4. Virtual Restaurant	VR	Delivery only	Owned	ODP	ODP
5. Consolidator-Bulk Drop System	CBDS	Pre-ordered meals to drop-off point	Rent	ODP/partner	ODP/partner
6. Aggregator ODP-No Driver Fleet	AONF	ODP with all meal menu in App	Rent	ODP	ODP
7. Aggregator ODP-Owned Driver Fleet	AODF	ODP with all hot meal menu in App	Rent	ODP	ODP
8. Aggregator ODP-Dark Kitchen	AODK	ODP rent space in strategic restaurant with all meal menu, coordinate, delivery	Rent	ODP	ODP

ODP = Online Delivery Provider

As the pandemic continued, the global demand for healthy and hygienic meals from virtual kitchen had predicted to grow at CAGR of 43.5% and reached 71 billion USD in 2027 [2]. The COVID generation customers changing behaviors toward more healthy and hygienic meals with embracing of new technologies, such as AI and AR to design and prescribe healthy and hygienic meals had accelerated growth of virtual kitchen market share in culinary industry worldwide. Many virtual kitchen service providers took advantages of using an innovative virtual kitchen partnership as a service (VKPaaS) providers with AI-based search engine to track consumer behavior, values, tastes, diets, costs and meal-on-demand to more customers in wider areas. However, challenges for VKPaaS providers remain to be constantly advancing their services to meet accelerated demand from hasty changes in new COVID generation customers behaviors [3]. Many customers had reported disadvantages and increasing problems from errors, inaccurate, missing, stealing, no health safety, contactless, no vaccination drivers in delivery services at pick-up point and the residences. Customers demand for more efficient delivery service for COVID-free healthy and hygienic meals to their isolated residences from VKPaaS become essential research question in this study [1], [4].

The objective of this study, therefore, was to study factors affecting new COVID generation customers behavior on making decision to choose and purchase healthy and hygienic meals from virtual kitchen partnership as a service (VKPaaS) providers to their health-related isolation environment. The expected findings of new COVID generation customer behavior model would be used to improve intelligence and advancement of VKPaaS providers delivery services in culinary and related industries.

II. LITERATURE REVIEW

A. Global Virtual Kitchen Market and Culinary Industry

In 2019, many food service providers with takeaway and no dine-in physical facilities to customers using online delivery service providers such as Grubhub and

DoorDash in USA or ele.me in China via major portal provider ordering systems to generate sales and delivery services were known as cloud kitchen, ghost kitchen, dark kitchen and virtual kitchen [2]. The major global portal providers were Microsoft corporation, HTC, IKEA, Samsung Group, LG, DoorDash, Grubhub, Ubereats, Dahmakan, Starbucks, GrabFood, and others. The global virtual kitchens in culinary industry had reached market size estimation of 43.1 billion USD in 2019 with CAGR at 43.5% and predicted to reach 71.4 billion USD in 2027. The Northern America and European regions were the largest global virtual kitchen market size with the fastest expansion rate. On the contrary, Asia Pacific region, such as Japan, China, India and Thailand were under the development of virtual kitchen market with expected growth rate at the highest CAGR in 2027, followed by South America, and Middle East & Africa, as shown in figure 1 [2].
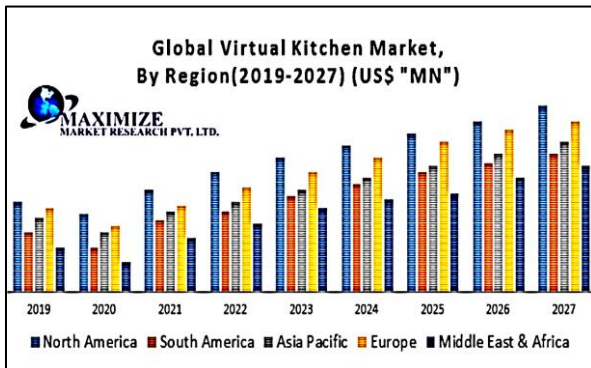

Figure 1: Global virtual kitchen market by region [2]

B. Healthy and Hygienic Customer Segmentation

As global virtual kitchen market continued to grow, customers were segmented into commercial space at approximately 33%, residential at 20%, hospitality at 15% and others at 30% in 2019. However, the hospitality customers were predicted to become the largest global virtual kitchen market segment at 35% of the culinary industry in 2027 [2].

The changing in customers behavior toward easy, fast, cost competitive, accurate healthy and hygienic eating had accelerated the growth of delivery-only with contactless from virtual kitchen business in the big cities. The embracing of technologies such as virtual reality, augmented reality, artificial intelligence and 3-D facial recognition images for customers to easily visualize, activate command and tracking with preview experience had potential to stimulate decision to choose and purchase healthy and hygienic meal online and led to an increasing market share in culinary industry.

C. Artificial Intelligence in Healthy and Hygienic Meal

In 2020, the current state of the art of using artificial intelligence in healthcare industry was valued at 4.49 billon USD and was expected to reach 34.8 billion USD at CAGR of 39.6% in 2026 [2]. The implementation of advance AI technologies in healthcare industry such as facial recognition for online real time massive data collection were advantageous in analyzing health condition and prescribing diets with accurate healthy and hygienic meal selection and efficient delivery service to isolated customers. For example, in April 2019, IBM in Cleveland USA had developed artificial intelligence algorithm for tracking, diagnosis and predicting customer dietary need with higher efficiency than human experts [5].

The relational and heterogeneous databases with advance AI rule-based algorithm were used to manage data from online real time-and-motion transaction to generate accurately design meals with optimal efficiency delivery service to influx of isolated customers in wider distance areas. Examples of attributes collected for AI rule-based data analysis from customers, virtual kitchen, delivery fleet, and suppliers of raw materials are graphically shown in table 2.

Table 2: Examples of data attributes used by AI [2]

AI-Big Data	Attributes
Customer	*Demographic*: health-related symptom, location, insurance, frequency of orders, facial and voice recognition, income, biometric identities *Marketing-Sale*: social media usage, favorite brands, music, video, emoji stickers, packaging, point-of-sale, online-customer acquisition *Preferences*: favorite healthy & hygienic menus, check out, payment, minimum orders, vouchers, discounts, promotion, 24-hour service, delivery charges, nearby restaurant and pick up point with no errors
Virtual Kitchen	Rent, license, kitchen staffs, equipment, robot-in-chef equipment, facilities, computer system, software, high speed internet, menus, inventory, LIVE kitchen studio, on-site cooking vending machine
Delivery Fleet	Vehicles, drivers, GPS, map, location, tracking number, driver license, vaccination, facial and voice recognition, camera, routes, plans
Raw Material Supplier	Fresh ingredients, nearby markets, local farmers, home grown, royal projects, importer, inventory, storage

The use of advance AI rule-based algorithms in virtual kitchen partnership becomes essential tools in predicting isolated individual dietary needs and responses to given meals. However, in health-related isolation environment, only isolated customers with wearable devices, high-speed internet would gain advantageous benefits from health-related AI service providers. The major global AI providers in the healthcare market in 2022 included Intel, Nvidia, Google, IBM, Microsoft, GNS Healthcare, Welltok, Benevolent AI and others [2].

D. Efficiency of Delivery Service Management.

Due to an increasing of influx to delivery and pickup orders from growing number of isolated customers, many virtual kitchens partnerships providers developed and migrated the fulfilling order operation processes to an innovative AI-based search engine in VKPaaS.

The main purposes are to share resources, outsource, share heavy capital expenditures, reduce marginal costs, reduce risk, increase investment and increase profit. More and more business owners in remote areas join VKPaaS to share virtual kitchen facilities, equipment, flexible procurement, human resources, thousands of recipes, health-related legal in order to provide efficient delivery services to mass customers in geographically wider areas.

The VKPaaS search engine calculates location of targeted customers, matches them with designed healthy and hygienic meals, selects the nearest virtual restaurant, fastest routes, and lowest delivery cost to targeted customers residences.

However, VKPaaS search engine required and used three algorithms together to analyze data and prescribe efficient delivery service to each customer including: (1) central of gravity, (2) factor rating and (3) transportation model algorithms [5]–[8]. See graphical representation of VKPaaS Model in figure 2.
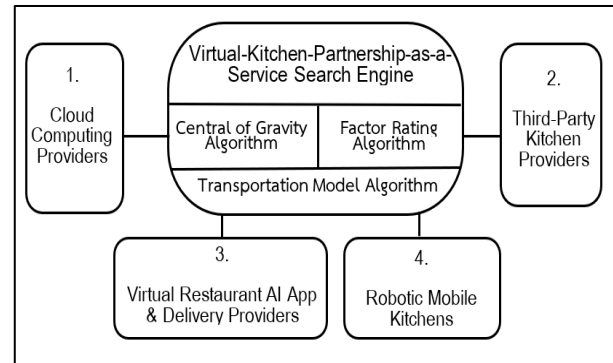

Figure 2: Virtual kitchen partnership as a service model

First, Central of gravity algorithm calculates location of nearest virtual kitchen facilities to targeted customers. See figure 3 for an equation of central of gravity algorithm [7], [9].

$$\overline{X} = \frac{\sum X_i Q_i}{\sum Q_i}$$

$$\overline{Y} = \frac{\sum Y_i Q_i}{\sum Q_i}$$

Where
$X = $ X coordinate of destination i
$Y = $ Y coordinate of destination i
$Q = $ Quantity to be shipped to destination i (place of customer or supplier)
$i = 1, 2, 3, …. n$

Figure 3: Central of gravity algorithm [7]

Second, factor rating algorithm uses AI-rule based data analysis to filter and rating variables for vital health related ingredients and designs healthy and hygienic meals that fit with each customer selection and purchased orders. Finally, transportation model algorithm calculates AI-based online real time-location metrics for fastest, easiest and least expensive routes to deliver meals to targeted customers [5]–[8]. In the transportation model, other methods may be used to improve accuracy of the calculation, such as northwest corner, steppingstone and Vogel's approximation method, see graphical representation of transportation model in figure 4 [7].

			Destination					
		1	2	3	4	5	6	Supply
Source	1	13	10 5	22	29	19	0	5
	2	14	13 0	16 4	21 1	M	0 1	6
	3	3 3	0	M	11 4	6	0	7
	4	18	9	19	23	11 4	0	4
	5	30	24	34	36	28 1	0 2	3
Demand		3	5	4	5	6	2	

$Cost = M + 260.$

Figure 4: Transportation model algorithm [7]

Although there are eight types of VKPaaS business models as shown in table 1, there are four types of VKPaaS hasty adopted and available during COVID pandemic. The four types of VKPaaS included: (1) cloud computing with high-speed internet connection only (e.g., zuul, cloud, Deliveroo, others); (2) virtual kitchen partnership providers with facilities (e.g., McDonalds, Starbucks, Chick-fill-A); (3) virtual restaurants application with artificial intelligence algorithms and delivery providers (e.g., grubhub, doordash, uber eats, whole30); and (4) robotic mobile kitchen on wheels (e.g., Zume Pizza, Ono Food). See figure 5 for graphical representation of VKPaaS in cloud computing environment.
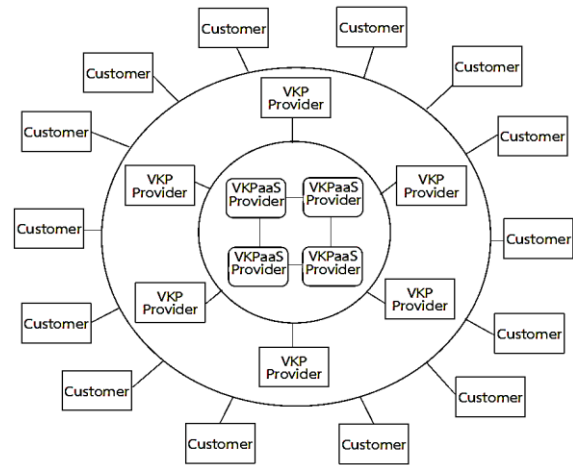

Figure 5: VKPaaS in cloud computing

Example, ele.me one of the largest and fastest growing virtual kitchen partnership providers in Beijing and Shanghai, China owned by Alibaba group had transformed into aggregator of delivery providers without driver fleets business model with capacity of more than 800,000 virtual kitchen partnership providers to 10 million customers. Customers used online food ordering and fulfilling delivery service application every day since the beginning of COVID-19 pandemic. The graphical representation of VPKaaS business model canvas including key partners, key activities, value propostion, customer relationship, customer segments, cost structure and revenue stream is shown in figure 6 below [1].

Figure 6: Example of VKPaaS business model canvas

However, the increasing demand for food safety standards, accuracy with no mistakes, and high security standards with contactless packaging at pickup point or no delivery cost if pick up from ready-meal vending machine had accelerated the need for more efficient delivery service of healthy and hygienic meals to customers inside big cities worldwide.

The research question in this study, therefore, became which factors affecting customers decision to choose and purchase healthy and hygienic meals from virtual kitchen service providers (VKPaaS) with potential impact on the efficiency management of delivery services in health-related isolation environment.

III. RESEARCH METHODOLOGY

Due to drastic changes in behaviors of COVID generation customers, the theory of consumer behaviors on consumption values (TCV) with focus on five values of functional, conditional, social, emotional and epistemic values was adopted to develop research model to study changes in customer behavior variables that may impact the intention to purchase healthy and hygienic meals from online VKPaaS providers [1], [3], [10]. However, the specific values from extended studies of food delivery service suggested that functional value (i.e., price, food safety, health conscious), social value (i.e., prestige and social values), condition value (i.e., effort expectancy) and epistemic value (i.e., visibility) may influence customers intention to purchase in isolation [3]. Additional study on variables that may affect the intention to choose and purchase from online application with AI assistance include performance expectancy, social influence, trust, security, timeliness and task-tech fit [6]. The combination of suggested thirteen variables are adopted to develop efficient VKPaaS delivery service management in health-related isolation research model in this study. See graphical representation of

research model in figure 7 and definition with measures for variables in table 3.

Figure 7: Delivery service management research model

Table 3: Research model variables and definitions [3]

Variable	Definition and Measures
1. Performance Expectancy	Accuracy of designed and ordered healthy & hygienic meals
2. Effort Expectancy	Easy and fast to find related health and value information of designed meals
3. Social Influence	Reliable health and hygienic meals promotion
4. Trust	Use health and hygienic certification seal
5. Security	PDPA, GDPR, Cybersecurity Acts
6. Timeliness	Accurate delivery within 30 minutes
7. Task-Tech-Fit	Easy to use smart phone/tablets to order
8. Visibility	Clear picture with legal data visualization
9. Prestige & Social Value	Authentic, Certify, Creative Common, Consent, Plagiarism,
10. Affordance	Fair selection with diversity and choices
11. Price	Fair/competitive price, discount, vouchers
12. Food Safety	Vaccination, contactless, clean delivery
13. Health Conscious	Links to diet, health, risk of covid-19 information

PDPA=Personal Data Protection Act; GDPR=General Data Protection Regulation

The quantitative and qualitative research methodologies were adopted in this study. The research model was used to develop online questionnaires survey using 5-point Likert scale to collect quantitative data from randomly selected 554 subjects using online food delivery service applications during June and August in 2021. Additional 1-hour in-depth interview with 10 open ended questions method was used to collect qualitative data from randomly and conveniently selected 18 international food delivery service providers with online applications to customers facing similar COVID pandemic and health-related isolation environment in Thailand, China, and USA. The statistical analysis using multiple linear regression and

descriptive analysis methods were used to generate results and findings as presented in the next section.

IV. RESULTS AND DISCUSSION

In making decision to choose and purchase healthy and hygienic meals from VKPaaS providers with efficient delivery management, the findings suggested that new COVID generation customers were influenced by five variables including performance expectancy, effort expectancy, perceived trust, social influence, and price, respectively. See graphical representation of VKPaaS efficient delivery management model in figure 8. However, the R squared value of 0.654 in table 4 suggested that only 65% of variation in customer intention to choose and purchase healthy and hygienic meals from VKPaaS with efficient delivery service management could be explained from high correlation values of the following five variables with high Beta values and significant level less than 0.055.

Table 4: Multiple linear regression results

R Square	Std. Error	F Change	df1	df2	Sig. F Change
.654	.51745	56.348	13	387	.000

a. Predictors: (Constant), Visibility, Social Value, Perceived Safety, Social Influence, Food Safety, Performance Expectancy, Timeliness, Price, Health Conscious, Affordance, Effort Expectancy, Perceived Trust, Task-Tech-Fit

Coefficients [a]

Model	Beta	t	Sig	VIF
(Constant)		.334	.738	
Performance Expectancy	.408	9.381	.000*	2.122
Effort Expectancy	.189	3.896	.000*	2.635
Perceived Trust	.179	3.658	.000*	2.687
Social Influence	.113	2.887	.004*	1.710
Price	.087	1.923	.055*	2.293
Affordance	.086	1.857	.064	2.391
Timeliness	.060	1.198	.232	2.783
Health Conscious	.030	.692	.489	2.141
Food Safety	-.009	-.203	.839	2.076
Visibility	-.020	-.444	.657	2.388
Security	-.041	-1.064	.288	1.647
Social Value	-.050	-1.383	.168	1.486
Task-Tech-Fit	-.056	-1.023	.307	3.311

a = Dependent Variable: Purchase Intention

First, *performance expectancy* variable referring to VKPaaS ability to accurately design, select and order healthy and hygienic meals with efficient delivery service to isolated customer had the highest impact on their decision to choose and purchase from VKPaaS

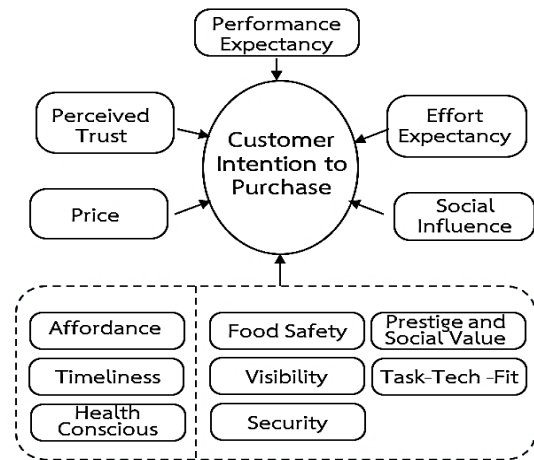with highest Beta value of 0.408 or 40.8% influence from high performance expectancy of VKPaaS.

Figure 8: VKPaaS efficient delivery management model

Second, *effort expectancy* variable referring to VKPaaS ability to provide easily search engine in diverse choices, quickly find innovatively designed healthy and hygienic meals, make purchase order, and accurately receive meals at their isolated residence had the second highest impact on customer decision to purchase with high beta value 0.189 or 18.9% influence from effort expectancy provided by VKPaaS.

Third, *perceived trust* variable referring to VKPaaS ability to create trust from certified health and hygienic seals, warranty of accurate and on-time delivery service, compliance to PDPR (Personal Data Protection Act), GDPR (General Data Protection Regulation), cybersecurity laws and regulations on payments had the third impact on their decision with beta value of 0.179 or 17.9% influence from perceive trust on VKPaaS.

Fourth, *social influence* variable referring to VKPaaS ability to influence customer to receive reliable healthy and hygienic meal information, marketing sales and timely promotions from ethical social influencers on social media had the fourth impact on their decision with beta value of 0.113 or 11.3% influence from social influence available on VKPaaS online application.

Fifth, *price* variable referring to fair and competitive price from VKPaaS for customer selected healthy and hygienic meals, delivery cost and time had surprisingly lesser impact than four variables above with beta value of 0.087 or 8.7% influence from fair and competitive price offered by VKPaaS.

The remaining eight variables including affordance, timeliness, health conscious, food safety, visibility, security, social value and task-tech-fit variables had impact on customers decision to purchase from VKPaaS with beta values lesser than 0.87 or 8.7% of influence from VKPaaS and at significant level higher than 0.05.

However, additional findings from Cronbach's alpha coefficient or construct reliability analysis values of all variables are greater than 0.7, except for security variable with value of 0.5, as shown in table 5, suggested unexpected errors or random errors such as missing payments, stealing or infected delivery orders may occur in security of service provided by VKPaaS with beta value of -0.041 or 4.1% influence from security on customer decision with significant level of 0.168.

Although three variables of affordance, timeliness and health conscious variables have lesser impact on customers decision, the findings suggested that VKPaaS should take advantages in providing more affordable choices, thousands of recipes for healthy and hygienic meals selection from many countries and local areas with innovative health-related tastes and diets, accuracy and timely delivery service to more health-conscious customers in health-related isolation environment worldwide to stimulate customer decision to purchase from VKPaaS.

Table 5: Cronbach's Alpha and Estimated Correlation

Factor	Cronbach's Alpha	Estimated Correlation with PI
Performance Expectancy	0.873	
Effort Expectancy	0.872	
Perceived Trust	0.922	0.726
Social Influence	0.915	0.596
Price	0.882	0.595
Affordance	0.911	0.669
Timeliness	0.857	
Health Conscious	0.907	0.578
Food Safety	0.829	
Visibility	0.879	0.644
Security	0.549*	
Social Value	0.924	0.323
Task-Tech-Fit	0.898	

PI = Purchase Intention

The remaining five variables of food safety, visibility, security, social value and task-tech-fit variables with lower beta value and significant levels of influence on customers decision suggested that VKPaaS should (1) add compliances with food safety on vaccination, contactless packaging, and clean delivery; (2) increase visibility with clear, attractive and innovative food-health-related pictures via high quality live AI or AR visualization technology for ease of selection; (3) compliance with health security standards such as Food and Drug Administration (FDA) or hearth association in each country; (4) increase prestige & social values with authenticity, certification, creative common, consent and no plagiarism in innovative recipes and creative packaging; and (5) add easy and fast ordering, tracking and fulfilling systems from any smart phones and AR wearable devices.

Furthermore, security variable had lowest convergent validity AVE value of 0.3785 than expected validity of 0.5 suggested that security variable was not enforced, visibled and complied in delivery services by VKPaaS.

In summary, new COVID generation customers were demanding for higher health and hygienic security standards from VKPaaS delivering service management with contactless packaging, no mistakes, no stealing and mistaken of identity in their delivery services.

Table 6: Convergent validity analysis using AMOS

Factor	AVE
Performance Expectation	0.6442
Effort Expectancy	0.6372
Perceived Trust	0.7487
Social Influence	0.7840
Price	0.6631
Affordance	0.6760
Timeliness	0.6664
Health Conscious	0.7103
Food Safety	0.7081
Visibility	0.6523
Security	0.3785*
Social Value	0.7161
Task-Tech-Fit	0.6888

In addition, the qualitative analysis using descriptive analysis was conducted to address the challenges and problems facing delivery service management among VKPaaS providers using 1-hour in-depth interview with randomly and conveniently selected 18 international food delivery service providers with online applications to customers in global COVID pandemic and health-related isolation environment in Thailand, China, and USA.

The findings suggested that many VKPaaS providers were remarkably gaining more online sale volumes and dramatically increased in number of customers with market share of 26.9% and 47% increase in revenue year-to-year during the pandemic locked down. See performance increase findings in table 7.

Many VKPaaS providers continued to add state of the art technologies to their surviving strategy and cloud kitchen platforms, such as, intelligent scheduling, AI based-automatic dispatching, local Live with AR platforms for fulfilling order systems with 30 minutes delivery time using diversity of food choices and thousands of recipes to more locked down isolated customers in wider areas.

More needs from isolated customers had emerged and added to their food delivery services including new market-trend platforms for non-catering retail-supermarket takeout, medical errands, flowers, vegetables and fresh ingredients.

Table 7: Emerging customer needs in VKPaaS

Efficiency Issues	Description
Business Purpose	Enhancing corporate image, promote products sales, reduce sale during pandemic, reduce service costs, and want to establish a perfect information release ordering system
Timeline	Since 2018, 12 years of service with 30 minutes delivery service, creating, and adding Local LIVE service platform and AR technology to stimulate more sales
Performance	Sale volume increase, number of users increase dramatically. More restaurants in cooperated with us. Market share of hungry reached 26.9%. Revenue increased by 47% year-to-year
Online Service	Using high technology AI-based facial recognition to provide convenient and fast ordering services for consumers who are busy, do not wat to go out. Offering diversity of food choices to consumers for repeated orders for a long time
Customer Needs	Adding new-retail non-catering takeout, i.e., supermarket shopping, flower ordering, medical errands, fresh vegetables, ingredients, and new market-trend platforms.

However, new issues facing VKPaaS were challenges & problems, adaptation, surviving strategy, cloud kitchen platforms, surviving factors, trend on online food and cloud kitchen, as shown in table 8.

Many VKPaaS providers encountered these challenges and problems of vast expansion by searching for more financial resources, crowdsourcing, shared investment, quick conversion from cash-in-flow to costs, compliance to localized food safety, health security of employees, vaccination, disinfection, cleanliness and others emerging issues.

Table 8: Emerging isolated economy issues

Emerging Issues	Description
Challenges Problems	High cash flow and conversion of costs, keep sustainable resources and investment, and team organization management ability
Adaptation	Adapt to surge of customer volumes, different needs, food safety, employee vaccination, disinfection and cleanliness
Surviving Strategy	Set intelligent scheduling system, used AI big data balance algorithm to realize automation dispatch.
Cloud Kitchen Platforms	Yes. Want to diversity services, attract customers, consumers with a novel enterprise model, publicized image of restaurant, gain trust and maximize profits.
Surviving Factors	Food safety, health and hygiene standards, quality and freshness of food.
Trend online Food	Develop and expand to multiple platforms, dimensions, more customers, improvement of takeout system ad more diversified choices
Trend on Cloud Kitchen	Health-related "Isolated Economy" accelerated takeout, more sale channels, increase revenue and new business models.

To survive in upcoming new health-related isolation environment, many VKPaaS providers swiftly adopted

food safety, health and hygienic standards, quality and freshness of food to meet the increasing demand for online healthy and hygienic food delivery services in new emerging "Health-related Isolated Economy".

Finally, to achieve higher efficiency in delivery service management, the findings from in-depth interview suggested that many VKPaaS providers constantly re-invested in advanced state of the art technologies to create innovative recipes with creatively designed packaging for contactless delivery service with automatic cleaning and disinfection robot using intelligence cloud-based VKPaaS software to attract mass new isolated non-sharing individual behavior customers with expected high return on their investments, as shown in table 9.

Extra allocation of funding to support compliances to food safety, health related laws and regulations in each region worldwide beyond the pandemic, such as, Food and Drugs Administration (FDA) and Heart Association were mandatory and incorporated into VKPaaS surviving strategies.

Table 9: Financial issues facing VKPaaS

Financial Issues	Description
Investment	About 500,000-1,000,000 yuan shall be increased or reduced according to medium-term operation and actual operation
Return on Investment	Expected return income of 2,000-5,000 yuan per month according to passenger flow, and provide flow from other extended businesses of the company to drive development
Fee & Cost	Rent, equipment costs, customer traffic, fee to increase business volume to online kitchen
Law & Regulations	On time and efficient food takeout, safety, quality distribution process should abide by relevant laws and regulations

In summary, the new VKPaaS efficient delivery management model for improvement and advancement of delivery service to new COVID generation customers suggested that performance expectancy, effort expectancy, social influence, perceived trust and price had significant impact on customers with new non-sharing behavior intention to choose and purchase healthy and hygienic meals from online VKPaaS providers. However, the findings were limited to two types of VKPaaS business model with delivery only service (i.e., ghost kitchen and virtual restaurant), as shown in table 1. Therefore, VKPaaS providers are recommended to improve and advance their new VKPaaS efficient delivery management model with remaining six VKPaaS business models. Additional research studies may include VKPaaS sharing capital and resources for expansion of business in wider areas, compliance to state-of-the art of health and hygienic technologies, security standards, laws and regulations in global and local countries for influx of new demand on online innovative healthy and hygienic meals delivery services to customers in health-related isolation environment in culinary and healthcare industries in 2027.

V. CONCLUSION

During global COVID-19 pandemic, many food service providers and online delivery providers had changed their behaviors and partnered into new business known as virtual kitchen partnership as-a-service providers (VKPaaS) on cloud computing with focus on new emerging demand for healthy and hygienic meals in culinary industry with fast, easy and in-expensive delivery service to new COVID generation customers in health-related isolation environment during 2020 and 2026. The VKPaaS used search engine with AI-based technologies in cloud computing and algorithms to determine and innovatively design proper healthy and hygienic meals for customers from the nearest location. This study was conducted to improve and advance VKPaaS efficient delivery management model with vital variables affecting new isolated non-sharing behavior customers decision to choose and purchase healthy and hygienic meals from online

VKPaaS. The quantitative survey research method and qualitative in-depth interview methods collected and analyzed data from randomly selected 554 subjects and 18 food service providers in Thailand, China and USA during 3 months in 2021. The findings suggested performance expectancy, effort expectancy, social influence, perceived trust and price variables had potential impact on isolated customers intention to choose and purchase healthy and hygienic meals with efficient delivery service management to their health-related isolation environment. VKPaaS providers were recommended to comply to state-of-the art in health-related technologies, security standards, laws and regulations in many countries worldwide for efficient delivery service management to influx of new demand for innovatively designed nutrition for healthy and hygienic meals to new generation of changed behaviors customers toward more isolation and no sharing environment in culinary and healthcare industries in the year 2027.

Recommendations for further research and studies may include the research in online crowdsourcing innovation for sharing global financial, facilities, expertise and intelligence resources for advancement of VKPaaS services to new COVID generation customers in isolation economy. The research may focus on artistically design packaging for contactless meals, robotic-mobile vehicles with advanced drone technology for live visualization of automated meals preparation to pick-up-point in geographically wider areas with compliance to healthcare standards, security and regulations for new emerging health-related isolation economy.

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