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The Value and Impact on Business Revenues through the Use of Digital Proximity Solutions

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ABSTRACT

This study examines the trends in the F&B markets and the actions of F&B businesses to explore the various ways companies use digital proximity solutions (DPSs) for marketing, customer service, etc. The purpose of this study is to analyze the impact and value of various DPSs on business revenues and to compare how businesses in different markets use these technologies to positively influence their business. To support the research, this study has conducted a survey using a random sampling method to invite residents from different countries. The survey investigates 153 consumers about their acceptance of DPSs in the F&B industry and their effectiveness in stimulating customer revisits. A quantitative research method is applied in the study. This study finds that companies use different solutions in different regions to achieve various improvements. Combining the secondary research on the value of each DPS with case studies and the survey in different geographic markets, this study provides some recommendations to F&B businesses that hope to increase revenues using DPSs.

Author Keywords

Digital proximity solutions, DPSs, F&B businesses, geographical market, value, impact, revenue.

INTRODUCTION & MOTIVATION

Technologies are changing the business landscape by integrating into the very fabric of commercial activities in all sectors. Following the sweeping trend of digital transformation, F&B companies also try to promote sales and increase revenues using technologies. Nowadays, F&B companies can leverage digital proximity technologies to maximize the effect of marketing and sales strategies. Among all the technologies, digital proximity solutions are popular in data collection and customized recommendation. Digital proximity solutions refer to devices that broadcast specified promotion content to customers within a certain range, or devices that quicken guest gratification. Common types of digital proximity technologies include Wi-Fi, QR code, geofencing, NFC, RFID, BOPIS locker, recommendation system, robotic waiter, digital assistant, and automated ordering system. While some of the solutions are widely used in almost all types of restaurants — such as Wi-Fi, NFC, and QR code, other solutions are popular in certain types of restaurants only.

Therefore, this research aims to give a comprehensive analysis of the values of the above-mentioned 11 digital proximity solutions for F&B companies. Specifically, the research will display how each solution increases revenues for F&B companies, and how different types of restaurants may implement their application strategies in different markets. The research includes two key points. Key point 1 is the business value of the various applications of 11 digital proximity solutions in F&B businesses. Key point 2 is how these digital proximity solutions are used in different types of restaurants (i.e., fast food chains, beverage companies, and Chinese restaurants) and different geographic markets (i.e., Singapore, China, and other countries).

PROBLEM STATEMENT

In the era of an increasing trend of digital transformation, many businesses use digital proximity solutions to support operations. However, with increasingly intense market competitiveness, businesses may use different digital proximity solutions in different markets. F&B businesses are applying various digital proximity solutions to increase their business revenue. In order to maximize business value, it is significant for restaurants to figure out the types of digital proximity solutions that are widely used in the current market, each market's characteristics, and how to develop an optimal strategy in different markets.

However, current research on this issue is scattered and lacks depth. While some studies have explained how such solutions can be technically implemented and executed, few studies have delved into the various ways companies are using digital proximity solutions in marketing, customer service, etc., and how they can positively impact revenue impact. Therefore, this study explores the various digital proximity solutions that F&B businesses use for marketing, customer service, etc. to increase business revenue. It also compares how F&B businesses develop DPS application strategies in different geographic markets. This study aims to provide F&B companies with insights and recommendations to drive revenue growth through various aspects.

LITERATURE REVIEW

Digital Proximity Solutions

Digital proximity solutions are technologies that conform to or implement the principles and rules of proximity to enhance marketing. Proximity in this sense is a two-fold concept. First, proximity is about the relative location of different objects in space. In other words, proximity describes how close one object is to a certain location or another object (Hightower & Borriello, 2001). Second, proximity also takes on a business-related meaning by referring to how quickly customers' requirements are met (Outthinker, 2022). The innovative consulting company Outthinker takes a further step to clarify proximity as gratifying customers' desire with temporal, spatial, and relational closeness (Outthinker, 2022). Therefore, digital proximity solutions are either technologies that transfer information to devices within certain distances, or technologies that fasten customers' gratification. The study will continue to introduce 11 types of the most sought-after digital proximity solutions in the current market.

Digital Transformation

Digital transformation was initially understood as a fundamental change in cross-industry organizations, which is gradually penetrating business processes, products and services, as well as business models of companies (Haffke, 2017). According to McKinsey's report, "digitalization" includes three aspects: digitalization of assets, digitization of operations, and digitization of labor (Woetzel et al., 2017).

The Accenture research team believes that the most notable feature of digital transformation is the improvement of operational efficiency under the application of digitalization. The digital transformation is not only a microscopic transformation of the deep integration of digital technology and product development, but also an innovative symbol of the transformation of companies from traditional production systems to digital systems (Wu et al., 2019).

Digital Transformation Trend in the F&B Industry

Digital tools can assist F&B businesses in improving service quality, building scenario-based experience models for target populations, promoting user-centered Internet thinking, and convincing customers to receive brand indoctrination in a relaxed environment (Jiang, 2012). According to McKinsey's report (Stacey et al.2020), in the era of the epidemic, strong online food ordering businesses, digital loyalty programs, and strong customer relationship management (CRM) systems have become the lifeline of restaurants in this crisis, because consumers' digital engagement has skyrocketed. For example, Starbucks' share of digital transactions has grown by 12% in

China in the post-pandemic era – from 15% in January to 27% in March. Customer experience is critical to retaining existing customers and winning next-generation loyalty.

Nowadays, traditional F&B businesses are impacted by the mobile internet era. F&B businesses must change their business model and leverage the latest technology into businesses (Li, 2018). Digital transformation must be strategically and purposefully implemented based on the current market environment and unique business features (Zhao, 2020).

METHODOLOGY

A key focus of this study is to explore the various ways that businesses can use digital proximity solutions in marketing, customer service, etc. in the current market. It also aims to analyze how businesses apply digital proximity solutions to have a positive impact on their business revenue. Since the process is difficult to quantify and there is little relevant literature, it was decided that secondary research would be adopted to explore the various ways and analyze the value of these ways. Secondary market research reports from McKinsey, Bain and BCG are one of the main sources. Particularly, case studies would also be conducted because cases can facilitate the process of analyzing how digital proximity solutions drive business revenue growth.

In addition, the study also aims to compare how businesses in different markets use such solutions to drive business revenue. To have a meaningful result, this study limits the research scope to the F&B industry and specifically looks to fast food chains (e.g., McDonald's, KFC), beverage businesses (e.g., Starbucks, HeyTea), and Chinese restaurants (e.g., Haidilao, Din Tai Fung). It was decided to use secondary research case studies in the geographical market comparison. A survey is also conducted to investigate consumer acceptance, preferences, expectations, and suggestions for digital proximity solutions in the F&B industry, as a supplementary analysis of the value of digital proximity solutions.

SECONDARY RESEARCH

Various Ways of Using Digital Proximity Solutions

The first step of the secondary research is to explore the various ways F&B businesses are using digital proximity solutions for marketing, customer service, etc. as well as to analyze the impact and value of various digital proximity solutions on business revenues. In this research, 11 ways are analyzed. Secondary market research reports from McKinsey, Bain and BCG are one of the main sources.

Automated Ordering System

According to McKinsey's report, with the outbreak of COVID-19, the take-out and food delivery ecosystem is growing rapidly, and online ordering has become a new trend (Ahuja et al., 2021). With customers focused on order delivery speed and order accuracy and completeness, relevant digital technology support is important. An automated ordering system can help restaurants maintain high operational efficiency and customer retention in this trend.

An automated ordering system is a software solution for restaurants that allow customers to place orders instantly through a website, mobile app, or digital board. Customers can simply confirm the ordered item and delivery time on the website or app or digital board. Its working mechanism can be seen in *Appendix 1*. An automated ordering system can create value for restaurants through improved marketing, customer service, operational efficiency, and cost savings.

(1) As online ordering allows customers to order from anywhere at any time, an automated ordering system can help restaurants reach broader demographics and expand their target operational geographic areas, broadening their revenue streams. As it allows numerous customers to place orders at the same time, it eliminates the limit on restaurants' order volume and allows them to multiply order volumes during peak times.

(2) The automated ordering system can also help restaurants efficiently collect customer information and understand customer preferences. For example, the system can help restaurants collect information on popular menu items, popular food combinations, and peak hours. This helps restaurants optimize menus, pricing, and marketing strategies, thus achieving sales growth. Customer data can also be stored and used for personalized recommendations when they revisit.

(3) An online ordering system (such as an App) allows restaurants to automate the management of loyalty programs and track each customer, for example by sending marketing and promotional messages to customers, which can help increase customer loyalty and thus increase revenue.

(4) An automatic ordering system provides consumers with a better ordering experience. If customers don't want to go to a restaurant, they can simply order online from anywhere at any time, which reduces waiting time and brings great convenience to their busy lives. Besides, the automated ordering system provides customers with dish images, and detailed ingredients and allows them to quickly view the total price, helping them make better dining decisions.

(5) An automated ordering system can help restaurants improve operational efficiency. First, it allows restaurants to make real-time menu changes. In the event of a food supply shortage, menu items can be quickly removed, avoiding customer complaints due to food unavailability. Second, it allows customers to check orders before ordering, avoiding potential mistakes and omissions and ensuring order accuracy, thus avoiding possible food waste and customer complaints. Third, it saves time and energy for staff, allowing them to focus on other vital tasks and improve customer service. Moreover, the automated ordering system can also serve as an intelligent accountant, helping restaurants track each transaction, calculate revenue and expenses, and generate transaction reports.

(6) The automated ordering system automates the ordering process and reduces employee involvement in order, which significantly saves labor costs.

Wi-Fi

Wi-Fi is a solution that attracts customers to stay by providing visitors with a free Wi-Fi connection. Restaurants can use Wi-Fi to provide customers with discounts or collect information on customer behavior and preferences.

(1) Attract broader demographics

Restaurants with Wi-Fi are always ideal places for business meetings, private parties, and other events because free Wi-Fi allows customers to work in restaurants, which helps restaurants to attract broader demographics.

(2) Improve customer experience

Providing free Wi-Fi makes it easier and more convenient for customers to use QR codes to order and make contactless payments. Wi-Fi allows customers to browse the web while dining. In this way, Wi-Fi can greatly improve customers' experience of ordering, dining, and checking out.

(3) Collect customer information

Before connecting to free Wi-Fi, restaurants can set up customized and exclusive request portals that require guests to sign in with their social media accounts or provide their email addresses to collect customer data and better understand their customers.

(4) Marketing

With Wi-Fi access, customers can share photos on social media and post comments online with the real-time location tag. This is a low-cost but effective way of advertising where Wi-Fi can be used as a marketing tool for restaurants. During customers' waiting time, Wi-Fi allows customers to know about restaurants' current special offers and discounts that they can use the next time they visit, which can improve customer loyalty.

QR Codes

QR codes are small and flexible and can be used to store user-defined information. Scanning a QR code can trigger different actions: 1) displaying text or images, 2) downloading a document, 3) filling out a form, 4) sending a message or email, 5) going to a website or a social media platform, etc. Restaurants can use QR codes as a contactless solution to create value in several ways.

(1) Marketing

QR codes can be created to jump to product advertisements, discounts and coupons, or the online ordering website to stimulate consumers' impulse to order and drive revenue. In addition, QR codes linked with social media sites such as Instagram can be used as an effective advertising tool to encourage customers to share positive dining experiences on social media and attract a wider range of customers.

(2) Ordering

QR codes can also be used as a cost-effective and sustainable digital menu, through which customers can simply scan the code to view the menu and order. A digital menu can not only improve restaurants' operational efficiency through real-time menu updates, improved order accuracy, and saved time and energy for staff, but can also improve customer ordering experience with food images and less waiting time. In addition, saved menu printing costs and labor costs can also boost profits.

(3) Payments

Nowadays, customers can simply scan a QR code and enter an amount to complete a transaction quickly. Restaurants can use QR code payment to reduce labor costs, improve checkout efficiency and enhance customer experience, resulting in revenue growth.

(4) A tool to collect customer feedback

QR codes can help restaurants collect customer feedback and improve food offerings and customer services based on customer feedback to maximize CLV (i.e., Customer Lifetime Value), which means extracting the maximum possible value of each customer by increasing customer stickiness to increase sales. A specific explanation of CLV can be found in *Appendix 2*.

Restaurants can create QR codes and link to a service comment website, a post-dining survey, or a social media site to collect customer feedback. For example, by scanning QR codes to jump to a post-dining survey, restaurants can encourage customers to give feedback that can be sent to the customer service department. In this way, QR codes can help restaurants collect customer feedback, improve customer service, and increase CLV.

In addition, customer information (e.g., phone number, email address) collected from QR codes can be used to improve customer loyalty. For example, restaurants can send customers a thank-you letter with discounts or coupons after a meal to invite them to revisit and join a loyalty program, thus building a deeper connection with customers and increasing customer loyalty.

Digital Assistants

Digital assistants are a new tool that business use to interact with consumers, Apple's Siri is an example. Digital assistants can search consumers' past search and purchase history and provide consumers with personalized recommendations. They can also chat with consumers, helping boost consumer engagement and loyalty.

(1) Reduce operating costs

Smart voice assistants can help businesses reduce operating costs by automating certain tasks, such as ordering and checkout. In this way, restaurants can save labor costs. They can help businesses save about 4 minutes, which means saving \$0.50 to \$0.70 per interaction.

(2) Improve operational efficiency

Human error is a common restaurant problem. For example, at peak time, waiters may disorder or miss orders which leads to customer complaints. Ordering by digital assistants can reduce human errors and food waste. Meanwhile, digital assistants can relieve employees' pressure, ensuring they are not overworked during peak hours, and they can prepare food and deliver food quickly and accurately.

(3) Improve customer experience

Digital assistants can be used to provide customers with a more interactive and engaging experience. For example, restaurants can use gesture recognition technology to allow customers to order food simply by clicking on a digital screen. At the same time, voice assistants can answer multiple calls at any time, providing a good customer experience that reduces customers' waiting time.

(4) Boost sales

Voice assistants can help boost sales by personalized bundling recommendations. For example, if a customer ordered a burger, the system would suggest adding fries or a drink.

BOPIS Locker

BOPIS refers to "buying online and picking up in store". BOPIS lockers are cabinets where commodities prepaid by customers are stored for them to collect. The working mechanism of BOPIS lockers is elaborated in *Appendix 3*. Restaurants can rely on BOPIS lockers to broaden their customer base, increase impulsive purchases, enhance customer service, and save costs.

(1) BOPIS lockers attract more customers for restaurants by integrating online and offline shopping channels. In this way, the lockers fulfill the requirements of customers looking for a personalized online shopping experience.

(2) BOPIS lockers stand as an advertisement that attracts new customers from the area of its position when located in places other than the physical outlet. As a new technology, lockers bring unique pleasure to customers.

(3) BOPIS lockers located at the physical store stimulate further on-spot purchases because customers tend to buy more items at the outlets when picking up their pre-paid orders.

(4) BOPIS lockers improve the ordering and the checkout experience. Customers can place orders and make payments on their devices anywhere and anytime. Besides, the locker doesn't charge delivery or storage fees, so customers can spend less on shopping.

(5) BOPIS lockers improve the dining experience by reducing unnecessary waiting for customers. The locker gives flexible options for customers on when and where to get the desired commodities.

(6) BOPIS lockers reduce logistics costs and time by reallocating the burden of last-mile delivery to customers. Retailers will have their delivery costs cut significantly when customers are those who are responsible for taking parcels back home.

According to McKinsey's report, BOPIS practice has enjoyed increasing rates of adoption even in the postpandemic period. A variety of businesses are now embracing BOPIS, including apparel, general and mass merchandise, sporting and leisure goods, and domestic improvement. The convenient and free services are likely to expand into other areas (Barbee et al., 2021).

Food Delivery Robots

Food delivery robots/robotic waiters are used in restaurants to automate services. These robots can help humanity in guest reception, order taking, payment processing, and food serving. Robotic waiters can help restaurants enhance advertising, improve guest experience, bring operational efficiency, and save costs.

(1) Food delivery robots can improve advertising and customer engagement by displaying real-time advertisements. When the robots glide around the restaurant with ads and promotions on their screens, they will increase ad exposure to the customers. Robots can also maintain interaction with customers with cute expressions.

(2) Robotic waiters bring fantastic dining experiences to customers. Robots can attend to many guests accurately and quickly. They are also reducing the possibility of bacterial infection by cutting human interaction and maintaining social distance.

(3) Delivery robots can eliminate errors and increase accuracy. Robots are good at repetitive jobs and carrying heavy meals. Algorithms and motion control systems ensure a much lower likelihood of spilling and falling over.

(4) Robotic waiters will save servants time and energy. Robots can take the most burden of labor-demanding tasks from human servants. In this way, human staff will have more time to rest or focus on more significant jobs.

(5) Robots can reduce labor costs for restaurants. Robotic waiters can work for a long time with no rest, nor do they require salaries or breaks. Robots are also capable of solving the problem of staff shortage.

RFID

RFID (radio-frequency identification) is a contactless system that uses radiofrequency electromagnetic fields to transmit data from tags attached to objects for automatic identification and tracking (Jia et al., 2012). The working mechanism can be seen in *Appendix 4*. According to McKinsey's research (Adhi et al., 2021), modern RFID technology can help businesses improve inventory management efficiency, improve operations, reduce costs, and increase revenue. Specifically, RFID can help businesses improve inventory accuracy by at least 25%, reduce work hours by 10-15%, and increase revenue by about 1.5% (Adhi et al., 2021). Restaurants can use RFID technology for inventory management and contactless payments.

(1) Inventory management

Restaurants can use RFID technology to track food in the supply chain to improve inventory visibility and tracking efficiency. RFID tags can be attached to each item to store and transmit all information about the product. This information may include product origin, manufacturer, production date, expiration date, nutritional information, and many other data. The RFID reader then collects and integrates the information into the restaurant's database system and presents it to the manager in an easy-to-read interface, who can then quickly and easily access and view inventory information in real-time on an electronic device, such as a smartphone.

RFID-based inventory management can bring restaurants a bunch of benefits. First, automated inventory management can provide restaurants with real-time, accurate and detailed inventory information, avoiding

problems such as under-stocking, inventory backlogs and human error, thereby optimizing supply decisions. Second, automated inventory retrieval is faster and cheaper compared to manual retrieval, which not only improves inventory management efficiency, but also saves labor costs. Third, automated inventory management allows staff to spend more time and effort on customer service. Additionally, RFID technology can help restaurants identify food safety hazards by tracking food's expiration date, and alert restaurants to dispose of expired food in time to avoid potential risks and losses.

(2) RFID payments

In addition to using RFID in inventory management, restaurants can also use RFID technology to provide selfservice checkout services. For example, restaurants can use an RFID reader to retrieve information from customers' RFID tags. Customers can purchase RFID tags and bind the tags to their restaurant accounts. When they reach the restaurant, they can use the RFID tag scanner to scan the tag, and the restaurant system will automatically deduct the meal fee from their account. This self-checkout method can save customers' checkout time, improve restaurants' operational efficiency, and help with data management and analysis.

NFC

Near Field Communication (NFC) is a technology that allows close-range, touch-free data transmission between RFID (Radio Frequency Identification) chips and NFC-enabled devices. The working mechanism of NFC communication can be referred to in *Appendix 5*. Restaurants can achieve improvement in customer loyalty, customer service, operational efficiency, and cost reduction.

(1) NFC can enhance customer loyalty by connecting customers to the reward program. Customers can win back points and other gifts by using NFC payment and redeeming those points for discounts and free products.

(2) NFC payment streamlines the checkout process for customers. With NFC exempting the involvement of cash and credit card in the checkout, diners can pay in a quick, safe, and convenient way.

(3) NFC payment reduces errors and improves accuracy. Customers will not face problems like the wrong amount of small change usually seen in traditional transactions.

(4) NFC payment saves staff time and energy, and lower labor costs for the restaurant. Compared to changemaking and credit card authentication, NFC payment requires only easier and fewer operations. The restaurant can save money to hire a cashier since every servant can learn how to activate NFC payments.

Geofencing

Geofencing is a location-based solution that uses virtual borders around a physical spot (such as a store) to target potential customers with advertisements or messages. It allows stores to send customized messages to their customers based on their real-time locations.

(1) Improve tracking efficiency and reduce costs

Based on information feedback gained from geofencing, restaurants can track peak hours and the number of visitors more effectively and make better decisions on operations or marketing. It helps restaurants improve efficiency while reducing labor costs.

(2) Improve marketing

Location-based technology helps restaurants measure the effectiveness of marketing campaigns. In addition, it can help restaurants track consumers' actions after advertisements or receiving a coupon, thus helping businesses produce more targeted marketing strategies to attract more customers and increase revenue.

Beacon

Beacons/Bluetooth low energy (BLE) beacons are devices that can broadcast information to Bluetooth-enabled receivers within their ranges. Beacons are capable of transmitting messages such as UIDs, URLs, plain texts, pictures, etc. Tablets, smartwatches, and smartphones are mobile facilities usually equipped with BLE receivers. Beacons can attract more customers, improve engagement and micromarketing, and save time, energy, and advertising costs.

(1) Beacons can expand the customer base to new geographical areas for the restaurant. Beacons can be located in districts other than the dinner to broadcast ads and restaurant information.

(2) Beacons can improve advertising and engagement by offering promotions, restaurant websites, dish information, and navigation to the restaurant.

(3) Beacons can collect customer data and provide personalized recommendations. As customers choose to receive information from the beacons, the beacons can note down customer preferences and habits for profiling. They can also provide recommendations based on customer location.

(4) Beacons can save staff time and energy. As beacons are broadcasting instructions and guidance to customers, servants can be exempted from such repetitive jobs and concentrate on other important services.

(5) Beacons are cost-effective advertisement enablers. Beacons take up little space and fit anywhere in the shop or the street. The energy consumption of one beacon is low and can operate on one coin battery for several years. The price of a beacon varies from 5 to 12 USD, which could be lower if the beacons are bought in large quantities. Beacons rely on Bluetooth signals alone to communicate, leaving the Internet connection unnecessary.

According to Bain & Company (2020), in-store sensors like beacons will have a positive influence on operational efficiency, conversion rates, real-time decision-making, theft prevention, and other aspects that directly relate to revenues after their adoption. Research done by Bain & Company (2020) also indicates promisingly great rates of satisfaction among current users of indoor sensors.

Recommendation System

A recommendation system is a machine learning model that filters a customer's interests and purchases and recommends content that customers may have an interest in. Restaurants use a recommendation system to suggest dishes that may match their tastes and interests based on user feedback and historical data. Its specific types can be found in *Appendix 6*. It helps restaurants better understand and serve customers, enhance customer experience, improve overall operations, and drive sales.

(1) Personalized recommendations can help customers quickly find new and delicious dishes that they like, which satisfies their insatiable desire to search for new and exciting cuisine. Thus, the system can help restaurants increase turnover and retain existing customers.

(2) The recommendation system can help restaurants intelligently collect user data and gain insights about customer preferences, so that they can optimize menu design and conduct targeted marketing campaigns to cater to consumer preferences and stimulate customer visits.

(3) The system can help restaurants save costs because a) the system's design and development costs little; b) By optimizing food offerings based on customer preferences, the system can help restaurants reduce food waste and costs associated with excess inventory.

Case Study

To have a thorough comparison of how F&B businesses in different geographic markets use digital proximity solutions to have a positive impact on their business, cases in different F&B businesses and different geographical markets are to be studied. In this research, six businesses with three types are studied: (1) McDonald's and KFC (fast food chains) (2) Starbucks and HeyTea (beverage businesses), and (3) Haidilao and Din Tai Fung (Chinese restaurants). Regarding geographic markets, this research specifically compares Singapore, China, and other developed countries with a well-developed F&B industry (e.g., the US, UK, Japan).

Table 1 is a summary of how the 6 F&B companies in different sectors (e.g., fast food chain, beverage business, Chinese restaurant) use digital proximity solutions in different geographical markets.

	Automate	Wi-Fi	QR	Digital	BOPIS	Delivery	RFI	NFC	Geo-	Beacon	Recommendatio
	d ordering		codes	assistant	locker	robots	D	payment	fencing		n System
	system								_		
SINGAPORE											
McDonald's		\checkmark	\checkmark					\checkmark			\checkmark
KFC	\checkmark	\checkmark	\checkmark					\checkmark	\checkmark		\checkmark
Starbucks	\checkmark	\checkmark	\checkmark					\checkmark	\checkmark		\checkmark
Hey Tea	\checkmark	\checkmark	\checkmark					\checkmark			\checkmark
Haidilao	\checkmark	\checkmark	\checkmark					\checkmark			\checkmark
Din Tai Fung	\checkmark		\checkmark					\checkmark			\checkmark
CHINA											
McDonald's		\checkmark	\checkmark					\checkmark			\checkmark
KFC		\checkmark	\checkmark								\checkmark
Starbucks		\checkmark	\checkmark					\checkmark			\checkmark
Hey Tea	\checkmark	\checkmark	\checkmark					\checkmark	\checkmark		\checkmark
Haidilao	\checkmark	\checkmark	\checkmark				\checkmark	\checkmark			\checkmark
Din Tai Fung	\checkmark		\checkmark					\checkmark			\checkmark
OTHER COUNTRIES (e.g., US, UK, Japan)											
McDonald's	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark			\checkmark	\checkmark	\checkmark	\checkmark
KFC	\checkmark	\checkmark	\checkmark					\checkmark			\checkmark
Starbucks	\checkmark	\checkmark	\checkmark					\checkmark			\checkmark
Hey Tea		\checkmark	\checkmark					\checkmark			\checkmark
Haidilao		\checkmark	\checkmark			V		\checkmark			\checkmark
Din Tai Fung						1					1

Table 1. A table shows F&B businesses' use of digital proximity solutions in Singapore, China, and other countries.

In Singapore

According to Table 1, automatic food ordering systems, Wi-Fi, QR codes, NFC payment and recommendation systems are used by most F&B businesses in Singapore. The fast-food chain industry also uses geofencing and BOPIS lockers. However, only some Chinese restaurants use delivery robots.

(1) Fast Food Chain

In Singapore, the automated ordering system and NFC technology are common digital proximity technologies in fast food chains like McDonald's and KFC.

McDonald's in Singapore is equipped with a digital ordering board that allows customers to order and pay using a touchscreen interface. This digital ordering board will display a digital menu with various food categories, attractive images, and automatic price calculations. This provides consumers with an extremely convenient ordering experience without long waiting times or poor menu-browsing experience, increasing consumers' desire to order. It also allows McDonald's to edit menu items and collect order information quickly and accurately at any time. In addition to improving operational efficiency, the automated ordering system can also reduce a large number of labor costs and thus drive net revenue growth.

Besides digital ordering boards in physical stores, McDonald's also allows consumers to order through its mobile app. If consumers are too busy to order in the physical stores, they can simply use the app to order from anywhere at any time. In this way, McDonald's creates an easy and convenient dining experience for busy customers, which not only increases consumer interest and engagement, but also helps build loyalty and drives long-term profits.

Another technology that can optimize consumer experience is NFC payment. Once customers complete their orders on the ordering board, they can simply put a credit card in the card-reading area and payment will be complete in seconds. Likewise, the convenience and speed of NFC payment have a positive impact on McDonald's revenue.

(2) Beverage Businesses

Starbucks in Singapore uses geofencing technology for a variety of purposes, including mobile ordering and payment, targeted advertising, and customer engagement.

Starbucks uses geofencing in its mobile app, which allows customers to order and pay for their drinks in advance through the app. Besides, the system can also automatically recommend the nearest store for customers, and customers can pick up the goods at the designated location. This not only increases convenience for customers, but also reduces the ordering pressure of store employees, avoids some errors in manual ordering, and reduces costs.

In addition, when customers are within a certain distance from the store, the app will also send notification reminders, including targeted offers and promotional information, etc. This can prompt some customers to place orders and encourage them to visit the store and make an order. For example, during the annual Pumpkin Spice Latte launch, Starbucks created geofences around some stores and offered exclusive offers and promotions to customers within the boundaries to attract customers to try new products and increase revenue. Besides, it also helps Starbucks identify new potential customers and retain existing customers, thus improving customer loyalty and engagement.

(3) Chinese Restaurants

Din Tai Fung has optimized its transaction process by adopting NFC based payment system in Singapore. In this way, NFC helps the restaurant improve customer experience.

First, diners can pay quickly and conveniently. They can simply put their devices with the Apple Pay function within the range of the NFC terminal to accomplish the transaction. Customers don't need to wait for their change or credit card authentication. The process is much quicker than traditional methods by cash and credit card.

Second, NFC payment is safer than cash and credit payment. In a traditional setting, customers must hand over their cards to servants, which may involve the risk of card loss or identity theft. They would also be facing the problem of receiving fake banknotes. Using NFC guarantees more security since no cash or credit cards will be involved. Customers are more willing to make purchases at a shop that cares about their identity and bank account safety.

Last but not least, the NFC system will increase customer loyalty by connecting customers to the restaurant's reward program. They can win back points and other gifts by using NFC payment, and then be able to redeem those points for discounts, free products, or other rewards. Seeing their purchases cherished by the restaurant with cashback and rewards, customers will continue their relationship with the brand. All of these advantages help offer good transaction service and will attract more loyal customers to the restaurant.

In China

According to Table 1, the automatic food ordering system, Wi-Fi, QR codes, NFC payment, and recommendation system are used by most F&B businesses in China. Some fast-food chains and beverage companies turn to

geofencing, beacons, BOPIS lockers, and digital assistants, while Chinese restaurants rely more on delivery robots and RFID.

(1) Fast Food Chain

In China, McDonald's and KFC have implemented a series of advanced and innovative digital proximity solutions, the most frequently used of which are QR codes. In the case of KFC, QR codes are used for contactless ordering and payment, marketing, service loyalty programs, etc.

When you see a digital outdoor advertisement for KFC on the street, it often has a QR code attached, which usually jumps to its official website. Depending on the content of the billboard, the QR code may jump to different content. For example, the QR code may be followed by KFC's seasonal recommended meals, whereupon consumers will see attractive food images and marketing content. This can greatly stimulate consumers' interest, engagement, and desire to order, thus converting them into potential order-takers and contributing to KFC's increased revenue.

In addition, one of the most common phenomena at KFC in China is using QR codes for orders and payments, which is associated with a robust online automated ordering system. When customers walk into KFC, they simply scan the QR code to access the digital menu, and then they can view a wide variety of food items, pictures of the food, as well as prices and discounts. The QR code menu not only helps KFC to make real-time menu updates and eliminate the cost of printing menus, but also gives consumers a great experience in selecting food, which potentially motivates customers to order. When they decide what items to order, they can simply order and pay online through the online ordering system. This process reduces customers' waiting time and potential manual errors, improving the dining experience for consumers. There are also significant savings in labor costs for processing orders and payments.

After the meal, KFC also uses QR codes to offer discounts or invite customers to join a loyalty program, typically in the form of inviting them to participate in games to earn points and then encouraging revisits. In this way, KFC can retain existing customers, increase customer stickiness and loyalty, and thus drive long-term revenue.

(2) Beverage Businesses

HEYTEA in China uses BOPIS lockers for customer services. With BOPIS lockers, consumers can order and pick up drinks at any time. Once consumers order online, shop assistants will prepare drinks, put drinks in the lockers and notify consumers. Then consumers will receive a code that can be used to open the locker and pick up drinks.

A group of HEYTEA's BOPIS lockers generally contains 40 lockers, which are designed based on the estimated maximal consumer flow. The executive of HEYTEA says that the purpose of introducing BOPIS lockers is to improve customers' pick-up experience and reduce customers' waiting time, as well as to improve operational efficiency by automating the pick-up process and allowing multiple pick-ups at the same time. A group of BOPIS lockers occupies a small space area, which helps HEYTEA save occupation area and reduce costs.

However, BOPIS lockers are only used in China mainly because only Chinese consumers are used to ordering online through WeChat mini-programs. And because as a Chinese local brand, the customer flow in China is larger, so this method is only used in China.

(3) Chinese Restaurants

As a hot pot chain that embraces cutting-edge technologies, Haidilao is using RFID dinnerware to bring better guest experience and income. The RFID dinnerware improves revenues for Haidilao by enhancing the guest experience and reducing ingredient waste. The RFID chips embedded in each plate are capable of recording and tracking the dishes' production time, which optimizes food safety for the customers. With the supervision from the smart chip system, dishes that have passed the serving limit will be shown on an "expired" list. These dishes will then be disposed of in time by the staff. By monitoring the dishes' production time, the RFID tableware helps to

make sure that all dishes served to the customers are within the prescribed time limit. Therefore, the customers are protected from stale food and possible diseases that result from non-freshness. They will also come more willingly back to the restaurant which emphasizes food hygiene and safety. This helps Haidilao increase traffic and turnover in its various outlets.

In addition to preventing food hygiene accidents, technology increases revenues for Haidilao by reducing food waste. With the RFID system recording the exact production time, the kitchen can serve eligible dishes at an earlier time first and save those produced later for subsequent customers. In this way, RFID tableware offers a reasonable serving sequence for the prepared dishes and reduces the number of expired dishes. The ingredients are used to their most with less chance of getting wasted, helping the restaurant reduce costs.

In Other Countries

Based on Table 1, in other countries such as the US and UK, most F&B businesses use the automated ordering system, Wi-Fi, QR codes, NFC payment, and the recommendation system as digital proximity solutions. Some fast-food chains and cafés use digital assistants, BOPIS lockers, geofencing and beacons, however, only Chinese restaurants use delivery robots.

(1) Fast Food Chain —— In the US

In the United States, the birthplace of fast-food giants McDonald's and KFC, the use of digital proximity technology is common. McDonald's in the United States has implemented a digital assistant called "Ask McDonald's" to enhance the customer experience. Customers can access the digital assistant through the McDonald's mobile app or the McDonald's website. By tapping on the "Ask McDonald's" button, they can use voice commands to start a conversation with the digital assistant. The digital assistant uses AI to understand customers' requests and answer a wide range of questions, including menu items, promotions, nutritional information, and restaurant locations.

In addition to answering questions, the digital assistant allows customers to customize their orders. Customers can use the digital assistant to modify menu items, select add-ons, and specify their preferences. The digital assistant also remembers previous orders and uses machine-learning algorithms to provide personalized recommendations to customers. In this way, the digital assistant can not only make it easy for customers to reorder their favorite meals, but also help customers discover new menu items and promotions that they may be interested in, leading to increased customer satisfaction and loyalty, and increased revenue.

Moreover, the digital assistant can also process payments for orders placed through the app or website. Customers can link their credit card or mobile payment account to the app, and the digital assistant will securely process the payment. This can undoubtedly help McDonald's increase efficiency, reduce labor costs and increase revenue.

(2) Beverage Businesses — In Japan

As a world-renowned coffee chain, Starbucks can provide customers with not only drinks but also a good working environment. Free Wi-Fi is a huge attraction. In 2010, Starbucks announced it to be the best café for work that provides customers with free Wi-Fi. Integrated with Starbucks' features, Wi-Fi helps Starbucks attract more customers and increase business revenue. Especially, Starbucks cooperates with Apple iTunes to offer consumers pleasant music. This means that consumers can stay in a great environment and enjoy music by simply paying for a cup of coffee. Additionally, Wi-Fi increases customer staying time, which means an increased likelihood of consumers' purchasing and spending, thereby increasing revenue.

Furthermore, Starbucks also uses Wi-Fi to collect customer information. Before connecting to free Wi-Fi, Starbucks may require customers to provide their personal information such as email addresses, phone numbers, etc. This can help Starbucks collect customer information at a low cost. Customer information is useful in subsequent marketing and promotion strategies.

(3) Chinese Restaurants —— In the UK

The famous Taiwanese restaurant Din Tai Fung spices up its outlet in London with two robotic waiters to deliver food and clear tables. Robotic waiters boost revenues first by reducing labor needs. Robots serve dishes in the place of humans at the restaurant. Regarding food delivery, all human servants need to do is check whether the dishes are consistent with the orders, and key in the respective table numbers for the robots. Extra human participation, if any, would be mere occasional assistance and complement when traffic is very heavy. In terms of clearing tables, robots still take large a burden from human servants. In the past, waiters took the used tableware back to the kitchen using trays or trolleys manually. This is a process that gradually consumes physical energy. However, with the assistance of robots, waiters only need to move cutlery and glasses to the carrying trays of the robots, who will send them back to the kitchen.

Second, robotic waiters help increase revenues by improving efficiency and customer experience. The food delivery robots used at Din Tai Fung are equipped with great capacity. Each robot has a three-layer shelf, and each layer can hold three to four dishes. At their full capacity, the two robots can bring twenty-four dishes from the kitchen at the same time. By delivering food more quickly, the robots bring a better dining experience to the customers. Besides, the robots also increase the table turnover rate as they decrease customers' waiting time.

SURVEY

To have a better understanding of the effectiveness of using digital proximity solutions to create value, a survey is conducted to investigate 153 consumers about their acceptance, preferences, expectations, and suggestions for digital proximity solutions in the F&B industry. The survey questionnaire is attached in *Appendix 7*.

Among the 153 participants, 75% participants are female, and 90% participants are Generation Z with ages between 18-27. In terms of residence country, 33% of participants are from Singapore, 33% participants are from China, and 34% participants are from other countries. Specifically, 14% of participants are from the UK, 13% participants are from the rest 7% participants are from Australia, Japan, Canada, and Italy.



Figure 1. Demographic factors of survey participants.

The survey result is shown in Table 2. Specifically, the survey result shows 1) customer acceptance or interest in various digital proximity solutions, and 2) the ability to stimulate consumer revisits of various solutions.

	Automated ordering system	Wi-Fi	QR codes	Digital assistant	BOPIS locker	Delivery robots	RFID checkout	NFC payment	Location-based solutions (Geo-fencing & beacon)	Personalized recommendation s
				Part 1	- Show acce	ptance or in	terest			
Singapore	70%	34%	84%	36%	66%	72%	80%	86%	26%	60%
China	90%	41%	88%	55%	80%	76%	86%	78%	29%	75%
Other countries	87%	54%	75%	35%	79%	79%	79%	90%	27%	58%
	•			Р	art 2 - Stim	ulate revisits				
Singapore	72%	22%	48%	10%	26%	28%	28%	46%	0	14%
China	82%	27%	69%	12%	51%	29%	31%	25%	0	16%
Other countries	85%	31%	48%	4%	52%	29%	31%	50%	0	15%

Table 2. A table shows 1) customer acceptance or interest in various digital proximity solutions, and 2) the ability to stimulate consumer revisits of various digital proximity solutions.

Note that in Table 2, indicators over 66% are marked in green, which signals high customer acceptance or a solution's high capacity of stimulating revisits. Indicators between 33%-66% are marked in purple, which means medium customer acceptance or a solution's medium capacity of stimulating revisits. Indicators below 33% are marked in red, which means low customer acceptance or a solution's low capacity of stimulating revisits.

Part 1: Consumers' Acceptance and Interest in Each Digital Proximity Solution

Similarities: According to Table 2 Part 1, consumers in different districts show similar acceptance and interest in these digital proximity solutions. In all districts, most participants show acceptance or interest in the automated ordering system, QR codes, BOPIS locker, delivery robots, RFID checkout, and NFC payment. And Wi-Fi, digital assistants, and the recommendation system show medium appeal to part of consumers. However, location-based solutions (such as geofencing and beacons) show low appeal to consumers.

According to the result shown in Table 3, the top 3 reasons why consumers dislike part of digital proximity technologies are: 1) they are overwhelmed by excessive messages, 2) they are concerned with private information leakage, and 3) they are annoyed about business marketing contents.

Reasons why consumers dislike digital proximity technologies	Feedback quantity
I feel that I am overwhelmed by excessive messages.	123
I am concerned with private information leakage.	115
I don't like businesses' marketing content, some of which is even false or annoying.	73
I think using tech is too complicated and is a waste of time.	34
I think there is little emotional connection using digital technology and I prefer human services.	28
I think the quality of such digital services is poor.	16

Table 3. Reasons why consumers dislike part of digital proximity solutions.

Difference: The only difference among the three districts is that Chinese participants show a higher interest in personalized recommendations.

Part 2: Solutions' Ability to Stimulate Consumer Revisits

Similarities: According to Table 2 Part 2, in all districts, the automated ordering system is acknowledged to be effective in stimulating consumer revisits; and Wi-Fi, digital assistant, delivery robots, RFID checkout, the recommendation system, and location-based solutions (such as geofencing and beacon) are shown to have weak abilities in stimulating consumer revisits.

Differences: QR codes are way more effective in stimulating revisits in China than in Singapore and other countries, which might be due to the popularity of QR codes in China. However, NFC payment is way less effective in stimulating revisits in China, which might be because there are so many advanced and convenient ways of payment in China. In addition, the survey data also show that BOPIS lockers are less effective in stimulating consumer revisits in Singapore than in other districts. According to the follow-up survey question, some Singapore participants say that they may find the lockers inconvenient due to their location or limited operating hours, and others say that they are worried about theft or damage to their purchased items while they are stored in the locker.

Combining Part 1 and Part 2, only the automated ordering system is shown to be highly effective in stimulating consumer revisits with consumers' wide acceptance and strong interests. However, all other solutions' ability to stimulate consumers' revisits is shown to be weaker than their consumer acceptance.

DISCUSSION

The Value of Digital Proximity Solutions

Based on the above research, digital proximity solutions can be used in marketing, customer services, efficiency improvement, and cost savings to create value for F&B businesses. Table 4 shows a summary of the value of digital proximity solutions.

	Automated ordering	Wi-Fi	QR codes	Digital assistant	BOPIS locker	Delivery robots	RFID	NFC payment	Geo- fencing	Beacon	Recommendation System
	system										
MARKETING	MARKETING										
Attract a broader range of customers											
Demographic	√	V	V								
Multi-channel	√		V		V						
Regional		\checkmark	\checkmark		\checkmark				\checkmark	\checkmark	
Improve advertising & customer engageme	ent										
Website & Ads & Discounts		\checkmark	\checkmark			\checkmark			\checkmark	\checkmark	
Location									\checkmark	\checkmark	
Stimulate impulsive spending			\checkmark		\checkmark				\checkmark		
Collect customer data		\checkmark	\checkmark						\checkmark	\checkmark	
Implement micromarketing											
Provide personalized	\checkmark			\checkmark						\checkmark	
recommendations											
Improve customer loyalty											
Ads, discounts, promotions, gifts, etc.	\checkmark	\checkmark	\checkmark					\checkmark			
CUSTOMER SERVICE											
Improve customer experience in											
Ordering	\checkmark	\checkmark	\checkmark	\checkmark							V
Dining						\checkmark					\checkmark
Checkout			\checkmark		\checkmark		\checkmark	\checkmark			
EFFICIENCY IMPROVEMENT											
Improve operational efficiency											
Edit menu conveniently	\checkmark		\checkmark								
Eliminate error & improve accuracy	\checkmark		\checkmark	\checkmark		\checkmark	\checkmark	\checkmark			
Save staff's time & energy	\checkmark		\checkmark	\checkmark		\checkmark	\checkmark	\checkmark		\checkmark	\checkmark
Intelligent accountant	\checkmark										
Inventory management							\checkmark				
COST SAVINGS											
Save costs on											
Advertising		\checkmark	\checkmark						\checkmark	√ \	
Printing	1			1							
Logistics					\checkmark		\checkmark				
Labor	\checkmark		\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark		
Inventory management							\checkmark				V

Table 4. A summary of the value of various digital proximity solutions.

Based on Table 4, the automated ordering system, QR codes, delivery robots, recommendation system, and digital assistants can have significant impacts on marketing, customer service, efficiency improvement, and cost savings. These five solutions can not only help F&B businesses increase revenue in various aspects but are also widely accepted by consumers from most districts with medium to high customer acceptance in the survey.

Wi-Fi can primarily help F&B businesses improve marketing, customer service and save advertising costs to some extent. However, its appeal to customers in the survey does not seem very positive. Although RFID and NFC payments are not able to improve marketing, they can help improve restaurants' operational efficiency and provide a better checkout experience for customers with high appeal to customers shown in the survey. Therefore, they are widely used in many regions.

The principles of geofencing and beacon are similar —— they are both used for micromarketing based on identifying customer location, but they are not useful in customer service, efficiency improvement, and cost savings. In addition, according to the survey, most customers show dislike and annoyance at this type of marketing. However, both BOPIS lockers and digital assistants can improve customer experience with medium to high customer acceptance as well as save logistics and labor costs.

In summary, combining the value and customer acceptance, the automated ordering system, Wi-Fi, QR codes, food delivery robots, recommendation system, and BOPIS lockers are more recommended for F&B businesses that look for revenue growth using digital proximity solutions.

Comparison among Geographical Markets

Based on Table 1 in the case studies, how the 6 F&B companies in different sectors (e.g., fast food chain, beverage business, Chinese restaurant) use digital proximity solutions in different geographical markets can be compared.

Similarities: Nearly all 6 companies studied in the research apply the automated ordering system, Wi-Fi, QR codes, NFC payment, and recommendation system in all geographical markets. Besides, both fast food chains and the well-known Café Starbucks use geofencing in all markets.

Differences: F&B businesses tend to use more digital proximity solutions in China, fewer in other countries (e.g., US and UK), and the fewest in Singapore. While almost all the 7 types of solutions have been adopted in Chinese and other markets, Singaporean restaurants only use the 5 universally adopted solutions (the automated ordering system, Wi-Fi, QR codes, NFC payment and the recommendation system) plus BOPIS lockers, and delivery robots.

Based on the comparison above, an examination of the underlying factors contributing to this phenomenon is undertaken. The PEST model will be employed as the analytical framework to elucidate these reasons, utilizing its four key factors for comprehensive analysis.

Political

Government regulations: In some countries, the government may launch related regulations that promote the use of digital proximity solutions in the F&B industry. For instance, in response to COVID-19, the Singaporean government introduced the Digital Resilience Bonus (DRB) to encourage the adoption of digital proximity solutions by F&B businesses. The DRB offers cash payouts to companies that implement digital proximity solutions, such as online food delivery, NFC payments, and automated ordering systems. The Chinese government has also launched regulations to encourage the adoption of digital proximity solutions in the F&B industry, including BOPIS lockers, QR codes, and automated ordering systems.

Economic

Market size and competition: The scale and competitiveness of the F&B market can also impact the adoption of digital proximity solutions. Businesses in larger markets with more competition may be more driven to implement

digital proximity solutions to acquire a competitive advantage, boost consumer engagement, and optimize their operations. For instance, the F&B market in China is extremely competitive. This is especially true in cities like Shanghai and Beijing, where there is a high concentration of cafés and all kinds of F&B establishments. As a result, digital proximity solutions, like delivery robots, are being used to draw in and keep customers in these locations. However, businesses may have less incentive to invest in digital proximity solutions in smaller markets with less competition since the return on investment is believed to be lower. However, businesses in less-crowded areas may be hesitant to spend money on digital proximity solutions because they may not see a significant return on investment. For example, the UK food and beverage industry may be less competitive in some places because of the country's lower market size compared to larger countries like the United States or China. As the UK market is likely to be small and competitive, companies there may not perceive a need to invest in technology like digital menu boards or a beacon.

Residential disposable income: A key factor in the adoption of digital proximity technologies is residential disposable income. For instance, in the United States, where inhabitants' disposable income differs greatly between cities, the F&B industry's decision to implement digital proximity solutions may be impacted by this factor. F&B companies may be more driven to invest in technology like NFC payments and recommendation systems in areas with higher disposable incomes, like New York, to cater to consumer tastes and offer comfortable dining experiences.

Social

Cultural preferences: In a society where mobile and cashless culture prevails, certain digital proximity solutions are usually easier to take off. For example, Chinese society embraces mobile technologies and cashless payment. Most of the young and middle-aged populations in urban areas rely on smartphones for social contact, communication, and commercial activities. China is also rapidly becoming a cashless society, with many people preferring to use digital payment methods instead of cash. As a result, digital marketing solutions such as QR codes and automated ordering systems have shared great acceptance among Chinese restaurants and F&B companies.

Habits of the demographics: Sometimes the differences in digital solutions' applications can result from the different preferences and habits of the populations. Even in areas with a strong cashless culture, how people pay without cash could vary. For example, in China, people are used to relying on WeChat and Alipay QR codes to process transactions and payments, while in Singapore people use either application from different banks, such as Paynow and Paylah, or NFC payment including credit cards and mobile wallets.

Age proportions: The proportion of young people in a population can be a significant factor in the adoption and usage of digital proximity solutions in the F&B industry. A younger demographic may predict a greater acceptance of new technologies such as BOPIS lockers, delivery robots, and RFID, while a customer base with high proportions of senior citizens tends to be more conservative in technological adoption.

Technological

Digital infrastructure: The availability and quality of technological infrastructure (such as Internet connections and payment gateways) can impact the adoption and usage of digital proximity solutions. In countries where such infrastructure is more adequate and integrated, digital solutions will be popularized with less friction. For example, Singapore's digital infrastructure is highly developed, but it may not be as advanced as China's in terms of the speed and accessibility of its digital networks, which may lead to differences in the numbers and types of technologies applied.

RECOMMENDATIONS

Based on all the analysis above (including the comparison of the use of solutions in different geographical markets and the survey result that shows customer acceptance), several recommendations can be given to F&B businesses that look to create value through digital proximity solutions. Table 5 shows a summary of recommended digital proximity solutions for different purposes in different regions. To give clear guidance for companies to improve services from different aspects, below are recommendations for different purposes.

District	Purpose	Digital Proximity Solutions
Singapore	Marketing	Automated ordering system, Wi-Fi, QR codes, BOPIS lockers, recommendation system
	Customer Service	Automated ordering system, Wi-Fi, QR codes, BOPIS lockers, delivery robots, recommendation system
	Efficiency Improvement	Automated ordering system, QR codes, delivery robots, NFC payment
	Cost Savings	Automated ordering system, Wi-Fi, QR codes, NFC payment, recommendation system
China	Marketing	Automated ordering system, Wi-Fi, QR codes, BOPIS lockers, recommendation system
	Customer Service	Automated ordering system, Wi-Fi, QR codes, BOPIS lockers, recommendation system
	Efficiency Improvement	Automated ordering system, QR codes, delivery robots, RFID, NFC payment
	Cost Savings	Automated ordering system, Wi-Fi, QR codes, BOPIS lockers, RFID, recommendation system
Others	Marketing	Automated ordering system, Wi-Fi, QR codes, BOPIS lockers, recommendation system
	Customer Service	Automated ordering system, Wi-Fi, QR codes, BOPIS lockers, NFC payment, recommendation system
	Efficiency Improvement	Automated ordering system, QR codes, NFC payment, recommendation system
	Cost Savings	Automated ordering system, Wi-Fi, QR codes, BOPIS lockers, NFC payment, recommendation system



Recommendations for Marketing and Customer Service

In terms of marketing and customer service, the automated ordering system, Wi-Fi, QR codes, BOPIS lockers, and recommendation system are useful solutions for F&B companies in all geographical markets (e.g., China, Singapore, the US, the UK, etc.). Specifically, for Singapore restaurants that want to improve customer service, delivery robots can be a good choice; while for businesses that hope to improve customer services in other developed countries such as the US and the UK, NFC payment might be helpful.

Recommendations for Efficiency Improvement

With the purpose of efficiency improvement, the automated ordering system, QR codes, and NFC payment are useful solutions for F&B companies in all geographical markets (e.g., China, Singapore, the US, the UK, etc.). In addition to these universally useful solutions, for Singapore restaurants, delivery robots can help improve operational efficiency. For Chinese businesses, delivery robots and RFID technology are good options. For businesses in other countries such as the US and the UK, recommendation systems are suggested.

Recommendations for Cost Savings

Regarding cost savings, the automated ordering system, Wi-Fi, QR codes, and recommendation system are useful for F&B companies in all geographical markets (e.g., China, Singapore, the US, the UK, etc.). Besides these universally useful solutions, for Singapore restaurants, NFC payment is recommended. Businesses in China are recommended to use BOPIS lockers and RFID technology. For businesses in other countries such as the US and the UK, BOPIS lockers and NFC payment are recommended.

CONCLUSION

This paper explores the business value of 11 digital proximity solutions in the F&B industry. We have a detailed analysis of the impact of various digital proximity solutions on business revenues through various aspects including marketing, customer service, efficiency improvements, and cost savings. Our study uses case studies to compare the similarities and differences in the application of digital proximity solutions by 3 types of 6 F&B companies in

different geographic markets (including China, Singapore, and other nations). And our survey investigates residents from China, Singapore, and other nations to understand consumer acceptance and preferences for digital proximity solutions in different geographic markets. Based on the case studies and survey, we find the differences in the application of digital proximity solutions in different markets and analyze potential reasons. Finally, we give recommendations for F&B companies that look to revenue growth using digital proximity solutions.

LIMITATION & FUTURE RESEARCH

Despite the rigor and completeness of our study, it still has limitations. First, according to the population of Singapore, we divide the market into Singapore, China and other countries, which lacks a detailed segmentation of markets. Our study is therefore more specific to the Singapore and China markets and relatively general for other regions. Second, only three types of six F&B businesses are included in our case study, which is scarcely representative of all companies in the F&B industry. Third, there are only 153 participants in our survey, with approximately 50 respondents each from Singapore, China and other countries. The consumer preferences revealed by the narrow and restricted amount of data may hardly represent the broad consumer preferences in a country. In addition, while the survey facilitates broad and quantifiable findings, it is difficult to have follow-up questions and answers to obtain more detailed and in-depth insights from respondents in the survey.

Future research can provide a more detailed and comprehensive segmentation of markets and business types for more in-depth analysis and a more comprehensive conclusion. Future research can also investigate a larger number of respondents in different regions and conduct one-on-one interviews with respondents to dig deeper into consumers' habits and preferences as well as their requirements and expectations of the F&B businesses.

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APPENDIX

Appendix 1 - How the Automatic Ordering System Works

Once an order is placed by a customer using the automated ordering system and accepted by the server, the order is automatically transmitted to the computer system and displayed on the Kitchen Display System (or KDS), a digital menu board used by kitchen staff to prepare dishes and serve as an electronic communication tool between front-of-house staff and kitchen staff. When the dishes are ready, the system notifies the waiters to deliver the dishes to each table in an orderly manner. The system also displays the availability of each dish, making it easy for customers to order. Once the order is generated in the system, the cashier automatically generates the bill.

Appendix 2 - Customer Lifetime Value

CLV (i.e., Customer Lifetime Value) is an important business metric in today's business world that measures the value a company can reasonably obtain from its customers throughout the lifecycle of the customer relationship and is designed to assess the financial value of each customer. CLV metrics can be used to measure the time it takes for a company to recover the amount of money invested in acquiring new customers and retaining them, such as marketing and cost of sales. In short, CLV is critical to the financial health of a business, not only to help businesses model their finances, but also to provide insight into business decisions and help identify valuable customers. Businesses can leverage CLV to measure profitability and revenue growth. Below is the CLV calculation guidance:

CLV=Customer Value x ACL (Average customer lifespan) x Gross margin

- Gross margin = Total revenue Total costs/Total revenue
- ACL (Average customer lifespan) can be calculated in two ways:
- 1) ACL=Sum of customer lifespans/Number of customers
- 2) ACL = 1/Churn rate (where Churn rate = Customers at start of the month Customers at end of the month/Customers at start of the month)
- Customer value = Average order value x Average purchase frequency
- Average order value = Total revenue/Total number of orders
- Average purchase frequency = Number of purchases/Number of unique customers

Appendix 3 - How the BOPIS Locker Works

After customers place orders and make payments online, the chosen commodities will be placed in the lockers by retailers. Then a unique picking-up code will be sent to the respective customers by instant messaging or email, through which their lockers can be opened to withdraw commodities.

BOPIS lockers are usually installed at different places. They can be situated within a moderate walking distance from customers' residences. Locating right in front of the offline outlets or in the stores is also a common choice to use lockers.

BOPIS lockers can be equipped with a temperature control system. Therefore, they can keep several kinds of commodities in good condition, including small packets, hot food, cold food, and everyday groceries.

Appendix 4 - How RFID Works

A typical RFID system consists of a tag and a reader. The tag is a microchip attached to an antenna that acts as an identifier attached to the object. The RFID reader uses radio waves to communicate with the RFID tag (Jia et al., 2012). Shopify (2021) explains the RFID tracking process: information is stored in the RFID tag and attached to the product; the antenna recognizes signals from a nearby RFID tag. The reader wirelessly connects to the antenna

and receives the information stored on the tag; the reader then sends the data to the company's database to store and evaluate the data.



Figure 2. A figure shows RFID's working mechanism.





Figure 3. A figure shows RFID checkout.

Appendix 5 - How NFC Works

A successful NFC transmission relies on collaboration between the RFID (Radio Frequency Identification) chip and the NFC-enabled device. RFID chips play the role of activating antennae that are in places with marketing potential, while NFC-enabled devices (usually smartphones, smart watches, tablets, etc.) can start the data transmission by switching to a certain web page or application within the range of communication. The range of NFC communication is from 5 to 10 centimeters (about 3.94 in).

Appendix 6 – How the Recommendation System Works

The working mechanism is shown in Figure 4.



Figure 4. A figure shows the recommendation system's working mechanism.

The main recommendation methods of personalized recommendation systems are content-based recommendation, collaborative filtering, and demographic-based filtering, the specific types of which are shown in Figure 5.

Recommendation Techniques	Definition	Example	Advantages	Problems
Collaborative	This type of recommendation system predicts what would interest a user based on the preferences of many other users.	It assumes that if person A likes burger, and person B likes both burger and fries, Then it is likely that person A will like fries too.	No need for domain knowledge. Capture's the change in user interests over time.	Cold Start. Scalability. Sparsity.
Content-based	This type of recommendation system relies on the products themselves and recommends other products with similar features.	If a user likes the web page of "real Madrid", "PSG", "Bayern Munich", the CBF will recommend pages related to the football.	Independent recommendation without users info. Recommends new to user. Transparency to their active user.	Difficult to generate attributes for the items. Overspecialization. It is hard to acquire feedback from the user.
Demographic	This type of recommendation systems focuses on the demographic of the user.	If a user is in country X then it will likely recommend based on country X.	They are fast and straightforward to obtain result. Overcomes Cold Start and Scalability	Stability. Mainly based on user interest. Information are impractical considering security and privacy.
Hybrid	This type of recommendation uses the combination of any two above system to recommend.		It combines the advantages of these individual systems.	It reduces the problems of individual systems.

Table 1. Quick Comparison between the filtering techniques

Figure 5. A figure shows the main recommendation methods.

Content-based recommendations

One of the most typical strategies of recommendation systems is content-based filtering, where "content" refers to the characteristics of items that customers prefer. The recommendation algorithm is based on past customer preferences and customer descriptions of products, using available information provided by customers online (e.g., past order history, restaurant reviews on third-party review sites, etc.) to extract consumer characteristics, analyze consumer preferences and interests, and recommend the food that best matches their interests.

Collaborative filtering

The collaborative filtering approach uses the content of interest to groups of customers similar to the customer to measure and analyze content that may be of interest to the customer and personalize recommendations to them. The recommendation algorithm is very accurate because it receives data from a large number of users rather than one customer, building a large available database.



Figure 6. A figure shows the difference between collaborative filtering and content-based filtering.

Demographic-based filtering

Demographic-based filtering does not require historical data about the customer but rather makes recommendations to consumers based on the user's demographic attributes (nationality, age, gender, etc.).

Appendix 7 - A Survey about Consumer Preferences for Digital Proximity Solutions in the F&B Industry

Our study aims to analyze the value and impact on businesses' revenues of digital proximity solutions. This survey investigates your acceptance, preferences, expectations, and suggestions for digital proximity technologies used by Food and Beverage businesses. Your responses are crucial for our study. You may take approximately 5 minutes to complete the survey. Thank you for your participation!

Part A

This part collects information about your gender, age, and residing country as demographic factors for research.

1. Are you a

- (5) Male
- (6) Female
- (7) Prefer not to say

2. Your age is

- $18 \sim 28$ (Gen Z)
- 29 \sim 42 (Gen Y)
- $43 \sim 58$ (Gen X)
- > 58 (Boomers & Traditionalists)
- 3. Which country are you living in?
 - Singapore
 - China
 - Others. Please specify _____

Part B

This part collects information about the types of digital proximity technologies that you've used or encountered and your acceptance and preferences for such technologies.

- 4. What types of digital proximity technologies have you used or encountered in restaurants (including fast-food chains, cafés, beverage stalls, etc.)? [You can choose more than one answer]
 - 3) Automated food ordering system (e.g., touchscreen ordering board in physical stores, online ordering system, mobile app)
 - 4) Wi-Fi
 - 5) QR codes
 - 6) A voice-activated digital assistant (e.g., Siri)
 - 7) "Buy Online, Pick up In-Store" self-service lockers
 - 8) Food delivery robots
 - 9) RFID checkout method —— an RFID tag is placed on the bottom of each plate to identify the food type and price, and you can check out by simply placing your meal at the counter
 - 10) NFC contactless payments (e.g., credit card payments, Apple Pay)
 - 11) Receiving notifications or text messages from businesses based on your position
 - 12) Receiving personalized recommendations based on previous orders and preferences when revisiting restaurants
 - 13) Others. Please specify _

5. In which way do you prefer to order?

- Using a touchscreen ordering board.
- Scanning a QR code.
- Ordering by a waiter/waitress
- Others. Please specify___

6. Do you always connect to public Wi-Fi?

- I like to connect to public Wi-Fi.
- I usually avoid connecting to public Wi-Fi.
- 7. Do you like to scan QR codes?
 - I like to scan QR codes.
 - I usually avoid scanning QR codes.
- 8. Do you like ordering with a voice-activated digital assistant (like Siri)?
 - Yes, I'd love to try it.
 - No, I don't want to try it.
- 9. Do you like using the "Buy Online, Pick up In-Store" self-service lockers to store and pick up your food?
 - Yes, I like it.

- No, I don't like it.
- 10. Do you like delivery robots' services?
 - Yes, I like it.
 - No, I'm not interested.
- 11. There is a checkout method where an RFID tag is placed on the bottom of each plate to identify the food type and price, and you can check out by simply placing your meal at the counter. Do you like this type of checkout?
 - Yes, I like it.
 - No, I don't like it.
- 12. Would you choose NFC contactless payments (e.g., credit card payments, Apple Pay)?
 - Yes, I'd love to.
 - No, I don't like it.
- 13. Would you mind if your location is identified by businesses?
 - Yes, I do mind it.
 - No, I don't care.
- 14. What is your attitude towards notifications and messages from businesses?
 - I like these notifications and messages.
 - I don't mind these notifications and messages.
 - I hate these annoying notifications and messages.
- **15.** Do you like personalized recommendations based on previous orders and preferences when revisiting restaurants?
 - Yes, I like it.
 - No, I don't like it.

Part C

This part collects information about 1) reasons why you dislike the above technologies, 2) types of digital proximity solutions that stimulate your revisit, and 3) your expectation and suggestions for digital proximity technologies in the Food & Beverage industry.

16. You dislike the above technologies because: [You can choose more than one answer]

- I feel that I am overwhelmed by excessive messages
- I am concerned with private information leakage
- I think using tech is too complicated and is a waste of time
- I think the quality of such digital services is poor
- I think there is little emotional connection using digital technology and I prefer human services
- I don't like businesses' marketing content, some of which is even false or annoying
- Other reasons. Please specify _____

17. Which digital proximity solutions stimulate your revisit? [You can choose more than one answer]

- 14) Automated food ordering system (e.g., touchscreen ordering board in physical stores, online ordering system, mobile app)
- Wi-Fi
- QR codes
- A voice-activated digital assistant (e.g., Siri)
- "Buy Online, Pick up In-Store" self-service lockers
- Food delivery robots
- RFID checkout method —— an RFID tag is placed on the bottom of each plate to identify the food type and price, and you can check out by simply placing your meal at the counter
- NFC contactless payments (e.g., credit card payments, Apple Pay)
- Receiving notifications or text messages from businesses based on your position
- Receiving personalized recommendations based on previous orders and preferences when revisiting restaurants

Others. Please specify _____
18. Would you like to share your expectations and suggestions for digital proximity technologies in the Food & Beverage industry?