https://doi.org/10.53656/str2025-5-5-art

Education in the Information Society
Образованието в информационното общество

ARTIFICIAL INTELLIGENCE (AI) AS AN OPPORTUNITY FOR ENHANCING THE COMPETITIVENESS OF THE RESTAURANT BUSINESS THROUGH INNOVATIVE MODULES (IM)

Dr. Eng. Mincho Polymenov, Assoc. Prof.
Burgas State University "Prof. Dr. Assen Zlatarov"

Abstract. The article focuses on the tourism industry, specifically on the restaurant business and the potential of artificial intelligence (AI) to enhance the restaurant experience. The aim is to implement innovative products that fully align with the cooking technology, consumer demand, and the profile of the tourist. The new category of Wellness tourists is increasingly interested in the quality of restaurant offerings (Polimenov 2014, pp. 76-77), particularly regarding their healthiness and nutritional value. Wellness Food and Drinks technologies are directly related to the structuring and production of modern culinary products. More and more restaurants will automate their operations by using artificial intelligence (AI) for analysis and laboratory diagnostic data. Modern nutrition, facilitated by artificial intelligence (AI), will utilise biometric sensors, cameras, and quantum bioscanners to gather information about the tourist's health status. These and other capabilities of artificial intelligence (AI) technologies will enhance the quality of restaurant products and create opportunities to significantly increase the competitiveness of the restaurant business (Gonzales 2023, pp. 1 – 37). It will be necessary to change the existing tourism policy by progressing to a higher level of offering-marketing (Buhalis 2022) and consumption of tourism products involving artificial intelligence (AI).

Keywords: artificial intelligence (AI), electronic module (EM), ECU, quantum bioscanners, competitiveness, restaurant business (RB), Wellness Food and Drinks, tourism policies.

Introduction

The benefits of implementing artificial intelligence (AI) in the restaurant business are undeniable, leading to innovations in technological processes and creating opportunities for quality improvement and specialised staff skills (Dimitrova 2017; Gonzales 2023). The new category of Wellness tourists is increasingly interested in the quality of restaurant offerings particularly regarding their healthiness and nutri-

tional value (Polimenov 2014, pp. 76-77; Dimitrova 2019, pp.11 – 39; Polimenov 2024). Wellness Food and Drinks technologies are directly related to the structuring and production of modern culinary products and Wellness Services (Polimenov 2019; Dimitrova 2020). The characteristics of the restaurant product and its flexibility in production allow for the combination of various manufacturing processes to achieve a new, innovative product (Asuzo et al. 2024). Combining several technological elements enhances quality and refines the creativity of production.

The innovative factors in the complex technological processes of the restaurant industry and Niche tourism are very fast growing in the last 3 years ((Dimitrova 2018, pp. 67 – 89; Buhalis 2022; Dimitrova 2024), Innovations includes material production, culinary production, and non-material service technology, are primarily influenced by the knowledge and skills of the professionals in the field (Dimitrova 2023). Better and more creative solutions, facilitated by artificial intelligence (AI) and the implementation of innovations, improve the quality of the restaurant product and yield higher added value to all Niche tourism (Dimitrova 2019a). The established quality objectives for innovations in restaurant products must be linked to a defined strategy and directly influence the production process. Artificial intelligence (AI) will enable the implementation of new technologies, impacting production factors and fostering the development of new skills that seamlessly complement automation – such as electronic modules (EM) and electronic control units (ECU). This will create opportunities for new information exchange, where smart technologies (SMART) and artificial intelligence (AI) will optimize decisions and directly target the production technological process and service delivery. The modelling of the restaurant product can lead to success, but it can also fail. In this context, artificial intelligence (AI) will seek to identify the reasons within the market by researching and analysing prices through promotional campaigns. The restaurant business (RB), supported by artificial intelligence (AI), will create and offer standardized restaurant products (RP) that fully meet the changing tastes of tourists in the market.

2. Methods

Today, the tourism market is characterized by greater competition, evolution in demand, an increase in the requirements of the gained tourists, accompanied by a decrease in purchasing power. A distinguishing feature of international tourist flows is that, for the most part, they are formed by tourists with medium and low purchasing power, with their percentage participation increasing every year. Modern tourists are not as loyal to habits, but rather to attraction and pleasure. This implies that their new needs and desires should be reconsidered, seeking suitable solutions that would guarantee the satisfaction of these constantly evolving needs. It will be essential to link the offered product to the health and mental state of the tourists by emphasizing the need for prevention. That is why the efforts of

artificial intelligence (AI) should focus on improving the processes that create hygiene in nutrition, ensuring that food products meet the requirements of being fresh, as well as adhering to technological standards in the preparation process (Daradkeh et al., 2023). The customer visits a specific establishment to enjoy particular special dishes and service. In this regard, tourists are quite demanding. There are still a few chefs who are dedicated to the secrets of dietary cuisine and balanced eating. In the future, artificial intelligence (AI) and the culinary field will stimulate the creativity of managers/masters/chefs. Another method in addressing global restaurant demand is the return to the values in preparation technology, where AI, once trained, will create the possibility to adjust recipes according to the physiological needs of each customer. There is also a search for a spiritual connection with nature through a return to traditions and family. AI will compile processes in nutrition as a primary tourism service, enriching progressive culinary technologies and forms of service (Trotta et. al. 2023). This will lead to achieving a qualitatively new level of production and service, ensuring a high standard and competitiveness in the tourism offering.

Results

The leading factors, electronic modules (EM), and the electronic control unit (ECU) for innovating and renewing the restaurant product have been analyzed and decomposed by difficulty. A methodology for self-assessment is proposed for each tourist facility when casting innovations and interdependencies with the selected technological standard. Special attention is given to artificial intelligence (AI) related to software electronic modules (EM) and evolution in offerings. The specific restaurant activity (RB) is directly linked to the food industry when offering food and beverages. It is well-known that not everything can be produced in local restaurant production modules. Fortunately, for the restaurant industry (RB), artificial intelligence (AI) and food robotics on the global market, according to Statista 2025, are growing. By 2030, an increase of about 5.4 billion units is expected (see Fig. 1).

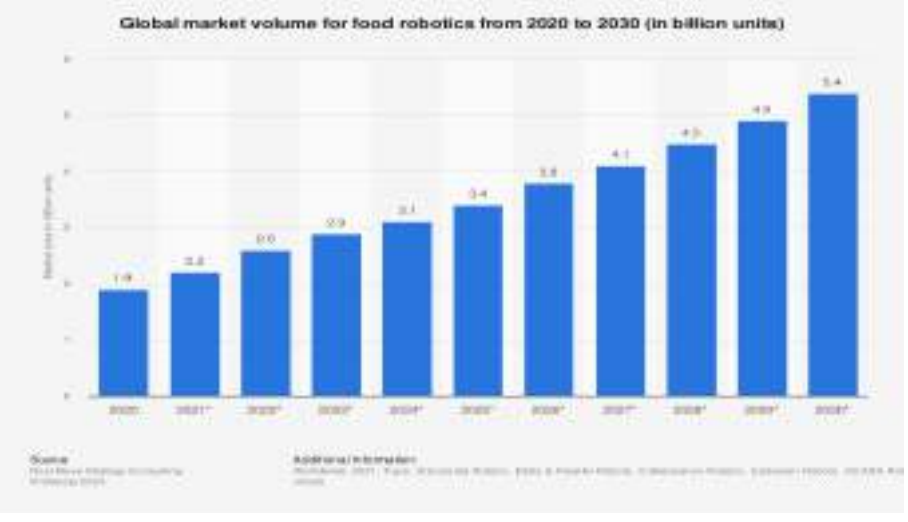


Figure 1. Global market volume for food robotics from 2020 to 2030
Source: Statista. 2025. https://www.statista.com/statistics/1290022/food-robotics-global-market-unit volume/[1]

The sustainability of the food industry relies on trends directly linked to demand and the efficiency of food products delivered in a sterile environment with active nutritional indicators and natural preservatives. The branding of food products serves as a guarantee of quality and bio-ecological standards, which also reflects ethical consumption. The food industry observes several continuous growth trends centered around sustainability and healthy living. More and more consumers are interested in brands that not only offer healthy and nutritious food but also prioritize ecological and ethical considerations in food and beverage production. Food control is essential, making the market healthier and food more nutritious. It is necessary to tighten control over the use of vegetable fats in culinary processing and replace them with animal fats, seafood, and eggs. Due to overconsumption, the human metabolism struggles to break down vegetable fats with trans-isomerization, where the bond is a strong triple (cross-linked) with a low boiling point of 47.5°C. For example, palm oil has a melting point of 95°F (35°C), which is significantly higher than the 76°F (24°C) of coconut oil (CRC 1980). In contrast, animal fats with cis-isomerization have a double (longitudinal) bond and a boiling point of 60.3°C, making them easier to process thermally and absorb by the human body with fewer residual effects and heavy radicals.

The restaurant business (RB) is expected to implement technologies aimed at ensuring the quality of healthy culinary production that is gentle on the gastrointestinal tract (GIT) (esophagus, stomach, small and large intestines). Additionally, it should

focus on the technological processing of fresh products under thermal conditions that fully align with the individuality of the consumer and their taste expectations. Thematic culinary production should rely on recipes, technological processes, and thermal treatments that result in delicious, nutritious, and healthy food. Nutrients such as proteins, carbohydrates, fats, and minerals in each dish must be in a specific proportion, complementing and balancing each other to ensure healthy eating. Tasty food is healthy and fully satisfies complex organoleptic taste preferences, as well as the visual and olfactory receptors of the consumer, making it highly sought after. The competition lies in ensuring that regional thematic culinary products meet all organoleptic indicators, technological and thermal characteristics for consumption, while also being desirable in terms of quantity, cost, and price for tourists.

Artificial intelligence (AI), through differentiated, analytical, and organoleptic evaluation methods, must be trained to analyze and assess the quality of culinary production in final processing kitchens—hot kitchens. This will lead to an improvement in culinary product quality and an increase in thematic competitive advantages. This future development will not only optimize costs and pricing but will also create an axiological advantage related to the value (i.e., quality) of the product and its competitive edge. In fact, these are the two main levers that AI modulates when innovating restaurant products, leading to increased competitiveness. This trend is also reflected in the global rise of artificial intelligence, projected to grow by 2030 through the integration of AI into local software modules (EM) that interact differentially via the cloud (see Fig. 2).

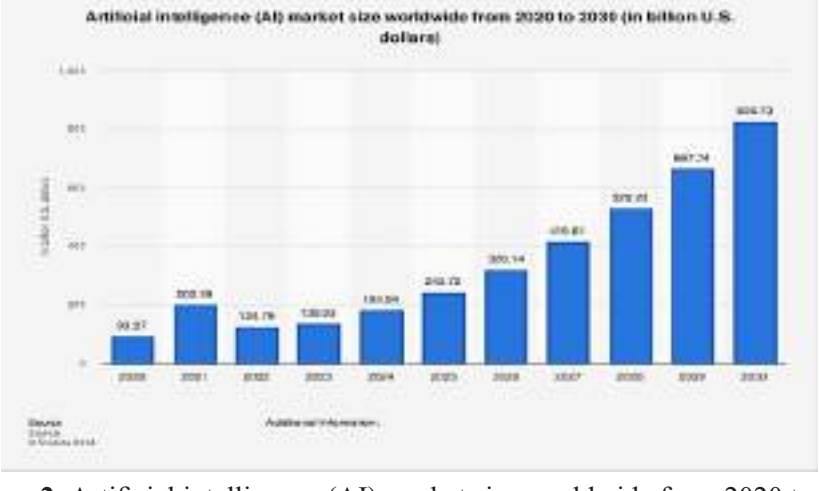


Figure 2. Artificial intelligence (AI) market size worldwide from 2020 to 2030
Source: Statista. 2025 at https://www.statista.com/forecasts/1474143/global-ai-market-size[2]

Artificial intelligence (AI), through various software solutions for the restaurant industry, will enhance connectivity and ensure service updates and delivery over the internet. Such software operates as a SaaS (Software as a Service), where all hardware is managed in the cloud, allowing for the expansion of capabilities in the restaurant business (RB). This includes interactions with online suppliers, accounting, menu technology recipes, resource and asset planning modules, customer relationship management with tourists, human resources, distributors, and more. With the fast-paced modern lifestyle, online home orders will become increasingly common, where robotics and AI will undoubtedly play a significant role. Health-conscious restaurants and prevention centres will be established, where tourists' physical and mental conditions will be assessed in real time using cameras and sensors. Based on this data, a personalized food and beverage program will be created to protect specific organs and support preventive health care. Sensors from a magnetic resonance bioanalyzer will perform comprehensive diagnostics, detecting cellular changes and recommending the consumption of specific culinary products. These recommendations will focus on recipes with a concentration of essential nutrients and thermal processing methods that fully preserve the nutritional value of the dishes. These sixth-generation bioscanners function seamlessly across various operating systems, generating reports and translating results into Bulgarian. The tests are effective for preventive health monitoring, and if necessary, further medical examinations can be conducted through appropriate clinical pathways. AI will also be capable of analyzing tourists' microexpressions to understand how specific culinary dishes influence their satisfaction (Polimenov 2019).

Modernist reverse recognition technologies, through AI training, will operate in real-time, providing insights into overall health or potential discomfort. Data from the bioscanner is processed by a microprocessor module that compares indicators such as bone density, cardiovascular and cerebrovascular health, liver function, excretory system performance, and deficiencies in specific vitamins and active substances. It is well known that not all amino acids are identical and that the human body synthesizes twelve amino acids as needed through enzymatic processes. However, the other eight essential amino acids – methionine, threonine, tryptophan, leucine, isoleucine, lysine, phenylalanine, and valine – must be obtained through food in their active form. The presence of active-form amino acids can be monitored in culinary products during the preparation process using electronic modules (EM). These modules include food supply tracking, electronic recipes and menus, activity control platforms (Asuzu et al. 2024), inventory management, and monitoring the caloric and nutritional value of specific dishes.

Each recipe must ensure the freshness of nutrients and their caloric value. The distinctive flavors of Bulgarian national dishes stimulate enzyme activity, promote the secretion of digestive juices, and attract consumers. The combination of flavors in semi-finished products through margination and technological processing with

herbs and antioxidants – such as resveratrol (found in red grape skins, certain herbs, blueberries, and seeds) – leads to the development of modern national culinary assortments with excellent organoleptic qualities, including taste and aroma.

Through technological processing, essential oils from ingredients such as artichoke and parsnip are introduced, which aid in breaking down heavy fats in food and help alleviate stress. The balanced intake of enzymes not synthesized by the human body, such as bromelain in pineapple and actinides in kiwi, stimulates bile and liver function, enhancing digestion and promoting connective tissue regeneration.

Particularly valuable in salads and dishes is chili pepper, which is rich in vitamin C and the powerful antioxidant and alkaloid capsaicin. The inclusion of corn in certain recipes and salads has a positive effect on the digestive tract, as its cellulose concentration is much lower than that of oats. Since the human gastrointestinal tract lacks the enzyme cellulose, which can cause spasms and discomfort, ingredients in recipes should be selected based on low cellulose content and minimal cellular structures.

Preserving meat juices during thermal processing of meat-based products is crucial for the quality of the culinary dish. The heating process should stop once collagen has broken down into gelatine, ensuring the product remains juicy, with good density, moisture, and a characteristic roasted colour. The quality of restaurant products can be associated with culinary branding, similar to the Nutri-Score system, which uses a five-colour scale from green (A) to red (E) to indicate which processed foods should be consumed more frequently and which less often. How is the scale interpreted? According to the Nutri-Score calculation system, a product with a green A rating is more likely to contribute to a healthy diet compared to a product with a red E rating within the same category (Polimenov 2024). The Nutri-Score system assigns 1 to 10 points for ingredients that should be limited (e.g., caloric content, saturated fats, sugars, salt) and 0 to 5 points for beneficial ingredients (e.g., proteins, fibres, fruits and vegetables, nuts) (see Fig. 3).

.



Figure 3. The Nutri-Score system is designed for product labeling
Source: eutoday.net Nutri-Score examples for labeling[3]

Artificial intelligence (AI) will intensify competition by leveraging theoretical knowledge and practical skills among tourism enterprises, where each strives to achieve set goals. The competitive struggle among restaurateurs revolves around product assortment, quality, organoleptic characteristics of culinary products, pricing, and market conditions. This competition is an external expression of the contradiction between the consumer value and the actual cost of the product, as well as a conflict between abstract and concrete labor within the work process. Ultimately, competition resolves these contradictions in favor of restaurateurs who offer high-quality, healthy culinary products with superior organoleptic properties while minimizing production costs.

Discussion

The Impact of Innovative Technologies on Consumer Behavior in the Restaurant Sector we summarise as following: The rapid advancement of innovative technologies is reshaping consumer behavior in the restaurant industry. From convenience to personalization, these technological shifts influence how consumers interact with restaurants and make dining choices. Convenience and Accessibility Technologies such as mobile apps and online ordering systems simplify the process of browsing menus, placing orders, and making reservations. The ease of access to restaurant services enhances customer engagement and fosters brand loyalty, as consumers appreciate seamless and efficient interactions. Personalization in the Dining Experience with the aid of data analytics, restaurants can gain insights into consumer preferences and behavior. Personalized marketing strategies, such

as targeted promotions and customized menu recommendations, contribute to an enhanced dining experience, encouraging repeat visits and strengthening customer relationships.

The Rise of Contactless Dining: The adoption of contactless technologies, including QR code menus and digital payment solutions, has gained traction, particularly in the post-pandemic era. These innovations enhance both safety and efficiency, providing a streamlined dining experience that aligns with modern consumer expectations. Transformation of Delivery and Takeout Services: The integration of third-party delivery platforms and in-house delivery options has revolutionized the way consumers access restaurant food. The growing preference for dining at home has driven restaurants to optimize their delivery services, ensuring convenience and quality in off-premise dining experiences. As technology continues to evolve, so do consumer expectations in the restaurant industry. Restaurants must adapt to these changing behaviors by integrating innovative solutions that enhance convenience, engagement, and sustainability. By leveraging these advancements, the industry can meet the demands of modern consumers while maintaining a competitive edge in an increasingly digital landscape.

Conclusion

The key takeaway is that AI is increasingly making its presence felt in the restaurant industry, driving the transformation of restaurant products. Restaurateurs are striving to meet the demand for high-quality and valuable culinary products that fully satisfy tourists‘ organoleptic expectations while promoting health and well-being. The most valuable and profitable restaurant products will be those where creativity and talent in healthy culinary production, service technology, and customer engagement contribute to lasting and memorable experiences for clients. At the core of profitability lies the Law of Effective Cost Increase, which plays a crucial role in forming the cost structure of restaurant products.

REFERENCES

ASUZO, O.; EBIRIM, G.; NDUBUISI, N., et al., 2024. Innovations in accounting and auditing: A comprehensive review of current trends and their impact on U.S. businesses. *International Journal of Science and Research Archive*, vol. 11, no. 1, pp. 965 – 974. DOI:10.30574/ijsra.2024.11.1.0134.

BUHALIS, D., 2022. Encyclopedia of Tourism Management and Marketing. Tourism, *Management and Marketing*, (4 volume set), ISBN 978 1 80037 748 6 (eBook), [viewed 9 January 2025] Available from: https://www.researchgate.net/publication/366020289

DIMITROVA, B., 2017. Recreational industry, innovations and the Bulgarian educational model for specialised staff. Original scientific paper. *Conference: international scientific congress Applied sports sciences. Available from: Proceeding _book_icass2017*.pdf, pp. 406 – 410 Sofia. DOI: 10.37393/icass2017/83.

DIMITROVA, B. 2018. *Research impact through the scientific publications in wellness culture:* scientific paper, pp. 67 – 89. ISBN: 978-619-160-666-5. Sofia: Avangard Prima, first edition.

DIMITROVA, B. 2019. *New smart educational model „Wellness instructor",* pp.11 – 39. Sofia: Avangard Prima,. ISBN: 978-619-239-150-8.

DIMITROVA, B. 2019a. Quality assessment about standards for wellness services and certified skills of specialised staff. (online) doi 10.15547 / tjs.2019.02.007. *Trakia Journal of Sciences*, vol. 17, no. 2, pp. 143 – 149, [viewed 21 November 2024]. Available from: http://tru.uni-sz.bg/tsj/ Vol.17,%20Suppl.2,%202019/7.pdf) eISSN: 1313-3551,

DIMITROVA, B. 2020. Relationships between education and innovations in the recreational Industry in Bulgaria. (online) doi:10.15547/tjs.2020.03.003. *Trakia Journal of Sciences*, vol. 18, no. 3, pp.194 – 202. [viewed 5 December 2024]. Available from: https://openurl.ebsco.com/ EPDB%3Agcd%3A16%3A16579488/detailv2?sid=ebsco%3Aplink%3Ascholar&id=ebsco%3Agcd%3A146186231&crl=f&link_origin=www.google.com, eISSN: 1313-3551

DIMITROVA, B., 2023. Educational policy, specialised staff, innovations and recreational industry. *Strategies for Policy in Science and Education-Strategii na Obrazovatelnata i Nauchnata Politika,* vol. 31, no. 5, pp. 532 – 546. doi.org/ 10.53656/str2023-5-6-imp

DIMITROVA, B., 2024. Sustainable quality of SPA programs through benchmarking the biomechanical profile of a new aqua spinning methodology. *Series on Biomechanics,* vol.38, no. 2, pp. 23 – 28, (online) doi:10.7546/SB.03.02.2024 [viewed 18 December 2024]. Available from:http://jsb.imbm.bas.bg/page/en/archive.php#Vol.%2038,%20No.%203,%202024

DARADKEH, F. M.; HASSAN, T. H.; PALEI, T.; HELAL, M. Y.; MABROUK, S., et al., 2023. Enhancing Digital Presence for Maximizing Customer Value in Fast-Food Restaurants. *Sustainability* (2071 – 1050), vol. 15, no. 7, p. 5690. https://doiorg.jwupvdz.idm.oclc.org/10.3390/su15075690.

GONZALES, J. T., 2023. Implications of AI innovation on economic growth: a panel data study. *Journal of Economic Structures, Springer: Pan-Pacific Association of Input-Output Studies* (PAPAIOS), vol. 12, no. 1, pp. 1 – 37, December.

POLIMENOV, M., 2014. *Inovatsii v restorantiorstvoto*. Monografiya. Sofia: Izd. Avangard Prima. [In Bulgarian], ISBN-976-619-160-416-6.

POLIMENOV, M., 2019. Transfer of innovation in the service technology for increasing the restaurant quality product. *International Scientific Journal Smart Innovations in Recreational, Wellness Industry and Niche Tourism*, vol. 1, no. 2, pp.29 - 35, [viewed 21 January 2025] ISSN 2603-4921 (online) [viewed 12 January 2025] Available from: https://scjournal.globalwater health.org/

POLIMENOV, M., 2024. The healthy restaurant product as an element of sports tourism, Smart innovations in recreative & Wellness industry and niche torism. *Inter national Scientific Journal Recreation, Wellness Industry And Niche Tourism*, vol. 6, no. 1 (January-December), pp. 6 – 13 eISSN: 2603-4921 [viewed 21 January 2025] (online) Available from: https://scjournal.globalwater health.org/current-issue/

TROTTA, A., ZIOSI, M., & LOMONACO, V., 2023. The future of ethics in AI: challenges and opportunities. *AI & SOCIETY*, vol. 38, no. 2, pp. 439 – 441. https://doi.org/10.1007/s00146-023-01644-x.

TUSSYADIAH, Iis., 2020. A Review of Research into Automation in Tourism: Launching the Annals of Tourism Research Curated Collection on Artificial Intelligence and Robotics in Tourism. *Annals of Tourism Research* 81: 102883. [Google Scholar] [CrossRef].

Internet sources

Statista, 2025. This time series represents the current and projected market volume for food robotics worldwide from 2020 to 2030. By 2030, the global food robotics market is expected to grow to around 5.4 billion units. https://www.statista.com/statistics/1290022/food-robotics-global-market-unit-volume/

Statista, 2025. The market for artificial intelligence grew beyond 184 billion U.S. dollars in 2024, a considerable jump of nearly 50 billion compared to 2023. This staggering growth is expected to continue with the market racing past 826 billion U.S. dollars in 2030. https://www.statista.com/forecasts/1474143/global-ai-market-size

CRC 1979 – 1980. Handbook of Chemistry and Physics. 60th. c. C-298.

✉ **Eng. Dr. Mincho Polimenov, Assoc. Prof.**
ORCID iD: 0000-0002-0159-3616
Department of Marketing and Tourism
Burgas State University "Prof. Dr. Assen Zlatarov"
E-mail: mpolimenov@gmail.com