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Implementation and utilization of Artificial Intelligence in food processing industries in Chennai area: An analysis using the UTAUT 2 model

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Abstract
The adoption of Artificial Intelligence (AI) is increasing in the food production industry to streamline the production, distribution, supply chain, and consumption processes. Increased awareness and enhanced expectations from customers resonate with the challenges of understanding consumer behavior. The current study aims to explore the implementation of AI in food processing industries within the Chennai region and recommend better adoption of AI using the UTAUT 2 Model. Three attributes were used to select companies: companies having a branch in Chennai, listed on the National Stock Exchange (NSE) with a turnover of more than ₹2,000 crores in the financial year 2023-24. The theoretical framework was set up based on the UTAUT 2 model to examine how constructs such as performance expectancy, effort expectancy, social influence, facilitating conditions, and price value influence user behavior. This study aims to explore the adoption and deployment of AI in food-processing industries and develop a business model for other industries to adopt AI. This study contributes to a better understanding of the role of AI in the industry and provides insights into the factors influencing its acceptance and usage.

Keywords: Artificial Intelligence, machine learning, deep learning, UTAUT2, technology acceptance

Introduction
Food processing products are items that are quickly sold and typically consumed regularly. Items produced by food processing companies are marketed using advanced technologies. Artificial intelligence is one of the technologies widely implemented across various industries. An increasing number of food processing companies are integrating Artificial Intelligence (AI) into their operations to streamline production, distribution, and consumption processes. With the rise of artificial intelligence (AI) and automation in business, food processing companies are confronted with new challenges. Technological innovations, especially in the fields of Conversational Artificial Intelligence and robotics, have heightened consumer demands and expectations. Consequently, food processing firms struggle to understand consumer behavior. Thus, AI and other advanced technologies support the food-processing sector. AI is particularly useful for simplifying complex decision-making processes. For instance, it can facilitate data and workforce analytics, which are vital for businesses to remain competitive and thrive in the market. Engaging with data analytics could serve as a crucial element in enhancing management within the food processing industry, potentially employing artificial intelligence to utilize existing data for more precise forecasts. The food processing sector requires a holistic approach to organize, assess, integrate, and draw insights. Automation, along with AI implementation, can provide effective solutions to improve the efficiency of food processing enterprises. Technologies such as Artificial Intelligence (AI), Deep Learning (DL), and Machine Learning (ML) are used to automate various processes. Machine learning and artificial intelligence can oversee food safety and quality data management, offering feedback to ensure high standards of food production. Artificial intelligence is poised to elevate the food processing sector by minimizing human errors and mistakes in manufacturing and, to a lesser degree, in waste reduction. This results in decreased packaging and delivery costs, enhanced customer satisfaction, expedited services, voice-activated searches, and more tailored orders.

Review of Literature

The Unified Theory of Acceptance and Use of Technology 2 framework was used to study the user acceptance of technology (Venkatesh *et al*., 2012). A study was conducted to explain the factors affecting the adoption of AI in the food processing industry (Neves *et al*., 2024). A study was conducted on the influence of AI in transforming the food industry and explaining how AI helps reduce costs, optimize resources, and respond to dynamic market fluctuations. Al can also be instrumental in eliminating low-quality products and enhancing production quality and efficiency (Song *et al*., 2025). A study highlighted the relevance of the UTAUT 2 model in understanding the adoption of technologies in agri-food supply chains and revealed that performance expectancy and facilitating conditions are the drivers influencing the adoption of automation in food processing. Several studies have been conducted on the use of the UTAUT 2 model to investigate the acceptance of technology in different domains. The model has been identified to understand technology adoption from a consumer perspective in a non-organization perspective (Tamilmani *et al*., 2019) [15]. A study that explored the intention to use e-wallets through the UTAUT 2 model (Upadhyay, 2024). A similar study was conducted using the UTUAT and UTAUT 2 models on the factors affecting mobile banking. Another study conducted during the COVID- 19 pandemic regarding the acceptance of video communication from students' perspectives (Almahri *et al*., 2024). Another study assessed the acceptability of communication technology by older adults from the health perspective (Macedo, 2017). A systematic review analysis was conducted on the factors affecting fintech adoption using the UTAUT 2 model (Firmansyah *et al*., 2022), and a similar perspective was examined on the perspective of consumer acceptance of fintech app payment. Another study extended the use of the UTAUT 2 model to assess the factors affecting consumer usage of OTT video streaming platforms. Tsang and Tsai used the UTAUT 2 model to investigate the factors contributing to businesses' continuous usage of mobile payment in the post-pandemic era. This model has also been used to check the acceptability of video games. Several studies have been conducted on the constructs and factors of the model, such as performance expectancy, effort expectancy, social influence, and facilitating conditions (Firmansyah *et al*. 2012), hedonic motivation, price value, and habit (Tamilmani *et al*., 2019) [15]. Certain studies have extended the model by adding specific constructs such as technology awareness, proactive personality, reward and technology innovation (Upadhyay, 2024), eudemonic motivation, and tranquility. Researchers have extensively used various approaches to study the UTAUT 2 model. Survey techniques were used to collect data to study technology acceptance (Xue *et al*., 2024), meta-analysis to evaluate UTAUT 2 constructs (Tamilmani *et al*., 2020) [15], and qualitative methods. The literature review helps the study explore the robust use of the UTAUT 2 model to understand technology acceptance. Few studies have been conducted from the food industry perspective, and the current study attempts to address technology acceptance through UTAUT 2.

Statement of the Problem

With advancements in science and technology, numerous business sectors have incorporated automation into their operations. The development and application of artificial intelligence, including robots, drones, 3-D printing in restaurants, eco-friendly packaging, and smart sensors for data collection, are facilitating data-driven decision-making and contributing to the prosperity of various industries. The food processing sector extensively utilizes artificial intelligence. At present, much of the manual labor is performed by AI, which enhances both the efficiency and effectiveness of production. Nevertheless, despite these technological advancements, many industries have been unable to fully meet customer expectations. Some food companies struggle with maintaining food hygiene and quality, properly managing supply chains, upholding efficient inventory systems, timely procurement of supplies, and ensuring on-time delivery of goods, among other issues. On one hand, there is an urgent need for artificial intelligence advancements to optimally support the food industry. On the other hand, it is essential for every food processing company to effectively leverage artificial intelligence to thrive in a competitive environment and satisfy their customers. Therefore, this research paper aims to explore the implementation and application of artificial intelligence in food processing industries within the Chennai region and propose robust recommendations for better adoption and usage of AI using UTAUT 2 Model.

Need for the Study

Numerous researchers have augmented the UTAUT2 Model to yield a more nuanced understanding. To illustrate, Alalwan and colleagues (2018) added the aspect of perceived risk to the UTAUT2 Model, while Shaw and Sergueeva (2019) brought in the idea of perceived value; Merhi and others (2019) focused on elements like security, privacy, and trust; lastly, Alalwan (2020) examined online rating, online review, and online tracking. As a result, in alignment with the focus of this investigation, the authors have further developed the UTAUT2 framework by incorporating user self-efficacy and personal innovativeness in technology (PIIT). These constructs provide valuable insights into individuals' capacities and readiness to embrace cutting-edge technology. This study examines the acceptance of artificial intelligence by users within the food processing sector in the Chennai region, positing the essential role of artificial intelligence in the foreseeable future.

Research Objectives

1. To ascertain the factors that are the key drivers in the adoption and deployment of AI in the chosen food processing sub-sectors
2. To offer business models for other Food Processing industries in Artificial Intelligence adoption

Theoretical Framework

UTAUT 2 Model (Venkatesh *et al*., 2003) used to explain consumer acceptance of new technologies is an extension to the of the original UTAUT model (Chang *et al*., 2019). This model helps us to understand technology acceptance and usage in consumer contexts. The theoretical framework of UTAUT 2 model is based on constructs such as performance expectancy, effort expectancy, social influence, facilitating conditions influence user behaviour. Performance expectancy is the degree to which an

individual believes that use of technology helps them attain benefits. Effort expectancy is the degree of ease associated with the use of technology. Social influence is the degree to which a person thinks that significant people believe they should use the technology. The construct facilitating conditions explains the belief of an individual that an organization and its infrastructure exists to support the technology use. Another constructs Hedonic motivation is the degree to which pleasure derived from using technology. Price value constructs explain the cognitive trade-off between benefits of using technology and the cost associated with it.

UTAUT 2 Construct Influencing User Behaviour:

Performance Expectancy: The users believe that Artificial Intelligence will enhance their work efficiency and output quality in the workplace which can contribute to the overall increase in the performance expected.

- Effort Expectancy: The degree of ease associated with the use of Artificial intelligence and acceptance of AI.
- Social Influence: The degree to which the opinions and behavior of peers and management significantly impact individual acceptance of Artificial intelligence.
- Facilitating Conditions: The degree to which the availability of resources and support systems with technical infrastructure is essentials for users to adopt Artificial intelligence.
- Hedonic Motivation: The degree in which the individual users as the pleasure or enjoyment derived from using Artificial intelligence technologies.
- Price Value: The Artificial intelligence in influencing technology adoption and perceived cost benefit analysis using AI.

EID Parry (India) Ltd

The EID Parry (India) Ltd with ₹3,300 crore of revenue turnover in FY 2023 -24 using sophisticated machine learning models to predict health and maintenance to analyse senor data from these production- equipment and identify potential failures before they occur. The Performance expectancy helps to improve overall quality control enhancement and real time production with AI capabilities alongside human operators. Effort Expectancy involves creating user-friendly interfaces for AI tools, providing training for employees, implementing AI decision-making tools, and using natural language processing for voice control to limit manual data entry. The EID Parry (India) Ltd conducting cost-benefit analyses for AI investments, considering cloud solutions to lower costs, exploring partnerships with AI providers, and focusing on projects with high returns. Facilitating Conditions emphasize the need for a strong IT infrastructure, dedicated teams for AI support, knowledge-sharing platforms, and clear guidelines for AI use. The use of Technology includes integrating AI with existing production systems and supply chain, using IoT for real-time data, employing AI for maintenance, and exploring collaborative robots. The company was able to promotes a culture of innovation, communication about AI successes, and opportunities for employees to suggest new AI applications. EID Parry Ltd effectively implements AI technologies in its production department, improving efficiency, reducing costs, and fostering a culture of innovation and technological advancement.

Hatsun Agro Product Ltd

The Hatsun Agro Product Ltd with ₹5,000-10,000 crore of revenue turnover in FY 2023 -24 major helps in streamlining the processes and lowering human error. It can analyze large data sets to anticipate maintenance needs, which minimizes downtime and enhances equipment performance. AI-based quality control can more effectively spot defects than human inspectors, resulting in better product quality and less waste. For better demand forecasting, The AI can help Hatsun Agro Product Ltd to align its production with market needs, cutting down on overproduction and storage costs. The effort expectancy which enhances supply chain management by ensuring timely delivery of materials and products. Hatsun has taken measures to increase productivity and lower costs, to all stakeholders.

To ease the adoption of AI, Hatsun Agro should use user-friendly designs and provide thorough training for employees, which can lessen resistance to change. Gradually implementing AI through pilot projects can help staff adjust without feeling overwhelmed, and creating a support system can assist them during the transition. Although the initial costs for AI might be high, the long-term savings and return on investment are noteworthy. It's essential for the company to assess costs and benefits effectively. Establishing the necessary infrastructure and fostering a culture of innovation will also aid AI adoption, leading to enhanced efficiency and competitiveness in the market.

Nestlé India Ltd

Nestlé India Ltd. incurred FY 2023-24 revenue of ₹19,562 cr, and the implementation of AI has greatly improved production by optimizing schedules, predicting maintenance needs, enhancing quality control, improving inventory management, and ensuring consistent product quality. User-friendly AI interfaces and gradual implementation help the staff adapt comfortably. Comprehensive training and clear procedures support the effective use of AI tools without disrupting the existing workflows. Although the initial costs of AI can be high, the long-term savings from reduced waste, better efficiency, and lower utility costs will offset these expenses. Predictive maintenance can also reduce repair costs. A strong IT infrastructure and dedicated AI team are essential for successful implementation, alongside fostering a culture of innovation. Involving production staff in AI choices can increase acceptance, and sharing positive examples from other departments can boost confidence. Offering incentives and creating feedback channels can further enhance the use and improvement of AI systems for the production department.

Hindustan Unilever Limited (HUL):

Hindustan Unilever Limited (HUL) incurred a FY 2023-24: ₹59,579 crore the company as AI can enhance production by optimizing schedules, conducting predictive maintenance, and improving quality control. It analyzes production data to find process improvements and forecast demand for better inventory management, leading to less waste. To adopt AI effectively, companies should create user-friendly interfaces, provide comprehensive training, and develop systems that fit seamlessly with current processes. AI should offer clear insights to managers and support their decision-

making. Initial investments in AI infrastructure, employee training, and the possible hiring of specialists should be considered. Long-term savings from improved efficiency and quality must be evaluated along with the scalability of AI solutions. Implementing AI in phases can help manage costs and demonstrate gradual returns, and a strong IT infrastructure and clear data governance are vital. Encouraging a culture of innovation and collaboration with technology partners can facilitate this adoption. Communicating the benefits of AI, involving employees in the process, showcasing successes, and providing ongoing support are essential for the acceptance and effective use of AI technologies.

Findings

Fast moving consumer goods: Changes in the technology, developments and uncertain market situations have accelerated the need on the part of Fast-Moving Consumer Goods (FMCG) industries and particularly the Food Processing Industry in dealing with durable goods, which in the recent years have posed a demand for a reengineering of the functional characteristics. Agriculture industries based on food processing are forced to embrace state of the art technology solutions, like Artificial Intelligence (AI), to survive in the market and make themselves better. In this paper, applications of Artificial Intelligence (AI) methods in food industry are investigated. This research work explores the implementation and utilization of artificial intelligence in food processing sector. This study shall limit its scope to five food processing enterprises in Chennai using three criteria: listed companies on the National Stock Exchange (NSE), industry having turnover (revenue) over 2,000 crores in the financial year 2023-2024, and has its branch in Chennai. The UTAUT2 is one of the models which assists in measuring the adaptability and usage of current Automation and Artificial Intelligence.

Conclusion

The study utilized the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model. This model was instrumental in measuring the adaptability and usage of current automation and artificial intelligence technologies within the selected food processing companies EID Parry (India) Ltd, Hatsun Agro Product Ltd, Nestlé India Ltd, Hindustan Unilever Limited (HUL). The paper provides valuable insights into the adoption and deployment of AI in the food processing sector within the Chennai region, highlighting how the UTAUT2 model can be used to assess technology acceptance and usage in this context and technological advancements and dynamic market conditions have accelerated the need for Fast - Moving Consumer Goods (FMCG) industries, particularly the food processing industry to reengineer their operations.

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