The Technological Feast: Innovations Reshaping Our Plates - New Approaches of Food Industry

Ilona Miklós[1]
[1)] *Edutus University, Budapest, Hungary*

E-mail: miklos.ilona@edutus.hu

Please cite this paper as:
Miklos, I., 2025. The Technological Feast: Innovations Reshaping Our Plates - New Approaches of Food Industry. In: C. Vasiliu, D.C. Dabija, A. Tziner, D. Pleșea, V. Dinu eds. 2025. 11th BASIQ International Conference on New Trends in Sustainable Business and Consumption. Oradea, Romania, 26-28 June 2025. Bucharest: Editura ASE, pp. 409-417
DOI: 10.24818/BASIQ/2025/11/036

Abstract

Food practices and beliefs surrounding what and how we eat are on the verge of profound transformation in an era of population explosion and urbanization. This article demonstrates how technological advances and a growing awareness of nutrition are driving new approaches that could completely transform our relationship with food, from production to consumption, in the next 10 years. The food industry is not only a witness, but also an active adopter of the spread of digitalization, artificial intelligence (AI), and automation in the food value chain, from production and processing to transportation and consumption. The article examines the theoretical paradox of the coexistence of food and the global era of digital transformation. Using forecasting trends and the theoretical concepts of industrial innovation and strategic necessity of the food industry, it argues for the long-term application possibilities of the Internet of Things (IoT) tools introduced so far. The development of digital technology in the food and hospitality industry, as well as in food and gastronomic tourism, is increasingly providing convenience, making the previously unattainable a reality, while potentially increasing productivity and improving quality of life.

Keywords

Technology, food industry, innovation, digital transition, metaverse, sustainability.

DOI: 10.24818/BASIQ/2025/11/036

Introduction

The food industry is facing unprecedented challenges in an era of population explosion and mass urbanization. A thorough understanding of the meaning of food, service, operations, and customer experience, as well as an overview of the essential process that can be created in the future by integrating existing technologies and brands along with increasingly fierce competition, is essential for success. This approach must be consistent not only with customer values, but also with the broader business philosophy of market players. Di Renzo et al. (2020) prove in their research that eating habits resulting from the COVID-19 pandemic have changed across different ages. School closures and home confinement developed unhealthy eating habits in healthy adolescents; routine changes, modifications to dietary habits, and quality may be even more significant. Technology is no longer something that exists outside the kitchen. Today, technology is becoming an integral part of creating a new food culture. It is actively revolutionizing every stage of the food system. The world of food technology is undergoing profound changes, driven not only by innovation in production and transportation, but also by fundamental changes in consumer values and behavior, characterized by the increasing integration of technological devices into everyday life.

Food processing involves all the processes required to transform raw or harvested food into new products, ensuring their safety, palatability and shelf life, a process that has changed dramatically to meet consumer preferences. Marino et al (2021) point out that consumer demand for foods with a longer shelf life and better taste has contributed to the increasing availability of processed foods. Ingredients high in sugar, fat

and salt also affect the nutritional value of UPF foods. Being cheap, fast and tasty are demands that manufacturers are responding to relatively quickly.

However, we cannot ignore the fact that health consciousness and personalized nutrition are becoming increasingly popular among consumers. Furthermore, we are also seeing that some consumers are not only looking for an affordable and convenient way of living, but are also demanding transparency, sustainability and ethical source from their suppliers, in addition to superior customer experience. These push factors put additional pressure on manufacturers in the processed food market. All these can only be competitively addressed through technological improvements. The 'smart food' is based on the introduction of high levels of automation and digitalization to increase productivity, production efficiency, and food quality and safety (Chen et al., 2017; Echegaray et al, 2022). Among the various innovations of Industry 4.0, robots, artificial intelligence, big data, cloud computing, blockchain and smart sensors are considered as the main contributors to smart food prices (Figure 1).

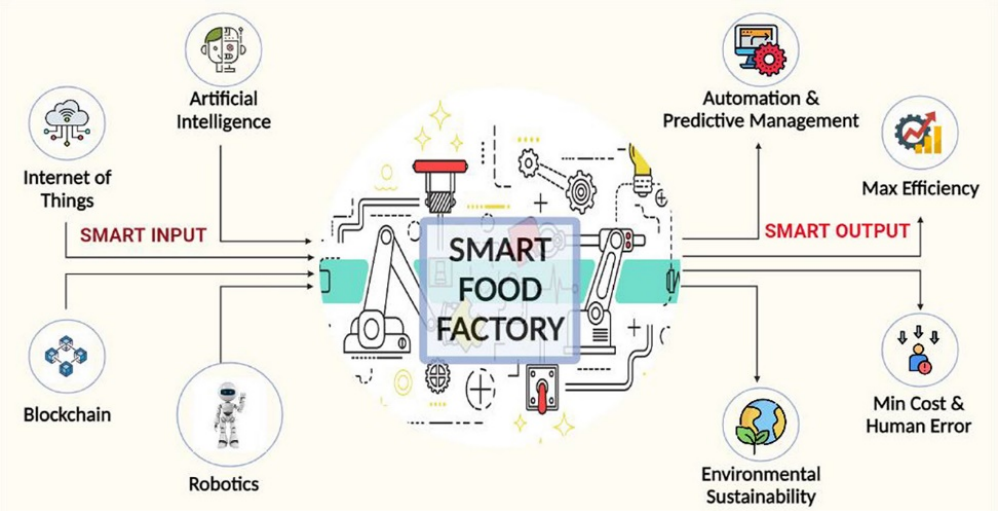

Figure no. 1. Key enablers of the digital transformation in smart factories

Source: Hassoun et al., 2023

Because of the increasing importance of technology, the analysis and forecasting of technology trends and futures are significant. In this article, the forecasting method explores the theoretical paradox of the coexistence of food and the era of digital transformation. Understanding this evolving food landscape is crucial in the context of global challenges such as population growth, climate change, and the pressing need for efficient and sustainable resource utilization. The theme uses the theoretical concepts of industrial innovation and strategic necessity to argue that new IoT tools do not necessarily make the "smart" performance of food more efficient but inevitably expand the conceptual framework of sustainability.

2. Literature review

2.1. Theories of digital transition

Just as the internet or IoT did for businesses in the 1990s, digitalization, robotics, AI, and the metaverse are creating a new competitive landscape for businesses in the 21st century. Competitive strategies now need to include building a virtual presence, creating immersive customer experiences, developing digital communities, and exploring new monetization models (Golmgrein, 2024) through virtual goods and services. Based on existing theories of competitive advantage, companies need to identify unique value propositions and create an effective business strategy, as well as choose the most suitable monetization model for customers. Freeman (1996), in his conceptualization of national innovation systems, sees innovation to sustainable development and advocates a holistic approach to understanding innovation processes. Bharadwaj et al. (2013) argue that the shift to digitalization is a key strategic choice and an inevitable choice for companies to modernize their management and information systems. According to Buhalis and Cheng (2020), the term "smart" is increasingly used as a prefix for developments based on a combination of automated data collection, open and big data systems, and artificial intelligence. However,

for an effective transition and successful operation, it is inevitable that postmodern food enterprises choose a strategy based on the right aspects.

The difference between sustainable and smart business concepts lies in the primary goals and methods: smart factories focus on technological innovation to optimize operations, while sustainable food systems focus on holistic approaches to ensure environmental and social sustainability. However, for consumers, these two concepts are not diverging, but are increasingly intertwined by the middle of the 21st century.

2.2. Competitiveness and digitalization

The early literature traditionally considered the food industry as a slow-response sector, with low research intensity and rather conservative in terms of the type of innovations (Martinez and Briz, 2000), as it mostly focused on minimizing production costs, keeping prices low and paying little attention to consumer needs and rapidly changing expectations.

Today, we see the food industry undergoing a process known as "chain reversal": production costs remain a priority, but there is also a focus on food safety and quality, and along the consumer segments, on health, well-being and satisfaction. Consumers now say what they want to eat (Aguilera, 2006). An innovative approach and a willingness to take risks, as well as the choice of an effective strategy based on digital technology, are essential for the success of a business. Recent decades have seen significant progress in the theoretical formulation of the reasons behind organizational success. Digitalization, the increasing use of digital technologies across all aspects of business and society, profoundly impacts competitiveness theories. Porter (1980) established that the reasons for business success depend fundamentally on the structure of industrial sectors and the competitive forces affecting them.

According to Porter (1980), technological change also plays an important role in competitive advantage because it creates new competitive opportunities and because its ubiquity in the value chain plays a central role in existing competitive strategy. In his view, “information technology” (IT) and “information systems” are particularly important because all activities create and use information. He emphasizes that modern information systems technology plays a particularly important role in scheduling, controlling, optimizing, measuring, and otherwise coordinating all kinds of activities. He adds that office or administrative technologies, although often neglected or subsumed under the umbrella term of information systems, also have an important role.

Wernerfelt (1984) and Baierle et al. (2001) argue that the original cause of competitive advantage lies in the company's possession of specific resources that are both capable of generating value and are rarely or hardly imitated or substituted by solutions obtained from the IT field. Bharadwaj et al. (2013) and Powell and Dent-Micallef (2017) have also analyzed how IT affects competitive advantage. In their opinion, industry competitive advantage was supported by a combination of low conflict levels, open communication, organizational flexibility, and IT planning integration within individual companies. According to Addo (2010), automation has become a key element as a result. Automation does not mean replacing human work with simple machines but rather integrating machines into a self-directed system that can perform a certain process without human assistance. We are living in the era of the Fourth Industrial Revolution (IR4.0), an era characterized by breakthroughs in emerging technologies such as robotics, AI, nanotechnology, quantum computing, IoT, fifth-generation (5G) wireless technologies, and self-driving vehicles, all of which will impact how we create and distribute value and change the way we live, work, and interact (Schwab, 2017; Bendig et al., 2022).

In short, technology is no longer just a kitchen tool; it is becoming an integral part of the creation of a new food chain and food culture. Digitalization is the measure of business success from farm to fork, and these technological innovations built on the internet are revolutionizing every stage of the food system.

2.3. The metaverse sustainability paradigm

2.3.1. Technology and food sustainability

The metaverse has many meanings from a gaming platform, a virtual retail destination, a training tool, an advertising channel, a digital classroom, a new gateway to digital experiences. Ritterbush and Teichmann’s (2023) analysis yielded two possible definitions of the term metaverse: One provides broader applicability, and a second provides a stronger focus on applicability to the current contemporary events of technology corporations. The metaverse, a network of immersive virtual worlds, presents a paradox within the context of sustainability. While offering digital alternatives that could potentially lessen physical footprint, its underlying technological infrastructure demands significant energy and resources. Metaverse incorporates advanced technologies such as virtual reality (VR) and augmented reality (AR), offering immersive digital

worlds. It provides a platform for various industries to expand their business beyond traditional physical borders.

Based on Kuhn's paradigm theory, the concept of metaverse sustainability is now supported by Mihalic (2024). The idea is to create a sort of higher-level internet, superimposed on the physical world. People connected to the metaverse are part of the physical world, but they can see and interact with things that others do not see, because they belong to a virtual world (Song and Chung, 2021). According to De Giovanni (2023), the metaverse is often viewed as a potential arena for sustainability, representing a new interface between digital transformation and sustainable consumption. The sustainable metaverse necessitates a conscious design approach, integrating principles of a circular economy for hardware and prioritizing energy efficiency. Social sustainability, ensuring equitable access and inclusive virtual spaces, is also crucial for a truly sustainable metaverse, echoing tenets of social equity within sustainability frameworks.

At the end, the metaverse sustainability paradigm requires a multi-faceted approach. It demands sustainable technological choices in its creation, prioritizing energy efficiency, using eco-friendly materials, and designing for longevity and recyclability. It also necessitates the development of sustainable practices within the metaverse, encouraging virtual behaviors that mirror real-world environmental consciousness. Moreover, ensuring social sustainability within these digital spaces, promoting inclusivity and equitable access, is vital for a holistic paradigm.

2.3.2. Environmental sustainability

The capability of making well-informed decisions to use resources and services more efficiently has a significant impact on sustainability and equal access (Appio et al., 2021; Ardito et al., 2018). Defining the future impact of digitalization and the metaverse on the environment is not at all simple. Observing the different points of view on the subject, however, the metaphor of promises and bets resonates again, perhaps even more glaringly (Boyd and Ellison, 2008; Kottler et al., 2023). The metaverse could have a laboratory with high potential for earth and climate sciences. By creating a digital twin of the planet by satellite data and combining these models with the sophisticated intelligence of the metaverse, it will in fact be possible to develop and test more effective solutions to combat climate change in the long term (Gaggioli, 2017).

Recognition that the involvement of the metaverse as a space (environment) in the interests of individual stakeholders is having an increasingly greater impact. In contrast to traditional “on-site tourism”, this trend is often referred to as a “virtual kitchen”, “virtual cooking classes with world-renowned chefs”, “virtual wine tours”, “virtual spirits tasting”, “nutrition-based online food ordering”, “virtual plant-based gardening and tasting”, “printing food in 3D”, “metaverse consumption”, and “metaverse food and wine tourism”. Digitalization also facilitates greater collaboration among stakeholders in the agrifood value chain. Farmers, food producers, distributors, and consumers can now connect with one another through virtual platforms and social media channels, allowing for greater sharing of knowledge and best practices. This connectivity can enhance the efficiency and sustainability of food production. For instance, indoor farmers are already using AR technologies to digitize and monitor plant biology, growth, and data.

2.4. Evolving consumer behaviors

Consumers are increasingly prioritizing convenience in their food choices, largely due to the demands of their fast-paced lifestyles. This has led to a significant surge in the popularity of online ordering platforms and food delivery applications, which have partnered with a wide array of restaurants to provide consumers with easy access to meals without the need to leave their homes. The COVID-19 pandemic further accelerated this trend, resulting in rapid growth in e-commerce and online food delivery services as people adapted to lockdowns and social distancing measures. This strong demand for convenience is a major catalyst for the expansion of online food ordering and delivery services. Zhou et al. (2023), who investigated the effect of higher ultra-processed food (UPF) during the pandemic, found that the UPF consumption in the diet was associated with a significantly increased risk. Their findings suggest that this association could be partly mediated by the effect of UPF consumption on BMI. They also point out that public health interventions to improve nutrition and poor metabolic health may be important for reducing the burden of the health insurance system.

This fundamental shift in consumer behavior has necessitated that food businesses adapt their operational models by significantly enhancing their online order fulfilment capabilities and fully embracing various digital platforms. The exceptionally high growth rate projected for the delivery segment underscores the profound significance of this evolving consumer preference. There is a growing trend of health consciousness among consumers, leading to an increased demand for healthier food options. People are becoming more aware of the link between their diet and their overall well-being, resulting in a greater

interest in functional foods that are fortified with essential vitamins and minerals. This heightened awareness is also driving a rising demand for food products that are organic and nutrient-dense and offer specific health benefits.

Consequently, there is an increasing consumption of low-calorie, plant-based, gluten-free foods, reflecting a broader shift toward healthier eating habits. This growing awareness of health and wellness is a significant driver influencing the demand for food products that contributes to overall well-being. This trend is actively shaping product development strategies within the food industry, as food processors are reformulating their existing product lines and introducing entirely new products specifically designed to cater to the needs and preferences of health-conscious consumers. Consumers are demonstrating a growing desire for greater transparency and traceability in their food supply chains, wanting to know more and be sure about the origin of their food, the methods used in its production, and the specific ingredients it contains. To access this information, they are increasingly relying on product labels, dedicated mobile applications, and technologies like blockchain. This increasing preference for transparency and traceability indicates a growing level of skepticism among consumers toward traditional food systems and a desire for greater control over the food choices they make. Digital technologies are emerging as critical tools for meeting this demand, fostering greater trust and accountability within the food industry by providing verifiable information about the food supply chain.

3. Research methodology

The article uses the theoretical concept of strategic necessity to support the idea that in the process of digital transformation, the smart performance of the food and gastronomy tourism sector through new IT tools does not necessarily become more efficient, but it inevitably expands the conceptual framework of sustainability and prompts closer cooperation (Gössling, 2021). At the same time, it inevitably requires a more sustainable approach (Madanaguli, 2023). Forecasting as methodology seeks to anticipate the future based on historical and current knowledge and trends. Coates (1994) pointed out that the forecast is a simple or complex look at the qualities and probabilities of a future event or trend that futurists differentiate between the forecast, which is generally not point-specific to time or place, and the prediction, a specific, usually quantitative statement about some future outcome.

The forecasting trends are complex. The food system can be better understood when its three contexts are examined separately: the food industry, food consumption, and technology as change. It is necessary to understand the interconnection of all three. The purposes in food trend forecasting focus is on change and how it intertwines with culture and industry. For Polányi, the “great transformation” indicates a shift in emphasis where the economy separates from society, but the logic of the state no longer satisfies the needs of society; society will resist this tendency and try to re-insert it into social relations by reconciling goals and means (Polanyi; 1944). Clemons, Reddi and Row (1993) support the duality with the strategic necessity hypothesis and Solow (1987) with the concept of technological paradox, claiming that new IT tools do not automatically improve a company's performance where they are used. It is only one way of establishing a commitment relationship that management is heavily involved in the introduction and development of technological resources that are necessary to increase member satisfaction.

4. Results and discussion

Integrating technology into the food system offers a novel opportunity to educate society. By connecting consumers with the stories behind their food, we foster global dialogue and advocate for sustainable practices. Technology is no longer just a tool in the kitchen; it is becoming an integral part of creating a new eating culture. Innovations brought about by digitalization are revolutionizing every part of the food system, from farm to fork. To address challenges in customer and supply chains and to remain competitive, the food industry is increasingly turning to the integration of technological innovations from production to communication. Modern data and AI have become a significant factor in future strategies. Companies are using IoT combined with AI to increase efficiency, improve customer service, reduce costs and increase revenues.

4.1. Precision agriculture

According to the U.S. Government Accountability Office’s *Precision Agriculture Report* (2024), agriculture is using technologies such as GPS and automation to make farms more efficient. For example, farmers can use automated steering systems to precisely seed fields, and activity monitors can help dairy farmers collect data on the health of their cows. Using sensors, AI, and data analytics, precision agriculture

optimizes resource use, reduces waste, and increases crop yields. It can also reduce seasonal labor challenges by tailoring irrigation and fertilization to the exact needs of each crop, leading to more sustainable and productive farming.

4.2. Advanced food processing, smart kitchens

There is growing recognition that everyone is different and needs different treatments and nutrients. Genetics and personalized nutrition can help people live healthier lives and improve performance and recovery. TNO, Wageningen University and Research Institute, and partners have developed an innovative mobile mini factory to produce 3D-printed food. Field studies show that the 3D printing system can successfully optimize nutrition for performance or recovery, tailored to individual needs, preferences, and daily circumstances, and has been tested on various target groups such as (elite) athletes, hospital patients, people with serious illnesses, the elderly, and people rehabilitating at home after an accident or surgery. Many people already believe that internet-based smart kitchen innovation will make meal preparation easier. They may be right, as developers of home robots and artificial intelligence hope that the integration of artificial intelligence, IoT, and genetic testing will pave the way for smart kitchens that can recommend recipes, track nutritional intelligence, and even offer personalized meal plans for each member of a family or organization based on an individual's DNA and health data.

4.3. Food delivery platforms and e-commerce

One of the most compelling ways to engage consumers over time is using technology, such as QR codes on food packaging. These codes can reveal stories about the origins of food through a website, providing insight into the lives of farmers and the methods they use. This initiative not only educates consumers but also fosters a sense of connection to the food they consume. Incorporating a QR code into the communication of a product or service shows that the business has successfully embarked on a journey toward understanding more conscious purchasing decisions. Since Covid-19, restaurants offering delivery have necessarily reached out to digital technology, as former guests sought home delivery options, and catering establishments sought survival opportunities through social media and websites. After the pandemic, restaurants' online ordering platforms remained in a hybrid form and became a separate business as a virtual restaurant with secure payment options. Covid-19 also brought to life a new form of service, ghost kitchens, which are not based on previous clientele, but offer a fast, efficient, diverse solution for busy guests with home delivery. Ghost kitchens reduce overhead costs exclusively for the operation of the cooking kitchen to increase profitability, thus offering a competitive offer behind digital systems.

4.4. Robotics and automation

Patel (2024) states that while automation of food preparation has obvious business benefits, such as lower labor costs and recipes prepared with greater accuracy and consistency, society seems to be reluctant and resistant to the digital transformation of the food market. The impact of IoT on consumer psychology is largely unexplored. For example, an early survey by OpenTable found that more than two-thirds of customers strongly dislike the presence of bots and chatbots during their dining experience (OpenTable, 2017). While consumers are ignorant or reluctant, businesses are increasingly open to automation in food preparation and are quickly adopting the tools and software available to them. Companies are also actively participating in experiments that promise to increase efficiency and productivity. Automation not only increases production speed but also reduces errors and improves food safety by minimizing human contact. Not to mention that automation can improve working conditions by reducing physically demanding, monotonous and dangerous tasks, as robotics in food processing plants are used to perform repetitive and labor-intensive tasks that previously relied on human labor, offering many opportunities for error.

4.5. Personalized nutrition

The growing global awareness of the connection between diet and health is a powerful driver of the new eating culture. Advances in food technology have made it possible to personalize nutritional plans to meet the unique needs of everyone, considering a variety of factors, such as their genetic makeup, lifestyle, and specific dietary preferences. One of the most exciting developments in this area is the use of DNA-based diets. By analyzing an individual's genetic profile, scientists can identify the specific genetic variations that influence how their body processes different nutrients. This valuable information can then be used to create personalized eating plans that optimize nutrient intake and minimize the risk of developing certain health conditions. This trend is fueled by remarkable advances in genetic testing capabilities, the proliferation of wearable health monitoring technologies, and the increasing sophistication of data analytics tools.

Conclusions

The integration of technology is also transforming traditional dining thinking. Digital tools, including online ordering platforms, smart kitchen appliances, service providers and even smart homeowners, are widely used to optimize daily operations and/or reduce costs. Automation is playing an increasingly important role in large-scale manufacturing and restaurant kitchens, where cooking and food preparation technologies are used. The emergence of robot waiters and chefs in some establishments further illustrates this trend. Artificial intelligence is also making its way into both commercial and home kitchens, helping with recipe suggestions and healthier food choices. Technology helps to shape the global conversation about drivers and opportunities for new eating habits while increasing consumer awareness. The continuous and rapid development and exchange of technology also makes the development of global and national data protection policies increasingly unavoidable. On the other hand, by learning about data, consumers can collectively influence the food industry towards fairer operations and more sustainable practices. The commitment to transparency and sustainability can transform the output of food production. In summary, the integration of technology into the food system offers a unique opportunity to positively influence society, if used correctly by those involved.

References

Addo, A.K., 2010. Urban and peri-urban agriculture in developing countries studied using remote sensing and in situ methods. *Remote Sensing*, 2(2), pp.497-513. https://doi.org/10.3390/rs2020497.

Aguilera, J.M., 2006. Seligman lecture 2005 food product engineering: building the right structures. *Journal of the Science of Food and Agriculture*, 86(8), pp.1147-1155. https://doi.org/10.1002/jsfa.2468.

Appio, F.P., Frattini, F., Petruzzelli, A.M. and Neirotti, P., 2021. Digital transformation and innovation management: A synthesis of existing research and an agenda for future studies. *Journal of Product Innovation Management*, 38(1), pp.4-20. https://doi.org/10.1111/jpim.12562.

Ardito, L., Petruzzelli, A.M., Panniello, U. and Garavelli, A.C., 2018. Towards Industry 4.0: Mapping digital technologies for supply chain management-marketing integration. *Business process Management Iournal*, 25(2), pp.323-346. https://doi.org/10.1108/.

Baierle, I.C., da Silva, F.T., de Faria Correa, R.G., Schaefer, J.L., Da Costa, M.B., Benitez, G.B. and Barney, J.B., 2001. Resource-based theories of competitive advantage: A ten-year retrospective on the resource-based view. *Journal of Management*, 27(6), pp.643-650. https://doi.org/10.1016/s0149-2063(01)00115-5.

Bendig, E., Erb, B., Schulze-Thuesing, L. and Baumeister, H., 2022. The next generation: Chatbots in clinical psychology and psychotherapy to foster mental health–a scoping review. *Verhaltenstherapie*, 32(Suppl. 1), pp.64-76. https://doi.org/10.1159/000501812.

Bharadwaj, A., El Sawy, O.A., Pavlou, P.A. and Venkatraman, N Anandhi., 2013. Digital business strategy: Toward a next generation of insights. *MIS Quarterly,* 37(2) pp.471-482. https://doi.org/10.25300/misq/2013/37:2.3.

Boyd, D. and Ellison, N., 2008. Social network sites: Definition and conception. *Journal of Computer Mediated Communication*, *13*(1), pp.210-230.

Buhalis, D. and Cheng., 2020. Exploring the use of chatbots in hotels: technology providers' perspective. Information and Communication Technologies in Tourism 2020. *Proceedings of the International Conference in Surrey, United Kingdom. Springer International Publishing.* https://doi.org/10.1007/978-3-030-36737-4_19.

Chen, B., Wan, J., Shu, L., Li, P., Mukherjee, M. and Yin, B., 2017. Smart factory of industry 4.0: Key technologies, application case, and challenges. *IEEE Access,* 6, pp.6505–6519. https://doi.org/10.1109/ACCESS.2017.2783682.

Clemons, E.K., Reddi, S.P., and Row, M.C., 1993. The impact of information technology on the organization of economic activity: The "move to the middle" hypothesis. *Journal of Management Information Systems,* 10(2), pp.9-35. https://doi.org/10.1080/07421222.1993.11517998.

Coates, J. F., Mahaffie, J. B., and Hines, A., 1994. Technological Forecasting: 1970-1993. *Technological Forecasting and social change*, *47*, 23-23.

De Giovanni, P., 2023. Sustainability of the Metaverse: A transition to Industry 5.0. *Sustainability*, 15(7), p.6079. https://doi.org/10.3390/su15076079.

Di Renzo, L., Gualtieri, P., Pivari, F., Soldati, L., Attinà, A., Cinelli, G., 2020. Eating habits and lifestyle changes during COVID-19 lockdown: an Italian survey. *Journal of Translational Medicine,* 18, p.229. https://doi.org/10.1186/s12967-020-02399-5.

Echegaray, N., Hassoun, A., Jagtap, S., Tetteh-Caesar, M., Kumar, M., Tomasevic, I., 2022. Meat 4.0: principles and applications of industry 4.0 technologies in the meat industry. *Applied Science,* 12, p.6986. https://doi.org/10.3390/electronics11111742.

Freeman, C., 1996. The greening of technology and models of innovation. *Technological Forecasting and Social Change,* 53(1), pp. 27-39. https://doi.org/10.1016/0040-1625(96)00060-1 .

Gaggioli, A., 2017. An open research community for studying virtual reality experience. *CyberPsychology, Behavior & Social Networking*, 20(2), pp.138-139. https://doi.org/10.1089/cyber.2017.29063.csi.

Golmgrein, I., 2023. A comprehensive overview of monetization strategies in creative industries. *International Journal of Latest Engineering and Management Research (IJLEMR)*, 8(10.56581), pp.90-100. https://doi.org.10.56581/IJLEMR.8.4.90-100.

Gössling, S., 2021. Tourism, technology and ICT: A critical review of affordances and concessions. *Journal of Sustainable Tourism,* 29(5), pp.733-750. https://doi.org/10.1080/09669582.2021.1873353.

Hassoun, A., Marvin, H.J., Bouzembrak, Y., Barba, F.J., Castagnini, J.M., Pallarés, N. and Regenstein, J.M., 2023. Digital transformation in the agri-food industry: Recent applications and the role of the COVID-19 pandemic. *Frontiers in Sustainable Food Systems,* 7, p.1217813. https://doi.org/10.3389/fsufs.2023.1217813.

Kottler, B., Fischer, S., Strauss, E., Bulatov, D. and Helmholz, P., 2023. Parameter Optimization for a Thermal Simulation of an Urban Area. *ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, *10*, pp.271-278. https://doi.org/10.5194/isprs-annals-X-1-W1-2023-271-2023

Madanaguli, A., Dhir, A., Joseph, R.P., Albishri, N.A. and Srivastava, S., 2023. Environmental sustainability practices and strategies in the rural tourism and hospitality sector: A systematic literature review and suggestions for future research. *Scandinavian Journal of Hospitality and Tourism*, 23(1), pp.1-28. https://doi.org/10.1080/15022250.2023.2174179.

Marino, M., Puppo, F., Del Bo', C., Vinelli, V., Riso, P., Porrini, M. and Martini, D., 2021. A systematic review of worldwide consumption of ultra-processed foods: Findings and criticisms. *Nutrients*, 13(8), p. 2778. https://doi.org/10.3390/nu13082778.

Martinez, M.G. and Briz, J., 2000. Innovation in the Spanish food & drink industry. *The International Food and Agribusiness Management Review*, 3(2), pp.155-176. https://doi.org/10.1016/S1096-7508(00)00033-1.

Mihalic, T. (2024). Metaversal sustainability: conceptualisation within the sustainable tourism paradigm. *Tourism Review*. *doi: 10.1108/TR-09-2023-0609*

Patel, M.K., Rani, R., Sohel, A. and Chauhan, A., 2024. Significant research and technology landscape on electrostatically charged sprays for agro-food and health industry. *Journal of Physics: Conference Series,* 2702(1) p.012013. https://doi.org/10.1088/1742-6596/2702/1/012013.

Polanyi, K. and MacIver, R.M., 1944. *The Great Transformation (Vol. 2, p. 145).* Boston: Beacon Press https://doi.org/10.2307/2144137.

Porter, M.E., 1980. Techniques for analyzing industries and competitors. *Competitive Strategy.* New York: Free Press.

Powell and Dent-Micallef 2017 Powell, T. C. & Dent-Micallef, A. 1997. Information technology as competitive advantage: The role of human, business, and technology resources. *Strategic Management Journal, 18(5), 375-405. https://doi.org/10.1002/(sici)1097-0266(199705)18:5%3C375::aid-smj876%3E3.3.co;2-z*

OpenTable Research Survey Explores Diner Sentiment Toward Technology Use Before, During and After the Meal 05/23/ 2017 *Hospitality Technology* https://hospitalitytech.com/opentable-research-survey-explores-diner-sentiment-toward-technology-use-during-and-after-meal

Solow, B. L. 1987. Capitalism and slavery in the exceedingly long run. *Journal of Interdisciplinary History*, 17(4), 711-737.

Song, S. W., and Chung, D. H. 2021. Explication and rational conceptualization of metaverse. *Informatization policy*, 28(3), 3-22.

Schwab, Klaus. 2017. The fourth industrial revolution. *Crown Currency*, https://doi.org/10.32920/24242932

Ritterbusch, G. D., and Teichmann, M. R. 2023. Defining the metaverse: A systematic literature review. *Ieee Access*, *11*, 12368-12377. *doi*: 10.1080/14626261003786251.

U.S. Government Accountability Office's Precision Agriculture Report (2024) *TECHNOLOGY ASSESSMENT Precision Agriculture Benefits and Challenges for Technology Adoption and Use* GAO-24-105962, *download*: 28/04/ 2025 https://www.gao.gov/assets/d24105962.pdf

Wernerfelt, Birger. 1984. "A resource-based view of the firm." *Strategic management journal 5.2: 171-180. https://doi.org/10.1002/smj.4250050207*

Zhou, L., Li, H., Zhang, S., Yang, H., Ma, Y., and Wang, Y. 2023. Impact of ultra-processed food intake on the risk of COVID-19: a prospective cohort study. *European Journal of Nutrition*, *62*(1), 275-287. https://doi.org/10.1007/s00394-022-02982-0