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Design and validation of a digital transformation model with innovative technology on sustainability in the food packaging industry

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Abstract

The present study was conducted with the aim of designing and evaluating a digital transformation model with an innovative approach based on sustainability in the food packaging industry. This study is applicable-developmental in terms of objective, and a cross-sectional survey research in terms of the data collection method. To achieve the goal, an exploratory mixed research design was used. The qualitative part of the participants included managers, experts, and specialized personnel in the food packaging industry. Sampling was carried out with a purposive method, and theoretical saturation was achieved with 20 interviews. In the quantitative part, the perspectives of 150 managers and experts in the food packaging industry were used. The data collection tool was a semi-structured interview, and a researcher-made questionnaire. The content analysis method was used for data analysis and structural-interpretive modeling for leveling; which resulted in 14 main components and 61 sub-components. Partial least squares was used for validation.

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Extended Abstract

Introduction

Digital transformation is a fundamental and basic change in the way digital technologies are applied to develop new business models and achieve greater value creation for organizations (Verhoef, & Haenlein, 2021). Specifically, digital transformation is the impact of information technology on information flows, organizational structure, routines, and organizational capabilities to adapt to technology (Li, Su, Zhang & Mao, 2018). While businesses are interested in the concepts and practical benefits of digital transformation for business, the academic world is seeking to conceptualize digital transformation and its interrelation with business management, organization, open innovation, sustainability, and other concepts (Robertsone and Lapiņa, 2023). Organizations must pursue their digital transformation to achieve sustainable development in today's volatile environment. Senior leaders of organizations believe that digital transformation goes far beyond the approach of applying transformative technologies to organizational processes and products, and consider it as a strategy and choice of direction in institutions and industries and the way business operates. By creating a specialized and appropriate digital transformation model for each organization or industry, this transformation journey can be made successful. Given the growth of the population, scarcity of resources, and environmental pollution; the food packaging industry must not only seek to develop solutions that reduce the destructive and harmful effects on the environment, but must also be able to align itself with the digital age. The future outlook of this industry in the digital age, as well as changes in transformative technologies, entails new production methods, new jobs and diverse specializations. The fundamental issue from a research perspective is that “food packaging”, “sustainable innovation”, and “digital transformation” have been studied separately in the studies conducted. Applicable research that organizes these concepts in the food industry space has been neglected by the researchers. Therefore, the present study was conducted with the aim of filling this research gap. The research contribution and theoretical synergy of the present study is that in this study, an attempt is made to identify the digital transformation structures with regard to sustainable innovation and explain the pattern of relationships between them with an exploratory approach based on the views of experienced and expert individuals. The present study answers this key question: what is the digital transformation model with a sustainability-based innovation approach in the food packaging industry?

Theoretical foundations of the research

Sustainable innovation: Sustainable innovation is the practice of continuously improving products, processes, and workforce to create a brighter and more sustainable future for customers, employees, and the environment (Gupta et al., 2020). Innovation and sustainability seek to find solutions to global challenges such as climate change, social inequality, and resource constraints (Afeltra et al., 2023).

Food packaging: Packaging can be considered a protector to maintain the health of the packaged product and ultimately ensure the health of the consumer, from the time of harvest to the time of consumption of the product (Iskandari et al., 2023). Food packaging is one of the major factors affecting consumer behavior.

Digital transformation: Digital transformation is one of the keywords of the Fourth Industrial Revolution. The term Fourth Industrial Revolution is the Latin translation of "Industry 4.0" in German. This term refers to a new generation of industry based on intelligence and technology that emerged after the previous three industrial revolutions. (Adam et al., 2024)

Digital experience: Digitalization has changed people's lifestyles and even the way they live and communicate (Hagberg et al., 2017). Service providers and business owners use digital technologies for their stores to create new experiences and improve services (Roy et al.,

2017). Also, social media has transformed communication from a traditional method to a large social nature by creating an online virtual world (Li et al., 2019). Organizations try to create desirable experiences to capture the minds and hearts of customers (Micu et al., 2019). Creating memorable experiences is of great importance for retaining old customers and attracting new ones; therefore, customer experience in online and offline spaces is a type of strategy carried out to create value, satisfaction, differentiation and customer loyalty (Fernandes, T. & Pinto et al., 2019).

Food industry: The food industry includes a set of activities such as preparation, production, processing, conversion, packaging, storage, transportation and distribution of food (Ristic et al., 2023). The food industry is of strategic importance for the country, as for the whole world, and ignoring the consequences related to the food industry has serious consequences for the country and must be carefully analyzed.

Research Method

The present study is an applicable-developmental research that was conducted with the aim of designing and validating a digital transformation model with a sustainability-based innovation approach in the food packaging industry. In terms of data collection method, it is also a descriptive research that was conducted using a cross-sectional survey method. In line with the research objective, a mixed exploratory research design (qualitative-quantitative) was used. The qualitative participant population included experts, managers, specialists, and specialized personnel in the food packaging industry. Sampling was conducted with a purposive method and repeated results was achieved with seventeen interviews. In order to avoid false theoretical saturation, three more interviews were conducted, thus 20 people participated in this study.

The quantitative statistical population included managers, experts, personnel, and people working in food packaging companies. The power analysis rule (Cohen, 1992) and G*Power software were used to calculate the sample size.

Because the questionnaire includes 14 main factors and 61 items; using the power analysis rule at a 95% confidence level with an effect size of 0.15 and a statistical power of 80%, the minimum sample size was estimated to be 143 people, and for greater certainty, 150 questionnaires were collected.

Research findings

The research results showed that the designed model was identified with 14 components: business resources, digital transformation leadership, digital/sustainable foresight, digital/sustainable strategies, application of new technologies in processes and operations, digital/sustainable key capabilities, digital employee experience, a new approach to innovative processes in the food packaging industry, improving sustainable food packaging practices, designing innovative food packaging, aligning digital/sustainable innovation strategy with digital/sustainable capabilities, business sustainability in the digital age, improving customer experience (digital/sustainable), and implications for the food packaging industry.

Conclusion

14 main components and 61 sub-components were identified in the qualitative part.

In the quantitative part; using ISM, the findings of the present study showed that all of these 14 components have one or more relationships with other components of the model, and the components were also leveled using Micmac software.

The components of the model were leveled based on their similarity in influencing the model. In this study, six types of similarity were identified in terms of the degree of influence of the components on the model. Based on this, it was determined that the components of the seventh level of digital/sustainable foresight, digital transformation leadership, and business

resources had the most influence, and the consequences of digital transformation in the food packaging industry had the least influence and the most effected.

Based on the level of influence and dependence; the constructs of digital/sustainable foresight, digital leadership, and business resources, which had the highest level of influence (14) and the lowest level of dependence (3) and were at level 7, it can be acknowledged that in all businesses, especially the food packaging industry, it is necessary to use these three components as the most important components. Foresight is one of the most important dimensions that organizations should consider to face future challenges. Some of these challenges are customer expectations, changing regulations and laws, and the growth of emerging technologies. Regarding foresight, the results of this study are in line with the research of Patel et al., (2018) Han et al., (2018), and Kazemian et al., (2020).

Suggestion for future research: According to the findings of the study, it is suggested that the digital transformation model be designed separately in different industries. In the past literature, researchers have assessed the maturity of digital transformation with a wide range. It is suggested that the maturity of this model be assessed at different levels, and that the indicators determined in this research be examined and evaluated more precisely, and that they be examined and compared in different industries.