

Retraction

Retracted: An Empirical Investigation in Analysing the Critical Factors of Artificial Intelligence in Influencing the Food Processing Industry: A Multivariate Analysis of Variance (MANOVA) Approach

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Manipulated or compromised peer review

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

In addition, our investigation has also shown that one or more of the following human-subject reporting requirements has not been met in this article: ethical approval by an Institutional Review Board (IRB) committee or equivalent, patient/participant consent to participate, and/or agreement to publish patient/participant details (where relevant).

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

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- [1] G. S. Raghavendra, S. S. C. Mary, P. B. Acharjee et al., "An Empirical Investigation in Analysing the Critical Factors of Artificial Intelligence in Influencing the Food Processing Industry: A Multivariate Analysis of Variance (MANOVA) Approach," *Journal of Food Quality*, vol. 2022, Article ID 2197717, 7 pages, 2022.

Research Article

An Empirical Investigation in Analysing the Critical Factors of Artificial Intelligence in Influencing the Food Processing Industry: A Multivariate Analysis of Variance (MANOVA) Approach

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In the era of digital technology, where innovation and digitization are transforming the business functions, the field of customer relationship management has witnessed sea change in the recent decade. The application of artificial intelligence in food processing has enabled enhancing the availability of food in an effective manner for all the individuals. It has been regarded that the application of labor force tends to play a crucial aspect for the overall execution of things in the different domains related to food manufacturing and processing, which are related to the enhanced involvement of individuals in the processing of food and related products, the industry could not able to meet the growing demand from the customers. So, in order to overcome these critical issues, it is noted that the application of technology such as automation and artificial intelligence is implemented for enhanced processing and enable delivering quality products to the customers at lower cost. The impact of AI in the current business world is becoming more indispensable as companies have started to unleash its potential. The role of AI in food processing is fast changing the manner in which the customer queries are addressed, enabling analysing the needs and requirements, and focus on creating improved packaging, high quality, and better shelf life. This empirical investigation is focusing on analysing the critical factors related to AI in influencing the food processing industry. The researchers intend to apply quantitative analysis using IBM SPSS package, and the results are stated in detail based on the analysis.

1. Introduction

The needs and preferences of the customers are fast changing the dynamic environment; hence, it is highly essential for the business and managers to understand the key requirements of meeting the growing food requirements, and hence, application of new technology can enable quicker processing

of the food, support efficient packaging, and enable better shelf life for the benefit of the customers. In recent years, there is a greater importance of implementing food processing so as to meet the growing demand from the individuals, and hence, the food processing companies are looking to implement new technologies to meet the requirements.

For a country to grow sustainably, it is important to possess a better food industry as they support meeting the basic essential requirements of human; furthermore, they also enable generating foreign exchange through making better exports. Hence, the quality of the food products, offering better safety with enhanced distribution channel are needed in the current context. Hence, it is highly essential to implement the sophisticated tools such as AI for aiming in getting better productivity and output which will enable realising food security in the country.

The application of artificial intelligence in food processing has enabled in enhancing the availability of food in an effective manner for all the individuals. The emergence of AI in the food processing support the manufacturers and customers in addressing the food challenges effectively; furthermore, it supports in understanding the future needs and requirements and enable in meeting the food security effectively. Furthermore, the implementation of AI in the agriculture and food industry supports in delivering better harvest and food quality of the products; also, it supports in increasing the shelf life for better sustainability. Therefore, using these techniques will support in addressing the socioeconomic requirements and delivery of better products on time; also, the usage of these technologies will aim in reducing the food scarcity, support in offering the goods at lower cost, and create better future generations.

AI-based or autonomous systems are widely used in almost all areas of major industries and business process. Furthermore, it can be stated that the implementation of the technology tends to analyse and effectively identify suitable solutions to the problems; in case of food industry, it enables transformation of the products of the food industry. The industry can use an electronic system to test and guarantee the improvement of the creative solutions which enable selecting the seeds effectively, enable managing and monitoring the crops better manner, support analysing the temperature and effectively monitor them for better irrigation. It can be stated that the use of AI is not only restricted to these aspects, but it is also applied in enhancing the overall processing of foods, storing the goods, and transporting them so that the end users will benefit. The application of critical devices in the production process tends to play a higher role in effectively monitoring the movement of goods and services. Furthermore, it supports to deliver food, work in hazardous environments, and provide high-quality products. The important roles of artificial intelligence in the food industry are divided into approximately two categories: one is food safety management and the other is food quality management.

The indispensable role of information technology in disrupting all areas of human life and hence businesses are using them to manage the process, deliver better products and services, and engage the customers in an effective way. The implementation of new and enhanced tools such as AI, IoT, and business data analytics are being applied in marketing function to enhance the process [1]. AI marketing is focused in applying the technology to enhance customer experience, address their needs, and deliver better products and services. The marketing managers has been enhanced by applying the technologies mainly AI and related measures

which will enable them to understand the customers in a better manner and devise strategies for overcoming the competition. Implementation of AI enables the business to make the process more convenient, support in engaging the customers, and use social media to the fullest advantage for generating more sales and profits [2]. Furthermore, AI supports in performing the routine activities at ease and can replace the noncore activities which are being performed by the humans in the organisation.

The food industry uses artificial intelligence for several purposes, as this system has proven to be particularly useful in the decision-making process. Knowledge-based expert system has been used in white wine production during the fermentation process for monitoring, intelligent control, and data retrieval. In addition, an online application was developed to calculate the nutritional value of food for users using ES, and the development of artificial intelligence helped PMIs obtain the data needed to purchase food and building certificate. Food safety is very important in the food industry, which is why the application of ES, which is closely related to food safety, is widespread, from process design to safety management to food quality and risk assessment. In addition, an original IT tool and correction guidelines for the food industry were developed that take into account ES in the model, where some critical factors such as food safety, nutrition, quality, and cost were studied.

Based on the context, it can be stated that the application of the technology enables identification of the opportunities in the food industry, use the tools for enhancing the productivity and harvest so that the products can be delivered to the consumers without any interruptions. It has been further stated by many researchers that application of AI supports the business in the food processing industry in sourcing critical data, utilise them to perform detailed analysis, and decision making. This results in more accurate forecast of the patterns and behaviours of the customers [3]. AI can be understood as the critical aspect of applying different tools and systems which has endowed with the key intellectual process of human, like ability to perform task, preparation of reports and dashboard, and data extraction and analysis with the purpose of providing the relevant information for effective making decision making [2, 3]. AI poses the overall potential to integrate the AI with the manual processing of data entry; hence, it supports the sales and marketing professionals in automating the information, enable them to save time and effort on various unproductive tasks, and use their time for more productive aspects. It is further stated that AI not only assist in centralising the customer database but also involve in analysing the lifecycle of each of customers, support in realising their needs, and offer better services for meeting their requirements. It can be of great help to companies to fully understand what artificial intelligence is and what benefits it can provide such as a comprehensive business strategy, as artificial intelligence is already changing industries such as economics, commerce, electronics, logistics, and many other sectors. Above all, the future prospects for artificial intelligence in food processing and artificial intelligence are expected to influence marketing strategies

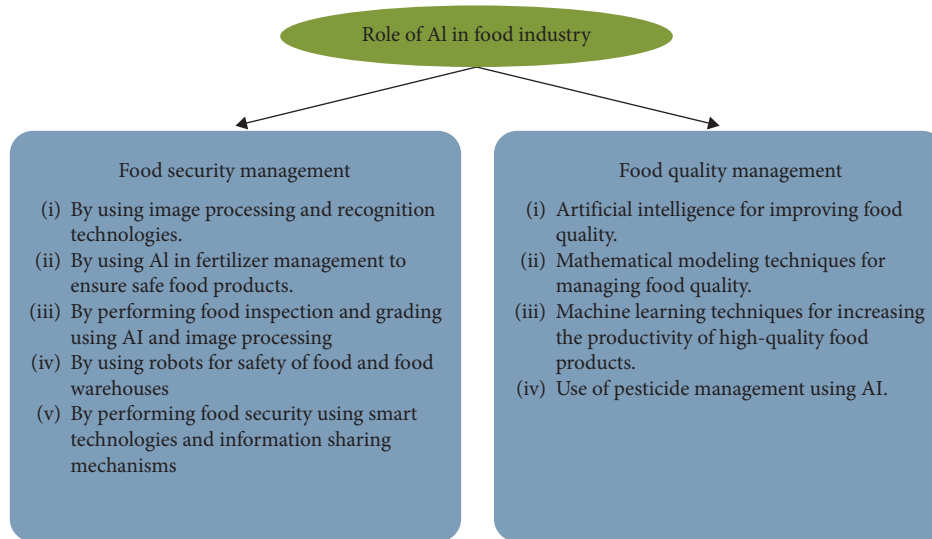


FIGURE 1: Role of AI in the food processing industry [4].

as well as business models, customer service, sales opportunities, and customer behaviour.

Modern innovations in the food industry have paved the way for new methods of food production and processing. Over the last five decades, there has been a demand for different types of foods, including some of these types of foods, such as functional foods, which have proven to be fundamental to a healthy lifestyle. To meet market demands and fast production, the food industry has used certain food techniques. State-of-the-art food processing and processing machines have been used and can be called innovative pioneers in the modernization of the food industry, which were later replaced by intelligent machines and production lines. This seems possible with the increased demand and corresponding increase in technological innovations. Over the past decade, there has been a significant paradigm shift in business models and investments with the emergence of 4IR technologies such as artificial intelligence and robotics. These latest technologies can be a potential tool to meet future demand for a sustainable food supply.

Also, AI tools is also used to engage the customers better and offer better experience, the total nature of the experience which the customers experiences with the business and its products through interactions is stated as customer experience [4]. Nearly 90% of all the interactions with the customers tend to be made through AI and this supports the managers and business to enhance their performance. Moreover, the interactions and feedback from customer experience can pave way as a source for the research and development in creating new products and deliver it to the customers. Customisation of products and cross-selling of products can be enhanced through AI as it requires minimum or no manual interventions.

Figure 1 tends to show the role of AI in enhancing the food security and quality management in the present economic environment, in the current context of the food security and quality which are highly important as there are

billion people to be fed. Hence, using advanced technological tools support addressing the critical challenges in the food industry.

AI also supports in the implementation of customer analytics to exploit the different opportunities based on information sourced from different sources, help the management in predicting the patterns with more accuracy, address the critical drivers of generating sales, support in addressing the issues, and problems faced by the clients so as to provide quick and permanent solutions [5]. AI not only support the organisation in minimising the churn rate of the customers but also immensely assist in making various opportunities to increase loyalty, make the customers visit the stores more often, improve decision making, cross-sell the products, and enhance operational efficiencies [6]. The study enables in apprehending the valuable role played by AI in order to reshape the products and services offering and support the marketers to devise the strategies for better customer experience. Also, AI can interact with different tools and techniques present in the organisation for unified communication and coordination, thereby realise the mission and vision of the organisation.

2. Review of the Literature

It is noted that the application of AI enables rendering the required data and information for effective decision making in the food industry. It has been observed that the implementation of these technology supports enhancing the business communication effectively, transfer of key data and information which will aid in informed decision making in various industries including the food processing industry.

In order to observe the critical decisions which can be enhanced, the researchers tend to understand the complexity of the decision structure in the current business environment. Today's business needs effective data at the right time

for making quick decision. In the food industry, it is more critical as the products are perishable and decision needs to be quick. Using AI, the managers can monitor the flow of goods, support in analysing the temperature and make quick decision so that the yield can be enhanced and support in realising better harvest which will benefit the end users [7].

In order to better understand the situations, the management tend to implement different systems which can be collaborated through AI for aiding in decision making and problem solving; this will support in close monitoring of the products, increasing shelf life and understand the demand supply cycle for better delivery of goods.

Many researchers have mentioned that the application of AI in the food industry supports creating synergies as it can integrate with different systems and machines for enhancing support for critical decision making. AI also enables supporting the automation of activities and reduce human intervention which will support in reducing cost and optimising the productivity. The cooperative intelligence systems enable in making the data and information available for informed decision making. Also, AI should be seen as a tool for critical decision making and integrating various technologies and systems in the organisation for adding more value [8].

Moreover, the usage of AI is supposed to grow exponentially in the future and hence organisation which adopts them enable in creating better association with the stakeholders, address the food needs of the individuals, and support in national growth and development.

These factors have also resulted in two ways of thinking about the future of traders. The first is that due to the constant changes in marketing due to artificial intelligence, the demand for well-trained marketers will increase in the coming years, while others believe that automation of a large number of tasks will ultimately lead to a reduction in workload marketing information [9]. An organisation's marketing department is often faced with a variety of complexities due to changing consumer demographics, increasing amounts of data, technical changes, changes in business models, and maintaining competitiveness through a diversification strategy [10]. If the marketing department does not have the competence to assess and analyse changing market needs and preferences, it is unlikely that the company's profitability will increase. This can cause problems with the marketing department's trust in the eyes of the CEO, and they may decide to take the department off the hook [11]. Research on this topic has already been presented and has shown that positions such as Chief Marketing Officer (CMO) often have very short lead times and higher fluctuations than other senior positions. However, this is not only a consequence of poor results but also because it is difficult to measure the performance of the CMO and hold them financially responsible. Artificial intelligence is a critical aspect of applying various tools and systems to basic human intellectual processes, such as the ability to perform a task, generate reports and dashboards, and extract and analyse data to provide relevant information for effective decision making.

3. Methodology

The study is mainly focused on analysing the key determinants of AI in influencing the food processing. For this purpose, the researchers intend to use the deductive approach. This approach aims in analysing the existing theory based on the information collected from various sources. The study enables apprehending the explanatory nature of the role of AI in the CRM. The researchers use previous studies to critically evaluate the key determinants of AI in the marketing domain. Also, the exploratory research supports in reviewing the previous study and apprehend them for the purpose of performing the current study [12].

The scientific research supports researchers in performing detailed investigation which will lead in identifying the suitable answers for the research question through the application of predetermine set of questions framed by the researchers [13]. The authors enable collecting the data using the predetermined closed-ended questions in order to source the responses for each question. The sample respondents were the employees who are currently working in the organisation where AI is mainly applied in the marketing domain for supporting the CRM functions. Since the research is focused in analysing the key determinates of AI in influencing the CRM in the organization, both primary data and secondary data are used. The researcher collects data from 165 respondents through the purposive sampling method.

3.1. Research Questions. Does automation of customer analytics through AI enable enhancing the food processing?

Is there any association between AI in supporting better food quality in the process?

Can AI offer more personalised customer experience which will support managing the process effectively?

Are there any statistical differences between forecasting the patterns through AI and effective shelf life for food in the industry?

3.2. Analysis. This section is mainly involved in performing detailed analysis through percentage analysis, regression analysis, and MANOVA.

3.2.1. Percentage Analysis. Based on the analysis in Table 1, it is noted that 84.8% of the respondents were male and remaining were female, 37.2% of the respondents were in the age group between 25–29 years, 32.3% were in the age group of less than 25 years, 18.9% of the respondents were in the age group between 35–39 years, and the remaining were in the age group between 30–34 years. 62.2% of the respondents have stated that they have the number of dependants between 1 and 2, and remaining stated that they have more than 2 dependants. 65.2% of the respondents stated that they are living in a metro city, and remaining 34.8% of the respondents have stated that they are living in a nonmetro city. 56.7% of the respondents are working in the food and beverage sector, 28.7% were

TABLE 1: Percentage analysis of demographic variables.

Gender	Frequency	Percent
Male	139	84.8
Female	25	15.2
<i>Age groups</i>		
Less than 25 years	53	32.3
25–29 years	61	37.2
30–34 years	19	11.6
35–39 years	31	18.9
<i>No. of dependants</i>		
1-2	102	62.2
3 and above	62	37.8
<i>Area of living</i>		
Metro city	107	65.2
Nonmetro city	57	34.8
<i>Type of organisation</i>		
Retail sector	47	28.7
Food and beverages sector	93	56.7
Telecom and IT	24	14.6
<i>Total experience</i>		
Less than 3 years of experience	47	28.7
3–5 years	49	29.9
5–10 years	27	16.5
10–15 years	9	5.5
More than 15 years	32	19.5
Total	164	100

TABLE 2: R-squared analysis.

Model	R	R-square	Adjusted R-square
Regression	0.862a	0.744	0.737

working in the retail sector, and remaining were working in the telecom and IT sector. 29.9% of the respondents possess between 3 and 5 years, 28.7% of the respondents were having experience of less than 3 years, 19.5% were possessing experience of more than 15 years, 16.5% were working between 5–10 years, and remaining 5.5% of the respondents were having between 10–15 years.

3.2.2. Linear Regression. The next set of analysis is related to linear regression, and this enables analysing the extent of association between independent variables and dependent variables.

From the above Table 2, it is noted that the R-squared value is 0.744 which is more than 0.600; hence, the models are considered to be best fit.

From the analysis in Table 3, it is noted that F value is 115.231 and significance value is 0.00 which is less than 0.05; hence, they are statistically significant. The regression equation can be stated as follows:

Y (AI in food processing) = 0.120 + 0.371x customer analytics + 0.331x better food quality + 0.022x customer experience + 0.182x higher shelf life.

3.2.3. Multivariate Analysis of Variance (MANOVA). Based on the multivariate analysis in Table 4, it is noted that the F value is above 13 for all analysis of AI in food

TABLE 3: Regression model.

Model	B	Std. error
(Constant)	0.12	0.184
Customer analytics	0.371	0.104
Better food quality	0.331	0.101
Customer experience	0.022	0.087
Higher shelf life	0.182	0.098
F	115.231	
Sig.	0.000b	

TABLE 4: Multivariate analysis.

Effect	Multivariate tests	Value	F	Sig.
Intercept	Pillai's trace	0.972	1377.678b	0.00
	Wilks' lambda	0.028	1377.678b	0.00
	Hotelling's trace	35.325	1377.678b	0.00
	Roy's largest root	35.325	1377.678b	0.00
AI in food processing	Pillai's trace	1	13.255	0.00
	Wilks' lambda	0.131	28.147	0.00
	Hotelling's trace	5.647	54.524	0.00
	Roy's largest root	5.476	217.678c	0.00

processing variables. Also, the significance is less than 0.05; hence, it is noted that the data are statistically significant.

From the data analysis, the significance value is less than 0.05; hence, it can be stated that there is a significant difference between each independent variable and dependent variable [14].

Therefore, based on the analysis in Table 5, it can be stated that all the independent variables possess significant influence in enhancing the AI in food processing in the organisation [15]. Hence, artificial intelligence is gaining more importance in the current business environment and managers in marketing domains are focusing to utilise these new technologies to achieve sustainable growth and development [13].

4. Results and Discussion

Customers' needs and preferences change rapidly in a dynamic environment. Therefore, it is very important that the company and the managers understand the basic requirements to meet the growing food demand so that the application of new technologies enables faster food processing, efficient packaging, and better shelf life for the benefit of customers. In recent years, it has become increasingly important to use food processing to meet growing individual needs, so food companies are looking to use new technology to meet the requirements [16]. The use of critical tools in the production process often plays a greater role in effectively tracking the movement of goods and services. It also supports food delivery, work in hazardous environments, and ensures high-quality products. The important roles of artificial intelligence in the food industry are divided into approximately two categories: one is food safety management and the other is food quality management [17]. Artificial intelligence can be understood as a critical aspect of

TABLE 5: Tests between subjects' effects.

Source	Dependent variable	Type III sum of squares	Sig.
Corrected model	Customer analytics	170.625	0.00
	Better food quality	201.791	0.00
	Customer experience	151.378	0.00
	Higher shelf life	157.194	0.00
Intercept	Customer analytics	1136.27	0.00
	Better food quality	1176.68	0.00
	Customer experience	1055	0.00
	Higher shelf life	1108.05	0.00
AI in food processing	Customer analytics	170.625	0.00
	Better food quality	201.791	0.00
	Customer experience	151.378	0.00
	Higher shelf life	157.194	0.00
	Adjusted R-squared: customer analytics	0.778	
	Adjusted R-squared: better food quality	0.805	
	Adjusted R-squared: customer experience	0.671	
	Adjusted R-squared: higher shelf life	0.736	

implementing various tools and systems with basic human intellectual processes, such as the ability to perform a task, generate reports and toolbars, extract data, and analyse for effective decision making.

5. Conclusion

In the digital age, where innovation and digitalization are changing companies, the area of customer relationship management has undergone profound changes over the past decade. The use of artificial intelligence in marketing, especially in customer engagement, question management, and relationship development, has enabled the organisation to understand customers' ever-changing needs and requirements and focus on creating products that meet unique needs, driving a successful business goal effectively. The effect of artificial intelligence becomes more significant in today's business world as companies begin to realise its potential, and the role of artificial intelligence in AI in food processing is rapidly changing the way customer inquiries are processed, enabling them to analyse needs and requirements and focus on building customer engagement and loyalty.

AI marketing focuses on applying technology to enhance the customer experience, meet their needs, and provide better products and services. Marketers have evolved primarily through the use of artificial intelligence technology and related statistics to better understand customers and design strategies that surpass competitors generate more sales and profit. It was argued that the number of customer interactions through artificial intelligence technology is likely to increase in the future as many organizations use the potential power of these tools to automate the CRM process. In addition, artificial intelligence helps to easily perform daily activities and can replace unnecessary activities performed by people in the body.

Data Availability

The data shall be made available on request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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