CHAPTER

21

The role of information technology in the food industry

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21.1 Introduction

In the past decades, the food industry depended highly on static marketing through the push theory, mostly using advertising channels such as televisions, magazines, and leaflets. The information is channeled to the mass public in a spoon-fed manner. The food providers will decide on the type of information they want to provide to the customers, when fair

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benchmarking information is seldom on the strategic list. For customers, they highly depend on the marketing information for purchase decisions, while information from word of mouth is normally restricted to friends and relatives. Upon reaching a new stage, information technology (IT) has overturned this status quo between the food industry and customers.

In the contemporary era, customers are not satisfied with static marketing information provided by the food companies and advertisements are no longer the main source of information that customers will refer to. They prefer to check photos and comments from: social media or blogs; they want to know not only the ingredients of the dish but also the source of the food; the transportation and preparation methods; and even the cooking philosophies of chefs. Diners will share their dining experiences online, with known and unknown people. They will share what they see and what they think, turning them into compliments and complaints, which will impose positive or negative impacts on the food companies.

In the past, customers make food consumption decisions mostly based on the brand name, experience, word of mouth, price, and taste. However, rise in food allergies, ingredient-specific diets, and general awareness on food safety and health have alerted the concern of customers about the food they consume. Customers are now seeking for information on the ingredients and the nutrition, the source, existences of harmful or chemical elements, the cooking process, and even how the ingredients are delivered and stored. Food transparency is no longer just nice to have but has become vital.

Take McDonald's in Canada as an example—as a response to customer requests, they produced a video to show how the chicken nuggets were made and have developed a website "Our food. Your questions" (https://yourquestions.mcdonalds.ca/) to answer customer queries about their food. In another example, McDonald's in the United Kingdom has launched a virtual reality experience for customers on their behind-the-scenes supply chain processes. It portrayed three key stages of the supply chain, farming, production, and cooking, to settle the customer concerns on the ethics and safety of their supply chain management.

The increased accessibility to people and information has enabled the food providers to reach their target customer segments instead of the mass public; in turn, customers can obtain information from a variety of sources, tapping into a wide information base tapping into an almost infinite. The customer relationship management (CRM) has changed from static to interactive. The food providers can now provide information to customers based on their need and preferences, while customers can benchmark the available providers and receive both marketing and factual word of mouth on the aspects of services, food quality, esthetics, and alike. These changes are brought on through the rocket transformation of IT. This chapter will discuss the major means of technological platforms that cultivate the interactive relationship and the available IT tools that the food industry can employ to utilize the available resources, improve effectiveness, reduce cost, and enhance customer experiences. The chapter will conclude with the discussion on how Internet of Things (IoT), big data, and the Cloud can be used as differentiation opportunities for the food industry.

21.2 Means of interactivity

Effective customer communication is one of the critical success factors in the digital era. From mere basic marketing of food and services, contemporary marketing will differentiate the food companies, position them within their segments, and furnish customers with unique

offerings, weekly specials, competitive information, and even behind-the-sense stories. Among all IT measures available this means, utilizing responsive websites, social media, blogs, as well as mobile apps and loyalty programs to take the message to the people.

21.2.1 Responsive websites

With improved connectivity and the advances in smartphone technology, most people now search online for restaurants and information on their food, the menu, location, and photos. A website is a kind of portfolio or online business card that officially presents the business. Responsive website applies smart artificial intelligence (AI) that will display the contents differently for individual gadgets such as desktop computers, tablets, and mobile phones. This type of website is normally informative in nature and covers the company background, its products and services, special events, photos, and videos for differentiation, market positioning, and promotion. These websites ranged from simple self-developed types to sophisticate professional designer versions and can be managed by user-friendly website interfaces called content management systems (CMS). The CMS is used as a tool for website content management and for pushing news to different social media on a timely basis.

To enhance customer relationships, a section for customer suggestions and comments is normally available. This is a type of important word-of-mouth management, when compliments should be treated as employee incentives, while complaints should be met with timely responses to avoid complaints going viral. The responsive website is also an important source of information for CRM, through add-on functions like integrating with online reservation systems, loyalty programs, and digital communication systems. The data collected can be analyzed for strategic planning and benchmarking.

21.2.2 Social media and blogs

Posting news on social media has become the trend for restaurant advertising (Toast Blog, 2017). Restaurants are now turning to websites and social media to stay in touch with customers and attract their attention. They will share restaurant news and menu's, events, and other activities, while chefs will post cooking videos and share tips in blogs to maintain closer customer relations. Some marketing campaigns are designed to be available only on social media; the most common ones include offering discounts or free dishes when customers share an event organized by the restaurant, share their dining experience, tag the restaurant, or like the post of the restaurants. This will enable a wider reach of potential customers through connecting to the friends of the existing customers.

According to BrightLocal (2018), around 85% of customers trust online reviews and consider the information as trustworthy and comparable to personal recommendations. The management of online customer reviews has grown in importance, partly because the extent of customer reach can cover a far more substantial customer base than traditional communication platforms like television or radios ever could. Moreover, while word of mouth can be compliments or complaints, can act not only as promotion tools but also as attacks. According to Gregoire et al. (2015), there are six major types of social media crisis and each can become either an opportunity or threat to the company, when the outcome of this duality depends on the strategic actions and responses of management.

21.2.3 Mobile apps

Once the idea or need to purchase arises, customers are changing the way they shop. Indeed the wide usage of mobiles and mobile devices is altering customer purchasing practices, from sourcing information through third parties to self-sourcing and from until-available to instant. The demand for one-stop source information seeking or purchasing on mobile devices has grown exponentially and this has given rise to the existence of mobile apps. Through these mobile apps, customers can check the menu, place the order, input personal preferences, settle payment, join loyalty programs and enjoy CRM benefits, track purchase history, develop personalized favorite lists, and even share their purchase and dining experiences or comment on the food and service quality. Restaurants can also subscribe to mobile apps from third-party service providers or develop their own apps. Starbucks launched their mobile apps since 2016 (Mobile Order & Pay). Together with their loyalty program, order, and payment system, Starbucks has achieved a significant increase in their online order sales, reduced queues, and motivated customer loyalty.

As mentioned, mobile apps from third-party service providers are taking off rapidly. Restaurant apps such as Yelp in the United States, Open Rice in Hong Kong, and Aomi (澳覓) in Macau are widely used by customers. Aside from restaurant location and information on cuisines, these apps also allow customers to make reservation, receive recommendations, provide online coupons, hold promotional events, and incorporate personalized functions through filters such as location, type of cuisine, price, or customer ranking. There are also add-ins like the remote queue function that provides added convenience to customers. For some of these third-party apps, customers can even create their own log books, like on Food Guru and Feedme Guru. Among the various mobile apps in the food business, delivery apps are the most demanded service by customers.

A delivery app can provide takeaway service like the Starbucks app that allows customer to make purchases online and complete advanced payment, before picking up the food from the company, or third-party mobile apps like UberEATS and Ele.me (e.餓了麼) that provide not only mobile order and payment but also delivers the food directly to the customers. Both of these serve similar purposes at increasing customer convenience and this is where opportunities lie. Nevertheless, mobile apps can also be a challenge. In the case of Starbucks, the company faced operational challenges when crowding swapped from long queues at shops to congestion at the handoff point due to the high online traffic volume (Forbes, 2017). A strategic plan has to be in place to capture the opportunities while avoiding the risks. For this case, a tailor-made menu can be designed for delivery service, to avoid providing food and beverages that require complicated preparation and cooking; design packing that can maintain the quality, taste, and freshness; re-engineer the workflow process; and set up a packaging delivery team or adding a kitchen to separate the delivery services from serving sit-in customers.

21.2.4 Loyalty programs

Loyalty programs are part of the CRM and have long been used in business and marketing. Through the use of technology, loyalty programs improved the interrelationship between the food industry and their customers and allow them to better understand the needs of their customers. In the past, customers were normally asked to present loyalty cards to enjoy

discounts or record purchase for loyalty points. When customers forget to bring along the cards and present it for benefits, they will feel disappointed and may have negative impressions on the service provider, bearing thoughts that they are setting up barriers to prevent them from enjoying the benefits. Under these situations, the loyalty program will fail its original objective on customer relationship building but turned into a costly tool that disappoints the customers.

With new technology, physical loyalty cards are no longer a requirement, when they are replaced by electronic ones. Customers can enjoy the loyalty membership benefits and earn the purchase credits using the electronic card on the mobile apps or on the web. They can enjoy discount coupons, check the bonus points, and update their membership status. They can also personalize their membership by marking special dates such as birthday or anniversary and using personalized background. The food industry is able to operate more effective CRM strategies with the digitized customer information (Fig. 21.1). They can closely connect with customers by sending messages on special promotions, coupons, or recommendation plans. Moreover, as purchase transactions are linked to point of sales (POS) systems, this allows better understanding of customer purchase behaviors and preferences, to tailor personalized correspondence and marketing strategies. The use of electronic cards to replace physical ones can also contribute to environmental friendliness.

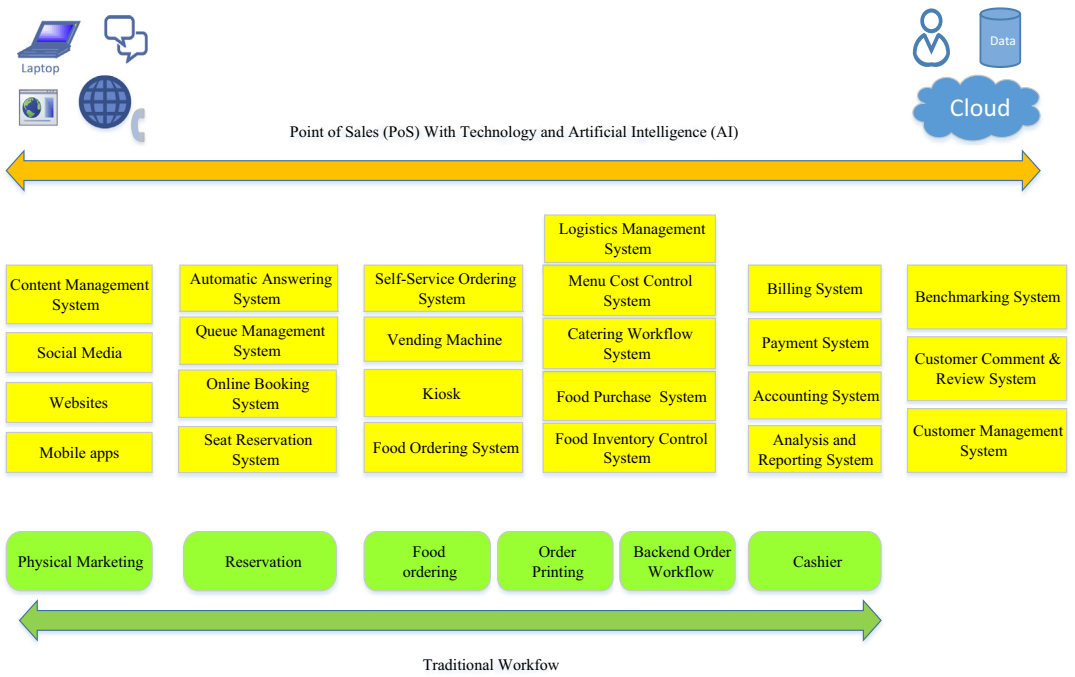

FIGURE 21.1 Technology and artificial intelligence in the food industry. *Source: Chammy, Ricky and Cindia*

21.3 IT tools for food industry

The food industry is a labor-intensive industry and service quality is the major value added that can differentiate food companies from their competitors. Moreover, laborers are human beings who have emotions and will be affected by their emotional and health status. The memory system of human beings is also complicated to the point that it affects the understanding of skills learned and the type and quality of service being delivered. To improve the effectiveness of the labor force and to minimize human error, IT has been widely applied in the food industry. The application of IT evolved from the simple POS system—an autovending machine that became a valuable aid to the various meal order and reservation systems. In the past, IT systems mostly focused on frontend operations, such as food ordering and bill payments at cashier. Nowadays, through the passage of time, IT is now involved in nearly every step of both the frontend and backend processes of many food-related businesses, even before and after customer purchases, from prepurchase marketing to postpurchase customer review. A competent catering system will collect a wide range of data from restaurant operations, which include sales details, purchases, inventory status, etc. These data are useful in the analysis of the overall operations within the restaurant including the sales, guest visit frequency, attendance rates at different time spans, waiting time, and duration of meals, etc. It also provides information on the sales of new dishes, on how far business has boosted by promotions or discounts, on the usage of check out rates and payment methods, etc., when all these can better serve to control costs and enhance the overall cost efficiency of the business.

21.3.1 Point of sales

The POS system is the most widely used tool for the sales of goods and services. In the food industry, the POS system can show the seat floor picture of the restaurant to customers and allow interactive pick-a-seat function. It also provides real-time information on seat availability, so frontend servers can easily make seat arrangement for customers. For customer orders, the receipts are printed with a barcode, when the cashier can check the bills simply by pressing the POS screen and scan the barcode; this speeds up the billing process and improves accuracy. In addition, a competent POS system can also be used to order food with mobile devices or smart tools. Smart tools are used not only to improve effectiveness but also as part of the marketing strategies with respect to the brand image. Aside from smart phones and iPads, with the application of AI, smart tools have taken a new era with robot attendants and robot chefs. The AI smart tools have commenced the experimental stage and will surely become the leading trend in the future.

21.3.2 Reservations

Crowding is one of the most common challenges for the food industry, when there are peak and slack time periods. For better reservation scheduling, managing available space resources, and allowing customers to have the correct expectations, restaurants can use the online booking system and queue management system (QMS). The online booking system

enables customers to make self-reservations online and receive instant confirmation on availability, while the reservation will be instantly recorded in the reservation database. For the QMS, it is mostly used for the controlling of queues. It will provide a queue number (ticket) to the customer and when table is available, the customer will be arranged to a table based on the number order. For advanced QMS, it can even provide the estimated waiting time as an added value.

The use of these tools can reduce manual manpower and simplify the processes, provide service providers with more information to predict the volume of customers with higher accuracy, and also assist with the food procurement and labor arrangement plans. These tools will also allow the customers to have factual information on the availability and waiting time required before service is available. These will improve the effectiveness of the service and minimize potential service quality gaps between customer expectation and perception, before they receive the service and on the actual service received (Fitzsimmons et al., 2014).

21.3.3 Placing orders

Traditionally, frontend servers will take down orders manually and send the orders to backend kitchen for processing. Meal (food) ordering system makes use of electronic devices; when the frontend servers or customers can place order directly on the device, the orders will then be printed out instantly and also directly in the kitchen for processing. At the same time, the orders are transmitted to cashiers for bill checks and records. This can improve the efficiency of the kitchen processes and reduce errors and omissions between order placements and checkouts caused by illegible handwriting. The orders can be revised and canceled, when instant updates will be recorded in the respective systems. Moreover, the time and date of order will be recorded together with the number of guests, membership, and the type and quantity of food and beverages ordered. The management can then analyze the data to better understand the preference of customers, perform segmentation, provide personalized service, and design high-return loyalty programs.

Some catering management systems support self-service meal ordering, through self-service vending machine (kiosk). Ordering is performed on the self-service meal ordering machine or electronic devices. This can help to reduce the workload of frontend servers and serve similar purposes as the meal ordering system. Logistics management system is also crucial as it handles the complicated logistics workflow of the food industry. It includes mainly the menu cost control system and the food and beverage inventory control system.

21.3.4 Payment

Mobile payment is always an embedded function of mobile apps. While WeChat pay and Alipay are growing rapidly in Mainland China, there are various digital payment platforms such as Apple Pay, Google Wallet, and others joining the market. The convenience of cashless payment has remarkably increase sales. A study by USA Technologies and Michigan State University indicated that customers in general spend 37% more when they pay by credit cards instead of cash (Maras, 2019). In Mainland China, mobile payment transactions have outreached US$13 trillion in early 2018 (SCMP, 2018). People in China are using mobile payment from street food to fine dining through Alipay and WeChat pay by scanning a QR code.

This practice is affecting other countries, when it is found that 65% outbound Chinese tourists paid by mobile payment, according to the outbound Chinese Tourism and Consumption Trends report by Nielsen Company (2018). Nowadays, mobile payment has also incorporated different add-ins, such as bill splitting, to better replicate customer actions at physical settings.

21.4 The new opportunities

From improving customer satisfaction and operation efficiency, IT will lead the food industry into a new epoch with foci on food safety, transparency, food wastage control, logistics management, and data usage for CRM. Among all, the IoT, the Cloud, and big data will certainly play an important role.

21.4.1 Internet of Things

IoT is a network of devices to gather and convey data via the Internet, which can facilitate the food industry to trace, monitor, and control the food supply chain activities. Commencing from the source, sensors are equipped to monitor the ambient conditions, transportation time, and the physical production conditions. These can safeguard the supply chain to comply with local and global regulations, while the sensors will collect data at each stage of the process for analyses, so problems can be identified for solution planning. The Hazard Analysis and Critical Control Points (HACCP) can be automated within the IoT to identify safety hazards and critical control points and for comparative analyses between stores, location, and even countries. During the production stage, the sensors will control the quality, track the products, monitor the activities, and undergo real-time analysis, so immediate actions can be taken at failure points. These sensors can also determine the standard of colors, specks, and moisture content of ingredients. For the distribution chain, the GPS systems and transmitters will monitor the delivery and storage processes from production house and at the sales points. This can automate the processes and provide data transparency to both management and customers. Meaningful data will be collected to identify the incompetency of the system and preferences of customers and minimize surplus. The IoT network can effectively reduce costs, wastage, and risks of the food supply chain.

21.4.2 The Cloud

Cloud computing provides a comprehensive coverage to almost all IT equipment and allows the access of information without limits through the use of different smart tools. Cloud has its basis on the concept of resource sharing pool (resource pooling). It provides services and assigns or reassigns companies and virtual resources according to the customer requirements by means of multitenancy mode. The Cloud allows users to easily access IT resources and services in accordance with personalized needs; it can flexibly adapt to demand and quickly adjust to the size of resources with ample grounds for expansion. The capacity and speed can also be increased in response to business demands, so resources will not be wasted. The Cloud services can help companies, especially small and medium enterprises (SMEs), to

reduce investment costs and expenses and save the cost of installing, maintaining, and upgrading of hardware and software. They can use Cloud services at low cost to improve operational efficiency and customer service. Traditional and mature industries can also benefit from the use of Cloud services to improve the inadequate communication problems between the supply chain and the demand chain. These inevitably improve the competitive edges.

Despite the powerful functions, there are, however, security threats in using Cloud computing services:

- Malicious internal employees

  The internal employees of Cloud service providers are most likely to have access to the Cloud data, but how they are regulated and being recruited is a mystery. The information on the Cloud platform is voluminous and it covered an extensive number of companies; therefore, the risk of internal staffs stealing data is relatively higher than that of general corporate organizations.
- Shared environment

  The key of using Cloud computing to reduce costs is by optimizing the use of resources. From the facet of users, Cloud appears to have independent computing environments and data storage space, but in reality, users are just sharing a main computer with others by means of virtualization technology. Cloud generates multiple virtual spaces in the actual environment by means of virtualization technology to provide customers multiple virtual spaces. In this instance, there are security risks associated with data storage and protection, isolation, and cross access of user resources.
- Data loss or leakage

  For the food industry, the impact of data loss or leakage is absolutely not only monetary but also invisible losses such as goodwill or customer confidence. The Cloud environment is affected by the platform architecture, and in sense of operation it is subject to high risk, while the threat of data leakage is also mounting. To reduce the risk of losing or divulging data in the Cloud, it is necessary to evaluate the Cloud service provider's verification, authorization and ensure that the auditing control measures are complete, the encryption technologies applied are legal, the data deletion methods are secure, and the disaster recovery are capable.
- Insecure interfaces and application interfaces

  Cloud service providers provide Internet-enabled interfaces for users to operate Cloud services; therefore, the security of these interfaces is closely related to the security and applicability of Cloud services. If the Cloud platform provides value-added services to third-party suppliers, the use of these interface services may increase the complexity and risks to the original application interface.
- The account or service being stolen

  Hackers stealing user accounts is one of the most common internet threats. Attacks are nothing more than fishing, fraud, and the use of software loopholes; however, in the Cloud environment, these problems have greater impact as users do not have control over the hardware and cannot implement remedial measures to reduce the loss from stolen account or service. When being hacked, they may even need to show evidence as a legitimate user of an account or service, otherwise, the hacker is likely to completely replace the original user.

- Audit and forensic

  Under the traditional IT infrastructure, it is not easy for companies to perform internal audits and collect computer evidence because of the complicated procedures. This situation becomes more complex with the information infrastructure located in the Cloud, as on how to obtain useful and effective information, in particular, when it involves a legal dispute. The Cloud service provider should have a corresponding mechanism for the company to prove the validity and legitimacy of the data.
- Unregulated evaluation

  The most common discussions about the Cloud are commonly on its applications, especially when emphasis is placed on its features, benefits, and functions. The deeper tiered information such as the internal security processes, platform infrastructure, patch formulas, audit systems, log records, data storage processes, and access rights seldom attract public attention. Ironically, this deeper tiered information is widely used to evaluate the security of the Cloud platform, when in fact there is no public supervisory mechanism on these areas. Without such information, it cannot effectively evaluate the risks of Cloud security.
- Legal compliance

  Cloud service providers are likely cross-border companies bound by dissimilar laws and regulations, including the security of personal data. If the country where the Cloud server is registered does not attach importance to personal data protection, it will inevitably erode the protection originally enjoyed by the users.

21.5 Big data

For the service-oriented food industry, the excavation and application of big data has become a priority to achieve continuous operation growth and effective management. Big data, officially interpreted as an information asset, refers to a collection of data that cannot be captured, managed, and processed with software tools within an affordable time frame. Traditionally speaking, it is a large amount of diverse data that is difficult to handle in traditional databases. It has a "3V" characteristic: large volume of data (Volume), high data growth rate, high processing speed (Velocity), and a variety of data types (Variety).

Big data is the collective name of all data, including structural, semistructured, and unstructured data. All kinds of data and consumption records in the food industry can be classified as big data. When these scattered data accumulate to a certain number, analytical methods for big data can be applied to identify underlying information that general data analysis methods will neglect.

21.5.1 Data collection

It is not difficult for the food industry to collect big data, especially with the application of commercial Wi-Fi. When customers use the Wi-Fi networks of the company, the hardware will require them to sign in to the social network account before they will be authorized. From there, company can control the various big data, such as the customer age through the customer social network account, habits, places of visit, and even the preferences of customers on products and services to the preferred brands.

Another important source of data is the POS system that records all the details of the customer order. The data collected will be analyzed to allow better understanding on customer preferences and market trends for business strategic planning. The customer management system (CRM) can also collect data from customers and summarize the preferences of different types of customers, such as the customer consumption frequency, consumption area, preferences, and consumption amount.

21.5.2 Opportunities

- Being the lead in consumption

  The power of big data is that it can convert customer spending habits, user preferences, and alike into a transparent data display that allows restaurants to more accurately grasp the market trend. In the era of big data, when customers refer to big data to select restaurants, restaurants are also using big data as a guide to perform their business models. For example, when customers order takeaway from a restaurant at an ordering platform and then revisit the platform after a period of time, the platform will "choose" from the platform menu the types of food similar to their previous orders and bring to the referral list. This kind of referral guide is the result of "match with preference" after using big data to analyze customers' preferences.
- Accurately plan marketing strategy

  From big data collection to analysis, company can understand the consumption pattern of customers in terms of time, amount, type, and all other available criteria; this enables the establishment of an informative customer database. The database will allow the segmentation of customers based on demographics or customer management criteria. The company will have better understanding of the customer consumption behavior, interest preferences, and the status of the market reputation.

  In this sense, company can forecast more dependable sales budget for the design of accurate and precise marketing strategies to meet the preference of customers. They can also make timely responses to the demand through price leveraging and differentiated pricing to increase market returns and revenue. The better match of marketing targets to products can also utilize resource allocation efficiency and effectiveness.
- Improve operational efficiency and market competitiveness

  For both short-term operation and long-term strategic planning, big data can provide comprehensive data support from a holistic view, such as market structure, products, customers, and marketing strategies, which enables the management to make scientific decisions. The basics of business operations is a contest of benefit effectiveness, cost reduction, increase in work efficiency, lock in customer demands, create profitable space, etc. The capability of big data to assist the management at achieving these is one of its greatest values.

21.5.3 Challenges

- Reliability of data source

  The amount of big data can be very huge. How can we extract valuable information from the sea of data? It is a challenge! For the characteristics of big data, besides having huge quantities, the speed of its production is also very fast, and the variety of data is

substantial. The reliability of the data is therefore in question, and it is important to determine the quality of data and strategically identify the methods to refine its value.

- Lack of big data analysts

  Big data is developing rapidly but specialized big data analysts are extremely rare. The threshold for becoming big data analysts is very high, as apart from being familiar with statistics, they need to have programming skills, big data—type library, and machine learning knowledge. Big data analysts should be competent enough to have thorough understanding in the different industries and companies, possess ability to create detailed analysis with the quantitative information, make logical analysis, and provide decision-making recommendations. These constraint the future development of big data.

21.6 Conclusion

The need to apply IT in the food industry is a must. The potential benefits not only allow short-term improvement in efficiency and customer satisfaction but also in the long-term, it will become a competitive edge of the company. The food industry is undergoing dramatic changes with the use of technology. From tradition marketing through advertisement on TV and magazine, newsletters, fliers, and trade shows, it is now necessary to understand the heave between push and pull marketing when self-service kiosks, tablets, social media, blogs, and mobile apps are picking up the leads. To maintain the pioneer role, food companies should consider new opportunities through high technologies such as 3D food printing, virtual reality, AI, and cloud services.

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