An Overview of the Feasibility of Improving the Hospitality Supply Chain Through AI

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Abstract: The epidemic has dealt a huge blow to the catering industry. It has led to the closure of tens of thousands of brick-and-mortar restaurant economy. But the rise of AI is bringing huge changes to all aspects of society. A new industrial revolution is imminent. This is a good opportunity to use AI to reinvigorate the restaurant industry. The article suggests and proves the feasibility that the F&B industry should use AI wisely in forecasting demand, inventory management, raw material transportation, food safety, and customer service. So as to improve the operation efficiency of the catering industry supply chain, reduce operating costs, and achieve a certain degree of automation and intelligence. Keeping up with the progress of the times. At the same time, AI also brings problems such as data quality, data security, technology and personnel costs, lack of customer communication, and employee unemployment. However, according to the analyses, these problems are promisingly able to be solved properly eventually with the human acceptance of AI and social development.

Keywords: AI, supply chain, hospitality

1. Introduction

In the era of the epidemic, almost all physical stores, offline service industries, and catering industries have suffered unprecedented blows. Restaurant businesses have been mainly affected during this pandemic due to the government's decision to impose lockdowns globally, which has led to the rapid closure of restaurants and hotels, resulting in billions of dollars in losses [1]. Luckily, with the development of science and technology, a new round of scientific and technological revolution is just around the corner. The rise of artificial intelligence and the widespread use of chatGPT show that artificial intelligence is quietly changing the way people live and think, and bringing great changes to all walks of life. AI is able to process large amounts of data in a short period of time and predict it through self-learning [2]. So, it can well improve the data mining ability of enterprises. The supply chain is the key to efficiency and quality in the catering industry, and it also determines the operating costs and profits of enterprises. According to J. Juliana et al's research, supply chain management has a positive correlation between restaurant performance and restaurant competitiveness [3]. Therefore, supply chain management plays a crucial role in the catering industry. Improving the supply chain of the catering industry through AI is also of great significance. This article considers the catering industry including restaurants, cafes and milk tea shops. Also, it explores the huge opportunities presented by the characteristics of AI itself and the feasibility of improving the supply chain of the

catering industry, including potential issues with the use of AI. This paper uses the literature survey method to fully investigate and summarize the references in the research process.

2. AI and Supply Chain

Russell and Novig's article defines AI as a "rational agent" that can act on the analysis of uncertainties to achieve the best outcome or the best-expected outcome [4].

The supply chain is a network of activities that deliver a product or service to a customer. It is the procurement, assembly, warehousing, order entry, distribution and delivery of raw materials. Facilities refer to warehouses, factories, processing centers, distribution centers, retail stores, and offices. Functions and activities that refer to demand forecasting, purchasing, inventory management, information management, quality assurance, scheduling, production, delivery, and customer service [5, 6].

2.1. Forecast Demand

Business operations rely heavily on large amounts of data predictions. Forecasting is the adjustment of certain foreseeable future to achieve cost control and sales strategy. In a large way, this affects the development of short-term and long-term strategic plans for enterprises. On a small scale, it is the guarantee of daily operation of the company's product sales and raw material supply. In procurement management, it is necessary to clarify the procurement cycle, procurement scale, transit time, procurement lead time and purchase price, etc., to ensure that the purchased raw materials meet the needs of production timeliness under the condition of controlling costs [7]. AI can independently analyze and integrate dynamic information such as historical sales data, dish sales, number of customers, preferences, geolocation information and per capita consumption of restaurants, predict future sales trends and customer needs, determine the purchase volume of suitable ingredients every day, or make corresponding adjustments to new dish research and development, marketing, etc. This allows AI to help companies better plan production and inventory. There have been companies using big data analytics and artificial intelligence to study customer behavior and transactions in real-time to better strategize products and services, implement dynamic pricing, and improve customer retention [8]. On the other hand, given enough data instances, AI is able to use tools such as text mining and natural language processing to understand how sales are affected by various characteristics. Including the marketing mix (prices, promotions, discounts, advertising), seasons, festivals, weather forecasts, and social media commentary [9]. Finally, AI can also manage risk for enterprises through machine learning [10]. All in all, AI's prediction of future logistics demand and price changes can help the catering industry optimize supply chain management, improve efficiency and reduce costs.

2.2. Transportation Routes Optimizing

Every link in the supply chain affects retail businesses downstream, including logistics. Sometimes slow logistics may reduce the freshness of raw materials, which also has a great impact on the taste of the product. For coffee shops, coffee beans are easy to spoil due to moisture. For restaurants, many cold and fresh slices of meat are more likely to spoil due to transportation delays. So, they need more efficient logistics. On the other hand, artificial intelligence has more efficient real-time data processing and computing capabilities, which can provide better logistics network arrangements. The digital logistics operations from data platforms can now monitor machines, vehicles and equipment by capturing a variety of data in real-time through sensor technology. It can also use sensors and control towers to monitor and autonomously analyze traffic conditions and weather to provide the optimal transportation route, manipulating geographically suitable cargo and transportation in real-

time, improving load factor and reducing vehicles on the road. This means less congestion and fewer chances of accidents, and fewer harmful greenhouse gas emissions. If the delay cannot avoid, AI can also determine whether the delivery truck will be delayed enterprises can recommend re-planning the production line according to the expected arrival time [2]. What's more, AI can use reinforcement learning to autonomously combine the prices of offshore suppliers' goods, and independently select cheap suppliers and suitable intermodal transportation routes, enabling companies to automatically achieve joint replenishment and coordinated transportation [11,12]. With the improvement and development of the Internet of Things and digital technology, the logistics of the supply chain will be more efficient, save resources and costs, and contribute to environmental protection.

2.3. Inventory Management Optimizing

Inventory costs are also one of the larger expenses in the supply chain. Companies need to ensure both minimal inventory costs and a timely supply of fresh raw materials. Similarly, greater order-picking efficiency is one of the key points for the supply chain run. For example, Starbucks found that coffee beans spoil if they sit on the shelves for too long, so proper inventory is a crucial factor [13]. However, AI can now replace some tedious tasks and automatically decide when and how much to order, dynamically update data, instantly optimize warehousing and transportation operation management systems, reduce redundant product production and waste of secondary flows caused by returns and expired inventory, and provide corresponding optimal recommendations at last. On the other hand, people have to consider not only the level of inventory and those products in transit but also the age distribution of the goods in the inventory, different kinds of classification, etc. AI can also help optimize the location, and layout of products in e-commerce warehouses and reduce warehouse problems caused by human error, thereby improving the efficiency of order picking. When managing inventory across multiple channels, reinforcement learning can dictate which products should be stocked locally to ensure fast delivery, and from which warehouse the corresponding products can be filled with corresponding customer orders. At the same time, after receiving the goods in the smart warehouse, the goods are fully automated to identify, sort, place, move, pack and transport, automation makes the process more agile, responds faster to demand and leaves little room for error. This will increase warehouse productivity by about 5% [2, 14, 15]. Similarly, with the implementation of artificial intelligence, about 58% of existing jobs in warehouses may be eliminated due to automation [16].

2.4. Food Safety, Quality and Production Efficiency Improvement

For every catering business, food safety is its last bottom line. Needless to say, the better the quality of the food, the better the product. In order to control food safety itself, Saizeriya builds its own farm to grow vegetables and build a production and logistics base. Starbucks also realized early on that improper practices in the supply chain can easily undermine the quality of coffee in the hands of customers [17,18]. And at the same time, they take responsibility for food safety on themself. So, it really needs AI to have more roles. Firstly, AI can be used to monitor food processing by using specialized cameras equipped with facial recognition and object recognition to determine whether workers are committed to complying with food safety regulations [19]. Secondly, AI can use sensors to autonomously grow raw materials and sort food, improving agricultural productivity. For example, AI uses features such as cameras and near-infrared sensors to sort food or distinguish between crops and weeds [20, 21]. Then, AI can check light intensity, temperature, wind speed, plant nutrition, salinity and precipitation, and farms can be evaluated to understand the impact of the presence of pests and diseases on plants and automatically adjust, aiding decision-making to determine when to plant, harvest, irrigate, feed and protect crops [21, 22, 23]. Eventually, AI can help reduce the

appearance of disease and identify toxins in food production. And through big data analysis to create more nutritious food [19]. According to a study, productivity in the agricultural sector will increase by about 70% through the use of AI robotics [24].

2.5.   Customer Service Improvement

Service to customers is not included in traditional supply chains, but in restaurants and coffee shops, service is the last and most important part of getting products into the hands of customers. AI can also play a big role in this. Firstly, AI can manage bookings, respond to customer inquiries, and help customers order. Some international chains, such as Starbucks and Pizza Hut, are using voice ordering assistants. Customers only need a few simple voice commands to order or reorder food without the presence of a human attendant. At McDonald, the system can automatically upload store orders and track sales, allowing restaurants to schedule staff in a timely manner and send forecast orders to distribution logistics centers [23, 25, 26]. Secondly, AI can provide more targeted and personalized services. A more personalized access box or voice assistant powered by featured language processing can be used by customers. Also, it can monitor consumer sentiment on social media networks and analyze customer habits and service history to provide customized customers with different purchasing combinations, including flavor combinations of spices and ingredients in unlimited forms. Meantime, nutritionists and health educators can provide personalized nutrition and health advice [19, 21, 27]. On the other hand, smart robots are used in kitchens to help prepare food and cook. Robots also work in the foreground, assisting humans with managing reservations, providing customers with some meal suggestions, picking up food, and helping customers check out at the end. Robots can also attract more customers. After a random survey, most of the customers were full of novelty about AI restaurants [28]. All in all, AI can help businesses save human resources, attract customers, and provide customers with more convenient and personalized services.

3.   Possible Challenges and Potential Solutions

3.1.   Possible Challenges

While the adoption of AI technologies has increased the connectivity, transparency and visibility of digital supply networks, it has in turn increased the complexity of global digital supply networks [1]. This raises a number of problems. Examples include quality of data and data bias, data security issues, additional technical and employment costs, communication needs of customers, and employee unemployment.

Firstly, the success or failure of all predictions depends on the accuracy of the data, and poor data leads to poor quality decisions [2]. AI models require a lot of historical data to support them. But data quality has always been a challenge. In addition to some random factors, lack of testing, reporting delays, different reporting standards, and data privacy regulations can all contribute to reduced data quality [1]. This will also lead to biased data analysis.

Secondly, the lack of data security can be fatal for a company because it can lose business or reputation. In order to provide effective predictions for companies, this requires it to obtain data not only from open databases but also from confidential databases. This also creates a risk of data breaches. Not only that, enterprises will also be hesitant to participate in the development of artificial intelligence [21].

Thirdly, when artificial intelligence is used, it is necessary for enterprises to pay maintenance costs and allocate funds for the recruiting and training of professional and high-tech personnel. As routine forecasting and data processing tasks are taken over by machines, companies need employees who specialize in analyzing computer outputs with more skills [29]. What's more, the labor market now

lacks the skilled labor needed for AI-related projects, as well as manufacturing experts familiar with detailed processes and operations to guide model development [1].

Then, for some customers who are withdrawn or prefer to enjoy a quiet dining experience, artificial intelligence-controlled robots will be the best choice. But the long-term use of robots may also lead some customers to think that restaurants are not sincere enough. Moreover, AI is inferior to humans in understanding the nuances of background and qualitative information. It cannot act like humans, especially feeling, expressing or imitating emotions [30].

Lastly, humans are increasingly worried about artificial intelligence replacing human jobs. When companies decide to use AI heavily, they will inevitably fire some people who don't have the skills required. This will also lead to some unemployment problems. For reasons of reputation and social responsibility, companies also need to consider these issues.

3.2. Potential Solutions

Regarding the quality of data, AI analysts are still needed to make autonomous decisions about AI outputs. And companies should standardize their data collection processes and hire more talented professionals to ensure the quality of data and security of the database. Regarding the emotional need of customers, a restaurant could keep some human attendants to talk with customers to gain some flexibility. What's more, about the cost of employment and technics, some of the process automation will not require in-house expertise, so they can be outsourced to even people without special expertise [2]. Although the daily maintenance or rental of artificial intelligence and the employment of personnel need to be expensive. These are worth it compared to the profits brought to the business. With the restructuring of the workforce and the rapid growth of unemployment, the lack of talent may also naturally ease [1]. As to the problem of unemployment, AI still needs professionals to create models, maintain the forecasting process, and approve and archive forecasts [2]. AI can take over some, but not all tasks. So far, in most supply chain implementations, AI itself does not imply autonomous decision-making, and humans still have the final say. Robots can be likened to virtual assistants triggered to support individual employees' tasks, increasing productivity [2, 31]. Moreover, Hazell J, et al.'s research has concluded that artificial intelligence has no effect on overall employment levels [32].

4. Conclusion

The widespread use of artificial intelligence will greatly advance social development. AI's powerful self-learning ability and data analysis ability can bring great changes to the supply chain of hospitality. Improve the efficiency of enterprise decision-making and production efficiency, and get the optimal solution to maximize benefits in each supply chain link. AI can meet the forecasted needs of enterprises, optimize inventory management, optimize logistics, ensure food safety, and improve customer service. But on the other hand, AI still faces many challenges. For example, AI analysis requires effective, large, and high-quality data as support, and it is difficult to collect these data requirements. Not only that, but there is also the danger of data security leakage, the cost of hiring high-tech talent, the lack of emotional service for customers in restaurants, and the unemployment of some employees who do not match technology. However, as the above research proves, these problems can gradually find solutions and be overcome with the development of AI. All in all, the offline service industry and catering industry should take this as an opportunity to rationally use artificial intelligence to achieve rapid economic recovery and even further improve the operation model and efficiency. However, there are still some shortcomings in this study. For example, there is a lack of specific data to support the arguments. Further research will focus on how AI can be used specifically to improve the customer dining experience. As Thorsten Wuest et al. argue that digital

technologies and artificial intelligence can enhance the resilience of future supply networks. AI-triggered digital transformation and the transition to digital supply networks can solve most of the problems [33].

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