



## **Analyzing the interaction of key factors of Sustainable Business Model Innovation in the Digital Age Based on Dynamic Capabilities Using An integrative meta-synthesis and interpretive structural modeling (ISM) approach**

**Ayoub Mohammadian\***

\*Corresponding author, Assistant Professor, Department of IT Management, Faculty of Management, University of Tehran, Tehran, Iran. E-mail: Mohammadian@ut.ac.ir

**Seyed Hamed Vares**

Assistant Professor, Department of Business Administration, Faculty of Management, University of Tehran, Tehran, Iran. E-mail: vares@ut.ac.ir

**Nastaran Hajiheydari**

Associate Professor, Department of Business Administration, Faculty of Management, University of Tehran, Tehran, Iran. E-mail: nhheidari@ut.ac.ir

**Datis Khajeheian** 

Associate Professor, Department of Business Administration, Faculty of Management, University of Tehran, Tehran, Iran. E-mail: khajeheian@ut.ac.ir

**Mohammad Kargar Shouraki**

PhD Candidate, Department of Management, Alborz Campus, University of Tehran, Tehran, Iran. E-mail: mk.shouraki@ut.ac.ir

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### **Abstract**

Due to the rapid changes and developments caused by technology in the digital age and the growing importance of achieving sustainability for the survival of businesses, the need to create the capabilities needed to innovate in the business model of organizations has become inevitable. This research is trying to provide a model for business model innovation with the aim of sustainability by considering the external factor of digitalization (digital transformation) and the internal factor of dynamic capabilities. The method of this research is mixed so that in the first

stage the qualitative method of Meta-Synthesis is used and in the second stage the quantitative method of Interpretive Structural Modeling (ISM) is used. In this research, based on the systematic review of previous researches in scientific databases, 402 related articles were identified and then 46 final articles were selected during the screening process. Based on the thematic analysis, a total of 4 main categories and 14 factors were extracted. In the second stage of the research, an interpretive structural model (ISM) is developed to show the inter-relationship of different factors and their levels of importance in the food industry. The 8-level hierarchy model of factors influencing the sustainable business model innovation in the digital age with a dynamic capabilities approach was proposed. Results show that a new component called network value has been added to the traditional business model components. Furthermore, the MICMAC approach has been used to categorise factors according to their driving power and dependence. Finally, digital technologies and Sensing were found to be the factors with the highest independence and the highest driving power, and “Economic Sustainability” was identified as the factor with the highest dependence and the least driving power.

**Keywords:** Business Model Innovation, Sustainability, Digital Transformation, Dynamic Capabilities, Meta-Synthesis, Interpretive Structural Modeling (ISM).

## Introduction

The need for innovation in business models stems from three major challenges: (1) the challenge of achieving sustainability in business practices, (Romero, et al 2021; Jørgensen & Pedersen, 2018). 2) the challenge of digitalization of business environments and the emergence of technological opportunities, and dynamic changes in customer lifestyle and preferences (Jørgensen & Pedersen, 2018; Verhoef, et al 2019).

Indeed, sustainability is one of the most important challenges of today's businesses, as they are expected to have a proper response to social and environmental issues as well as the economic demands of their shareholders (Geissdoerfer et al 2018; Aluchna & Rok, 2018; Zabihollah & Miryazdi, 2021)

Sustainable business models have become increasingly popular in the first two decades of the 21st century as they can greatly affect the success of sustainable development strategies and efforts (Szromek,2021)

Today, the orientation of many innovations in the business model of organizations has changed from paying special attention to maximize short-term profitability to create long-term value for all stakeholders. In addition to paying attention to economic issues, organizations

should also pay special attention to social and environmental issues (Bocken, N., et al 2019 and Nosratabadi, S., et al 2019). In many countries, the protection of the environment for the present and future generations is a public duty and economic activities that are associated with environmental pollution or irreparable damage are prohibited (Rezaee, Z., and Gholam, H., 2017, p. 24). So, in addition to financial reports, businesses have to publish non - financial reports, related to society and the environment for all stakeholders (Yeganeh, Y., et al 2018). Therefore, innovation in business model in order to achieve sustainability has been considered by many businesses that seek competitive advantage and adapting to the environment "(Rezaee, Z., and Gholam, H., 2017, p. 13 and Aluchna, M., Rok, B., 2018 and Clinton, L., and Whisnant, R., 2019).

Furthermore, most of the businesses in the digital age are looking for innovation in their business model due to the high capacities of transformational digital technologies beyond innovation in products and services and innovation in processes (Pazhouhesh, A., 2015, and Mohammadian, A., 2015, p. 212). In addition, along with technological advances in the digital age, changes in consumer behaviors and emerging Z generations can also lead to a change in the market needs, which requires business model innovation (Tesch, J. F. 2019). Therefore, innovation in the business model is increasingly recognized as one of the most important challenges of organizations in the digital age (Aluchna, M., Rok, B., 2018).

Many organizations despite the use of digital technologies, may lose their stability over time, so they need the ability to integrate, build, and reconfigure internal and external competencies to address rapidly changing environments. organizations that have dynamic capabilities can guarantee continuous innovation in business models (Teece, D. 2018). In other words, due to rapid environmental changes, if organizations want to take advantage of past competitive advantages, they can not compete with leading organizations, so they must create and maintain dynamic capabilities (Teece, D. 2018). For this reason, the flexibility for changing the business model is very important for organizations through the creation of dynamic capabilities (Khodaei, H., Ortt, R., 2019).

Many companies have started moving toward economic sustainability (Leleux, B., Van, J., 2019), But many of them seek an answer to the question that how they can redesign their business models by creating dynamic capabilities so that they can continue to be sustainable by emphasizing social and environmental factors alongside economic factors (Leleux, B., Van, J., 2019, and Brenner, B., 2018 and Lakshmi, R., et al 2018, and Parida, V., 2019).

Therefore, considering that today's businesses, including food industries, have entered the digital age and to be stable and achieve sustainable results, they need to innovate their business model based on dynamic capabilities, the purpose of this study is to provide a model to determine the interaction and sequence between the external factor of digitalization and the internal factor of dynamic capability for innovation in the business model of organizations with

the aim of achieving sustainability. To achieve this main goal, the following sub-goals need to be considered:

1. Identifying the key factors of the "business model innovation"
2. Identifying the key factors of "sustainability" in business model innovation.
3. Identifying the key factors of the "dynamic capabilities" in business model innovation.
4. Identifying the key factors of the "digital age" in business model innovation.

Identifying priorities and interrelationships between key factors for business model innovation to create sustainability based on "dynamic capabilities in the" digital age"

## Background

Based on studies conducted in the research background, the factors affecting the business model innovation, as shown in Figure 1, can be divided into three factors: a) The role of sustainability in business model innovation c) The role of digital transformation developments in business model innovation d) The role of dynamic capabilities in business model innovation. Sustainability factors and developments in the digital age can be considered as external factors (Parida et al., 2019) and dynamic capabilities can be considered as an internal factor influencing the business model innovation (Franco et al., 2021)

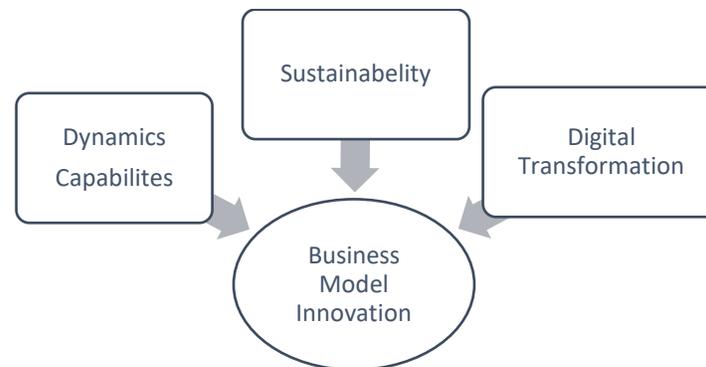


Figure 1. Factors affecting business model innovation (Adapted from Parida et. al., 2019 and Franco et al., 2021)

In the following, based on the objectives of the research, the main aspects of the research include; Business model innovation, sustainability, digital transformation and dynamic capabilities and their relationships have been described in previous research:

### Business Models Innovation

Innovation in processes, products and services is not a new topic, but innovation in business models is a new topic that can be one of the ways to create a competitive advantage for organizations (Mohammadian, A., 2015, p. 213, and Pazhouhesh, A., 2015). Innovation has

traditionally been done through the development of new products and services (Aluchna, M., Rok, B., 2018). Although the development of new products is the driving force of organizations, another element of their success is having a systematic approach to creating value in the market with the help of a new business model in that organization (Mohammadian, A., 2015, p. 213). Survival in rapidly changing environments, relying only on innovation in the field of product and process is not enough and requires innovation in the field of the business model (Mohammadian, A., 2015, p. 213, and Pazhouhesh, A., 2015, and Aluchna, M., Rok, B., 2018). The idea of business model innovation - especially whether a company can launch a new business model for the first time or change an existing business model of the industry - has been considered by all business leaders in the world (Clinton, L., and Whisnant, R., 2019). Based on research conducted in recent years and the predictions of senior managers of global companies, the importance of innovation in the business model is increasing and even more than innovation in products and services (Mohammadian, A., 2015, p. 213, and Pazhouhesh, A., 2015). The main factors in increasing the importance of innovation in the business model can be attributed to the processes of globalization, short production and operations cycles and drastic changes due to the developments of the digital age (Pazhouhesh, A., 2015, and Clinton, L., and Whisnant, R., 2019).

Therefore, on the one hand, the main issue of the digital transformation paradigm is the issue of innovation in the business model of organizations to create value (Pazhouhesh, A., 2015). On the other hand, for the leaders of global organizations, meeting the needs of human beings on the planet has been much more important than winning over competitors (Mohammadian, A., 2015, p. 213, and Clinton, L., and Whisnant, R., 2019), and therefore seek to innovate in the business model to achieve Economic sustainability and the creation of environmental and social values for human society (Aluchna, M., Rok, B., 2018).

For this reason, first, the role of the sustainability factor in business model innovation is examined and then the impact of digitalization on business model innovation is examined.

### **The effect of sustainability on the business model innovation**

The three dimensions with which sustainability can be assessed include; People, planets and profits are described below:

- People: refers to the social dimension of equality for all human beings and the creation of equal opportunities for them to access their basic resources and needs such as water, food and development through improved living conditions such as health care and education.
- Planet: refers to the planet's environment and ecosystem and includes attention to the earth and reducing the effects of human footprints on it, especially the issue of imbalance in terms of pollution, ozone layer, greenhouse gases, non-degradable waste; deforestation, overfishing and so on.

- Profit: The profit dimension emphasizes that the production of goods and services is a prerequisite for improving living conditions and economic well-being at the global level (Aagaard, A., 2019, p.4).

Hence, sustainable business model innovation refers to value creation for customers and companies by addressing social and environmental needs through business improvement. In the face of the need to achieve sustainability, business models need basic design. To understand and improve these issues and create a positive impact on the environment, society, the economy and other key stakeholders, little research has been done on the "ecology" of different business models (Bocken, N., et al 2019). For this reason, sustainable business models are currently the main focus of academic literature as well as organizations and policymakers who are directly exposed to environmental and social impacts (Geissdoerfer, M., et al 2019). Today, the impact of companies on the external environment is considered a global concern and stakeholder expectations from companies are constantly increasing (Yeganeh, Y., et al 2018). To this end, a company must seriously seek to create positive social and environmental value and optimize value for itself as well as for a wider network of stakeholders, including the community and the environment as key stakeholders, so it is necessary to value Optimize for the whole system (Bocken, N., et al 2019). On the other hand, the market and business environment are changing drastically and the emergence of continuous developments in the field of technology has reduced the life of products and has created a very stressful and chaotic environment for companies (Pazhouhesh, A., 2015). Therefore, in addition to long-term economic benefits, organizations want to pay attention to social and environmental factors and include it in their business model; On the other hand, due to the existing and forthcoming changes, especially the developments caused by the digital age and its impact on business sustainability, has caused new needs and priorities of each of the stakeholders in the digital age to innovate in the business model. For this reason, the next section examines the factor of digital age developments on sustainable business model innovation.

### **The effect of digitalization on the business model innovation**

In recent decades, due to the widespread development of technology, a new concept called the concept of "digital transformation" has become common (Kotarba, M., 2018). Digital transformation is defined as: "the use of new digital technologies for important advances in business, including improved customer experience, operational improvement, and innovation in business models." Businesses and industries are undergoing a comprehensive and impactful transformation from digitalization (Ukko, J., et al 2019) and the developments of the digital age are already taking place. For this reason, the increasing growth and development of business models based on digital technologies have had a tremendous impact on the world economy (Mohammadian, A., 2015, p. 213). Successful companies (such as Apple) can open new ways to create value for the customer with the help of new technologies (Warner, K., Wager, M., 2018). Hence, in general, digital transformation can be defined as a fast path for modification (or

adaptability) of business models.

The rapid development of digital technologies and the resulting innovation has even led to changes in consumer and community behaviors (Kotarba, M., 2018). Thus, the digital transformation is a fundamental change in the business of organizations and is higher than the use of digital technologies for "gradual changes" in the performance of organizations (Warner, K., Wager, M., 2018). In fact, with the advent of new digital technologies such as artificial intelligence, the Internet of Things, mobile phones, the Internet, social networks, blockchain and big data, firms in almost all industries have taken various steps to discover and exploit the benefits of these technologies (Fellenstein, J., Umaganthan, A., 2019). Therefore, it should be noted that digital transformation is not primarily related to technology, but the senior leaders of organizations need to look for ways to invest in business model innovations and improve the customer experience (Warner, K., Wager, M., 2018). This requires a change in all key business activities and affects products and processes as well as organizational structures and especially management processes to perform these complex changes at the company level (Fellenstein, J., Umaganthan, A., 2019).

In the era of digital transformation, it is necessary to examine how companies operating in traditional industries (as studied in this study) can achieve innovation in their business model due to the rapid changes in digital technologies (Warner, K., Wager, M., 2018). In fact, the increasing speed of environmental change, especially in the era of digital transformation, which has affected all businesses as an external factor, has made companies need dynamic capabilities to innovate in their business model as an internal factor affecting innovation in Business models, which are described below, how dynamic capabilities affect business model innovation.

### **The effect of dynamic capabilities on the sustainable business model innovation in the digital age**

The concept of dynamic capabilities means that resources alone do not create a competitive advantage (Vicente, A., et al .2018). Teece (2017) argues that management ability in developing and recreating business models is a key pillar of dynamic capabilities. This is important not only in the design of the initial business model but also in the replacement and reconfiguration of business model components that change over time (Fellenstein, J., Umaganthan, A., 2019). Success in creating a business model requires the creation of a set of capabilities that enable companies to redesign the building blocks of their business model to suit their changing environment (Inigo, E., et al 2017).

Dynamic capabilities are grouping organizational skills, behaviors and organizational capacities, and also processes and procedures that make the company distinctive in contrast to its rivals in the competitive market. Teece (2007) stated that although the long-term performance of the firm is somehow related to their external conditions, it is the development and implementation of dynamic capabilities (internal factors) that are at the center of business

success or failure (Mendonça, C., et al 2018). Studies show that organizational dynamic capabilities with emphasis on the digital transformation era affect all three dimensions of sustainability performance including economic, social and environmental and the relationship between dynamic capabilities in the digital age to review and create business models, leading to improved corporate performance (Brillinger, A., 2018).

## Methodology

The main purpose of this study is to provide a model for business model innovation based on sustainability in the digital age with a dynamic capabilities approach that leads to the expansion and development of existing literature and determine how different factors affect business model innovation. Therefore, this research is applied in terms of purpose. The main research approach is mixed methods using qualitative and quantitative methods in two stages. In the first stage of this research, the meta-synthesis qualitative method, which has been one of the types of Meta-Synthesis research, has been used for systematic review. Then in the second stage, the Interpretive Structural Modeling (ISM) method has been used for modeling the factors of the business model innovation by using the opinion of the industry experts in the food industries. Meta-synthesis is done in four stages, including 1- Formulation of research question 2- Systematic search 3- Screening and selection of appropriate research 4- Extraction of results and presentation of findings, the steps of which are presented below.

### The first stage: Qualitative Method

#### Setting up the research question:

The research question was formulated using the answers to the following questions:

1. Identifying the main elements of business model innovation, sustainability, dynamic capabilities and digital age developments and the relationships between them is considered as the main goal of this research (what?).
2. All articles in scientific databases are considered as the scope of this research (who?).
3. All related research from 1/1/2010 to 01/30/2020 has been reviewed (when?).
4. All related research in the form of articles, book chapters, dissertations and international reports such as the United Nations related to the subject and objectives within the specified time period (how?).

#### Conducting a systematic search:

The search is based on the words of Table 1 in domestic databases including Irandoc, Civilica, Meg Iran and Normagz, as well as foreign databases including Elsevier, Science Direct, Springer, Scopus and web of science.

Table 1. Persian and English words searched

No	Vocabulary Title
1	Business Model Innovation & Sustainable
2	Business Model Innovation & Digitalization
3	Business Model Innovation & Dynamic Capabilities
4	Business Model Innovation & Digitalization & Dynamic Capabilities
5	Business Model Innovation & Sustainable & Digitalization
6	Business Model Innovation & Sustainable & Dynamic Capabilities
7	Digital Transformation & Dynamic Capabilities
8	Business Model Innovation & Sustainable & Digitalization & Dynamic Capabilities

### Screening and selection of appropriate research:

Based on the criteria in the first stage and keywords in the second stage, the articles were reviewed in terms of relevant title, abstract, related content and appropriate quality and some of them were removed. Finally, from a total of 402 reviewed articles, 46 articles were selected for research. The results of this screening are summarized in Figure 2.

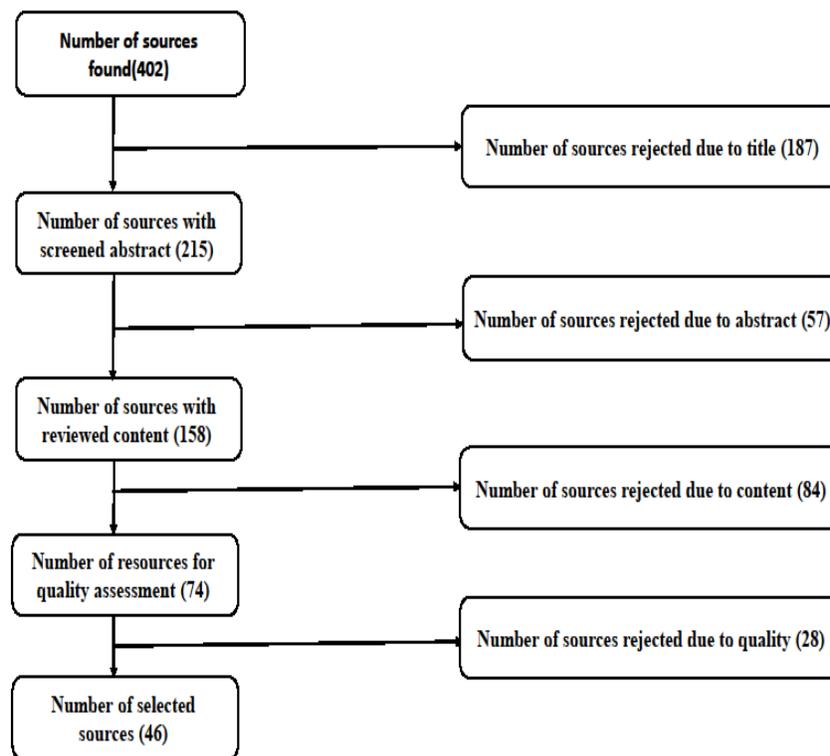


Figure 2. the process of selecting the final articles in presenting a model for business model innovation

Critical Appraisal Skills Programme (CASP) has also been used in screening to evaluate the quality of articles, and 28 articles have been removed in this section. The criterion for accepting the article in this section was equal to or higher than 30 points. After scoring 46 articles, they obtained equal points and more than 30 and were selected as the final articles for systematic content review.

### Analysis of research findings:

By reviewing the full content of 46 selected articles, the codes were extracted and based on the theme analysis, the codes were classified into main and dimension. The findings include the identification of dimensions with the most repetition as key factors for each of the main categories including business model innovation, sustainability, digital transformation and dynamic capabilities are presented in Tables 2 to 5.

Because innovation in the business model can be created through changes in its components. Therefore, it is necessary to identify the dimension of business model innovation as shown in Table 2 (Pazhouhesh, A., 2015).

Table 2. Dimension of the business model innovation

Business Model Innovation	Innovation in Value Proposition (What?)	Li et al. (2020) Guldmann and Huulgaard (2020) Joicevski et al. (2020) Müller et al. (2020) Bocken et al. (2019) Obaya et al. (2019) Tesch (2019) Aagaard (2019) Maffei et al. (2019) Fellenstein and Umaganthan (2019) C̃ irjevskis (2019) Weking et al. (2019) Minatogawa et al. (2019) Lopez et al. (2018) Kotarba (2018) Battistella et al. (2018) Yip and Bocken (2018) Rachinger et al. (2018) Michalik et al. (2018) Karlusch et al. (2018) Vodovoz and May (2017) Barth et al. (2017) Nußholz (2017) Stolka et al. (2017) Yang et al. (2016) Pigneur et al. (2016) Bocken et al. (2014)
	Innovation in Value Creation (How?)	Li et al. (2020) Guldmann and Huulgaard (2020) Joicevski et al. (2020) Müller et al. (2020) Bocken et al. (2019) Souza et al. (2019) Obaya et al. (2019) Tesch (2019) Aagaard (2019) Maffei et al. (2019) Fellenstein and Umaganthan (2019) C̃ irjevskis (2019) Weking et al. (2019) Aguilar et al. (2019) Minatogawa et al. (2019) Lopez et al. (2018) Kotarba (2018) Battistella et al. (2018) Yip and Bocken (2018) Rachinger et al. (2018) Michalik et al. (2018) Karlusch et al. (2018) Vodovoz and May (2017) Barth et al. (2017) Nußholz (2017) Stolka et al. (2017) Yang et al. (2016) Pigneur et al. (2016) Bocken et al. (2014)
	Innovation in Value Delivery (For Whom?)	Li et al. (2020) Guldmann and Huulgaard (2020) Joicevski et al. (2020) Müller et al. (2020) Bocken et al. (2019) Souza et al. (2019) Obaya et al. (2019) Tesch (2019) Aagaard (2019) Maffei et al. (2019) Fellenstein and Umaganthan (2019) C̃ irjevskis (2019) Weking et al. (2019) Aguilar et al. (2019) Minatogawa et al. (2019) Lopez et al. (2018) Kotarba (2018) Battistella et al. (2018) Yip and Bocken (2018) Rachinger et al. (2018) Michalik et al. (2018) Karlusch et al. (2018) Vodovoz and May (2017) Barth et al. (2017) Nußholz (2017) Stolka et al. (2017) Yang et al. (2016) Pigneur et al. (2016) Bocken et al. (2014)
	Innovation in Value Capture (Why?)	Li et al. (2020) Guldmann and Huulgaard (2020) Joicevski et al. (2020) Müller et al. (2020) Bocken et al. (2019) Souza et al. (2019) Obaya et al. (2019) Tesch (2019) Aagaard (2019) Maffei et al. (2019) Fellenstein and Umaganthan (2019) C̃ irjevskis (2019) Weking et al. (2019) Aguilar et al. (2019) Minatogawa et al. (2019) Lopez et al. (2018) Kotarba (2018) Battistella et al. (2018) Yip and Bocken (2018) Rachinger et al. (2018) Michalik et al. (2018) Karlusch et al. (2018) Vodovoz and May (2017) Barth et al. (2017) Nußholz (2017) Stolka et al. (2017) Yang et al. (2016) Pigneur et al. (2016) Bocken et al. (2014)
	Value Network innovation (Between Whom?)	Li et al. (2020) Cantele et al. (2020) Joicevski et al. (2020) Obaya et al. (2019) Maffei et al. (2019) Kotarba (2018) Breuer and Freund (2017) Fjeldstad and Snow (2017) Yang et al. (2016) Breuer and Freund (2015)

Table 3. Dimension of the sustainable business model innovation

Sustainability	Economic Sustainability	Li et al. (2020) Cantele et al. (2020) Parida et al. (2019) Bocken et al. (2019) Aagaard (2019) Eikelenboom and Jong (2019) Aguilar et al. (2019) Jørgensen and Pedersen (2018) Yip and Bocken (2018) Battistella et al. (2018) Inigo et al. (2017) Osburg and Lohrmann (2017) Pigneur et al. (2016)
	Social Sustainability	Li et al. (2020) Cantele et al. (2020) Parida et al. (2019) Bocken et al. (2019) Aagaard (2019) Eikelenboom and Jong (2019) Aguilar et al. (2019) Jørgensen and Pedersen (2018) Yip and Bocken (2018) Battistella et al. (2018) Inigo et al. (2017) Osburg and Lohrmann (2017) Pigneur et al. (2016)
	Environmental Sustainability	Li et al. (2020) Cantele et al. (2020) Parida et al. (2019) Bocken et al. (2019) Aagaard (2019) Eikelenboom and Jong (2019) Aguilar et al. (2019) Jørgensen and Pedersen (2018) Yip and Bocken (2018) Battistella et al. (2018) Inigo et al. (2017) Osburg and Lohrmann (2017) Pigneur et al. (2016)

Table 4. Dimension of the dynamic capabilities for the business model innovation

Dynamic Capabilities	Sensing	Parida et al. (2019) C̃ irjevskis (2019) Warner and Wager (2018) Obaya et al. (2019) Vicente and Ferasso (2018) Rachinger et al. (2018) ) Vodovoz and May (2017) Yeow et al. (2017) Inigo et al. (2017)
	Seizing	Parida et al. (2019) C̃ irjevskis (2019) Warner and Wager (2018) Obaya et al. (2019) Vicente and Ferasso (2018) Rachinger et al. (2018) ) Vodovoz and May (2017) Yeow et al. (2017) Inigo et al. (2017)
	Reconfiguring	Parida et al. (2019) C̃ irjevskis (2019) Warner and Wager (2018) Obaya et al. (2019) Vicente and Ferasso (2018) Rachinger et al. (2018) ) Vodovoz and May (2017) Yeow et al. (2017) Inigo et al. (2017)

Table 5. Dimension of the digital transformation for the business model innovation

Digital Transformation	Digital Technologies	Li et al. (2020) Jocevski et al. (2020) Müller et al. (2020) Verhoef et al. (2019) Parida et al. (2019) Weking et al. (2019) Aagaard (2019) Kotarba (2018) Warner and Wager (2018) Michalik et al. (2018) Tesch (2019) Karlusch et al. (2018) Michalik et al. (2018)
	Digital Competition	Jocevski et al. (2020) Verhoef et al. (2019) Kotarba (2018) Rachinger et al. (2018) Michalik et al. (2018) Michalik et al. (2018) Yeow et al. (2017) Rossotto et al. (2017)
	Digital Customer Behavior	Jocevski et al. (2020) Kamalaldin et al. (2020) Verhoef et al. (2019) Kotarba (2018) Rachinger et al. (2018) Rahman et al. (2018) Spsychalska (2018) Michalik et al. (2018) Michalik et al. (2018) Rossotto et al. (2017)

### The second stage: a quantitative method

In the second stage of the research, interpretive structural modelling (ISM) has been used which is "a well-established methodology for identifying relationships among specific items, which define a problem or an issue. This approach has been increasingly used by various researchers to represent the interrelationships among various elements related to the issue. ISM approach starts with an identification of variables, which are relevant to the problem or issue. Then a contextually relevant subordinate relation is chosen. Having decided the contextual relation, a structural self-interaction matrix (SSIM) is developed based on a pairwise comparison of variables. After this, SSIM is converted into a reachability matrix (RM) and its transitivity is

checked. Once transitivity embedding is complete, a matrix model is obtained. Then, the partitioning of the elements and extraction of the structural model called ISM is derived” (Attri et al,2013).

in order to develop contextual relationships among 14 key factors, expert opinions were considered. In this exercise, 15 experts from the food industry, finally agreed to participate. the various steps involved in the ISM technique are:

### Step 1: Identification of problem variables

As shown in Table 5, the problem variables were the dimensions obtained from the content analysis, which, after the approval of experts, were used in their coded (acronym) form to build the structural self-interaction matrix.

Table 5. Codes used for the approved variables

Symbol	Factors	Symbol	Factors
X1	Value Proposition	X8	Environmental Sustainability
X2	Value Creation	X9	Sensing
X3	Value Delivery	X10	Seizing
X4	Value Capture	X11	Reconfiguring
X5	Value Network	X12	Digital Technologies
X6	Economic Sustainability	X13	Digital Competition
X7	social Sustainability	X14	Digital Customer Behavior

### Step 2: Formation of structural self-interaction matrix

Structural self-interaction matrix (SSIM) is a matrix with the same number of rows and columns as there are variables (X1-X14), where the entries of the first row and column are the variables themselves and other entries express the relationship between the variables in the corresponding row and column using the symbols given in Table 6 &7. SSIM must be formed based on the results of a discussion among a group of experts.

Table 6. Symbols of the relations between variables in SSIM

Relation	Symbol	Relation	Symbol
the two-way relationship between i and j	X	i leads to j	V
no relationship between i and j	O	j leads to i	A

In this step, the opinions of the 15 experts on the relationship between variables were compared and the "mode" of the opinions for each pair of variables (the relation with the highest frequency in the opinions of experts for those variables) was used in the final table.

Table 7. Structural self-interaction matrix of key elements of sustainable business model innovation in the digital age with the dynamic capabilities approach

14	13	12	11	10	9	8	7	6	5	4	3	2	1	Dimensions	j i
A	A	A	A	A	A	V	V	V	X	V	V	V		1	Value Proposition
A	A	A	A	A	A	V	V	V	A	V	V			2	Value Creation
A	A	A	A	A	A	X	X	V	V	V				3	Value Delivery
A	A	A	A	A	A	A	A	V	A					4	Value Capture
A	A	A	A	A	A	V	V	V						5	Value Network
A	A	A	A	A	A	A	A							6	Economic Sustainability
A	A	A	A	A	A	A								7	social Sustainability
A	A	A	A	A	A									8	Environmental Sustainability
V	V	X	V	V										9	Sensing
X	V	A	V											10	Seizing
A	X	A												11	Reconfiguring
V	V													12	Digital Technologies
A														13	Digital Competition
														14	Digital Customer Behavior

### Step 3: Formation of initial reachability matrix

In this step, the initial reachability matrix was formed by converting the entries of SSIM into binary values based on the rules given in Table 8.

Table 8. Rules for the conversion of the entries of SSIM into quantitative values for the initial reachability matrix

Cell (i,j) of SSIM	Conversion rule
V	Place 1 in the cell (i, j) and 0 in the cell (j, i) of the reachability matrix.
A	Place 0 in the cell (i, j) and 1 in the cell (j, i) of the reachability matrix
X	Place 1 in the cell (i, j) and 1 in the cell (j, i) of the reachability matrix
O	Place 0 in the cell (i, j) and 0 in the cell (j, i) of the reachability matrix

As can be seen in Table 9, the specific concept symbols given have been converted to 0 and 1 points.

### Step 4: Formation of final reachability matrix

After forming the initial reachability matrix, the final reachability matrix was formed by considering transitivity in the inter-variable relationships (Table 9).

Table 9. Reachability matrix of key elements of sustainable business model innovation in the digital age with the dynamic capabilities approach

14	13	12	11	10	9	8	7	6	5	4	3	2	1	Dimensions
0	0	0	0	0	0	1	1	1	1	1	1	1	1	Value Proposition
0	0	0	0	0	0	1	1	1	0	1	1	1	0	Value Creation
0	0	0	0	0	0	1	1	1	0	1	1	0	0	Value Delivery
0	0	0	0	0	0	0	0	1	0	1	0	0	0	Value Capture
0	0	0	0	0	0	1	1	1	1	1	1	1	1	Value Network
0	0	0	0	0	0	0	0	1	0	0	0	0	0	Economic Sustainability
0	0	0	0	0	0	1	1	1	0	1	1	0	0	Social Sustainability
0	0	0	0	0	0	1	1	1	0	1	1	0	0	Environmental Sustainability
1	1	1	1	1	1	1	1	1	1	1	1	1	1	Sensing
1	1	0	1	1	0	1	1	1	1	1	1	1	1	Seizing
0	1	0	1	0	0	1	1	1	1	1	1	1	1	Reconfiguring
1	1	1	1	1	1	1	1	1	1	1	1	1	1	Digital Technologies
0	1	0	1	0	0	1	1	1	1	1	1	1	1	Digital Competition
1	1	0	1	1	0	1	1	1	1	1	1	1	1	Digital Customer Behavior

**Step 5: Level partitioning**

In this step, the reachability (output) set, the antecedent (input) set, and the intersection set of each variable were determined. The reachability set of a variable consists of the variable itself and other variables that contribute to it. The antecedent set of a variable consists of the variable itself and other variables to which it contributes. The intersection set of a variable consists of all elements that are present in both the reachability set and the antecedent set of that variable. For level partitioning, first, the variables whose reachability and intersection sets were identical were placed at the first level of the model. The above-described process was then repeated without the variables placed at the first level to determine the second level of the model. Repeating the same process for all variables, the eight levels shown in Figure 3 were obtained.

Table 10. Adapted Reachability matrix the main elements of sustainable business model innovation in the digital age with a dynamic capabilities approach

No	Reachability Set	Prerequisite Set	Common Collection	Level
1	1,2,3,4,5,6,7,8	1,5,9,10,11,12,13,14	1,5	Fifth
2	2,3,4,6,7,8	1,2,5,9,10,11,12,13,14	2	Fourth
3	3,4,6,7,8	1,2,3,5,7,8,9,10,11,12,13,14	3,7,8	Third
4	4,6	1,2,3,4,5,7,8,9,10,11,12,13,14	4	Second
5	1,2,3,4,5,6,7,8	1,5,9,10,11,12,13,14	1,5	Fifth
6	6	1,2,3,4,5,6,7,8,9,10,11,12,13,14	6	First
7	3,4,6,7,8	1,2,3,5,7,8,9,10,11,12,13,14	3,7,8	Third
8	3,4,6,7,8	1,2,3,5,7,8,9,10,11,12,13,14	3,7,8	Third
9	1,2,3,4,5,6,7,8,9,10,11,12,13,14	9,12	9,12	Eight
10	1,2,3,4,5,6,7,8,10,11,13,14	9,10,12,14	10,14	Seventh
11	1,2,3,4,5,6,7,8,11,13	9,10,11,12,13,14	11,13	sixth
12	1,2,3,4,5,6,7,8,9,10,11,12,13,14	9,12	9,12	eight
13	1,2,3,4,5,6,7,8,11,13	9,10,11,12,13,14	11,13	sixth
14	1,2,3,4,5,6,7,8,10,11,13,14	9,10,12,14	10,14	Seventh

According to Table 9 and with the help of the fashion index, Table 11 can be obtained based on two variables of drive power (1 point obtained from the row) and dependence power (1 point obtained from the column).

Table 11. Separation of drive power & dependence power

No	Title	Drive Power	Dependence Power
1	Value Proposition	8	8
2	Value Creation	6	9
3	Value Delivery	5	12
4	Value Capture	2	12
5	Value Network	8	8
6	Economic Sustainability	1	14
7	Social Sustainability	5	12
8	Environmental Sustainability	5	12
9	Sensing	14	2
10	Seizing	12	4
11	Reconfiguring	10	6
12	Digital Technologies	14	2
13	Digital Competition	10	6
14	Digital Customer Behavior	12	4

**Step 6: Drawing the final interpretive structural model**

In this step, the levels and final reachability matrix obtained in the previous step were used to draw an initial model, which after removing transitivity, turned into the final model shown in Figure 3.

At this stage, according to the levels of variables and the final Reachability matrix, the research model is presented. In this research, 14 factors are placed in 8 levels according to Figure 3. It should be noted that factors that are at high levels are less effective and are more affected by factors at lower levels. Therefore, it can be said that the lower levels will act as a basic requirement and infrastructure for the improvement and achieve better results of the higher levels.

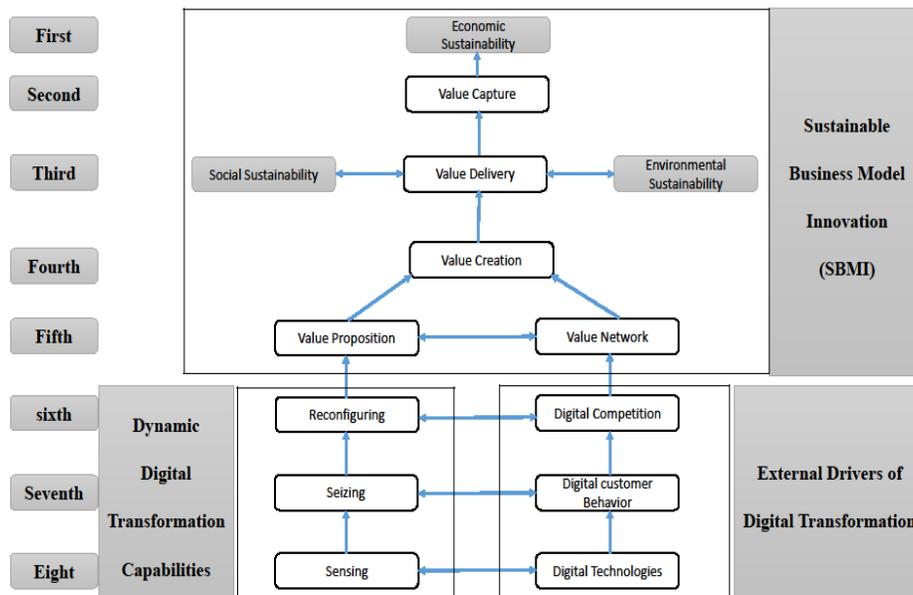


Figure 3. Digraph depicting sustainable business model innovation in the digital age with the dynamic capabilities approach

**Step 7: Analysis of driving power and dependence (MICMAC diagram)**

MICMAC diagram is a diagram where the vertical axis represents the driving power and the horizontal axis represents the dependence of a variable. As shown in Figure 4, the research variables were classified into four groups of independent, linkage, autonomous, and dependent based on their position on the MICMAC diagram. As can be seen, “digital technologies & Sensing” were found to be the factors with the highest independence and the highest driving power, and “Economic Sustainability” was identified as the factor with the highest dependence and the least driving power.

Based on the MICMAC diagram, research variables can be analyzed. As shown in Figure 4, this diagram consists of two horizontal axes including the degree of dependence and a vertical axis including the force of penetration or guidance.

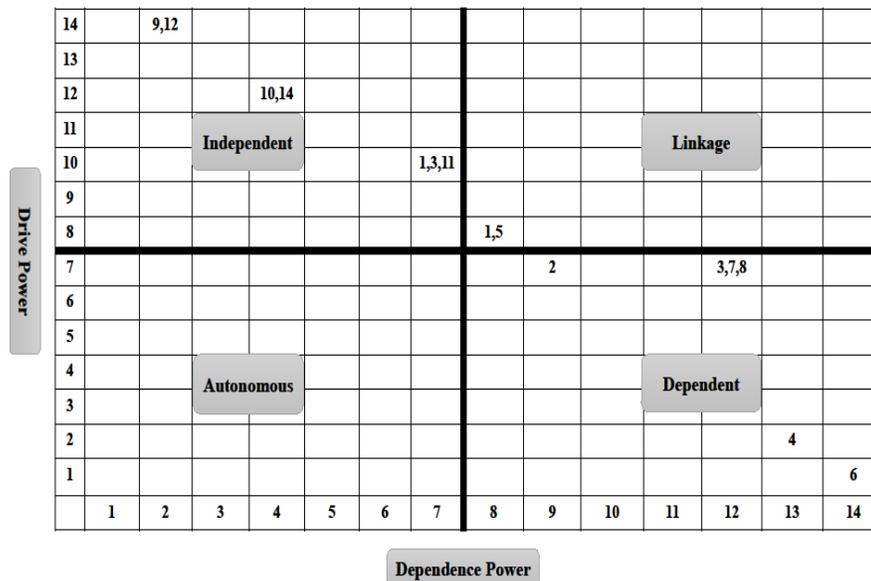


Figure 4. Chart analysis of the key factors of sustainable business model innovation in the digital age with a dynamic capabilities approach

Findings obtained from the analysis of the above matrix show that the two key factors are the use of digital technologies and the ability to understand and be aware of environmental changes due to high impact power and low impact of other factors as the first and most fundamental key binding factor. On the other hand, it was found that achieving economic sustainability and capturing value in businesses is not possible without considering the social and environmental aspects. Another important finding of this study is paying more attention to the importance of linkage factors that are "value network" and "value proposition" as intermediary factors to achieve sustainable business model innovation in the digital age based on dynamic capabilities.

## Conclusion

Sustainable products and services can offer a solution to both customer problems and social-environmental problems. These products and services have been defined as processes or commodities that while meeting the needs of customers, offer significant environmental and social benefits throughout their life cycle (Belz & Binder, 2013).

Established companies need change and innovation in their business in order not to find the same fate as the old bankrupt companies and not only to survive but also to move towards growth and development and remain stable. One of the necessary innovations is the innovation in the business model so that in addition to paying attention to economic factors, they also pay attention to social and environmental factors. According to the results of research literature and modeling based on the opinions of industry experts, although achieving sustainability in economic performance is necessary for any organization, but it is not enough and organizations need to pay attention to social and environmental achievements.

Today, customers are more aware of environmental issues and prefer products and services that do less harm to the environment. Furthermore, they have realized that the health of the environment has an impact on their own health (Radjou & Prabhu, 2015).

Furthermore, this is especially important in the digital age, because it's necessary to respond quickly to the needs of the new generation of digital customers. To this purpose, organizations have to create or acquire new internal capabilities such as the ability to understand and analyze the new needs of the market and customers, the ability to seize and take advantage of environmental opportunities and organizational reconfiguration. Compared to previous research, the main contribution of this research is considering the impact of three variables of sustainability, digitalization and dynamic capabilities on the business model innovation and also determining the relationship between key factors related to each of these variables.

With a strong focus on achieving long-term value creation for stakeholders, business sustainability benefits entrepreneurs with long-term investment prospects and business organizations that highly value customer satisfaction, employee welfare, and social and environmental responsibilities. To maintain sustainability in today's highly competitive global business environment, companies need to adjust their thinking, decisions, actions, and integrated performance (economic, social, and environmental) with a focus on the results that are of value for all stakeholders (Zabihollah & Miryazdi, 2021).

Identification of key factors in this study, which was done by meta-synthesis and thematic analysis based on high repetition, consists of four parts. In the first part, five dimensions for business model innovation were identified, which include innovation in the value proposition, value network, value creation, value delivery and value capture. It should be noted that the innovation in the value network is a new component that was less considered in other business

models, but in this study, based on the analysis of the MICMAC matrix, it was found that this factor to achieve business sustainability in the digital age as an important linkage factor that has the most impact and effectiveness, it needs to be seriously considered.

Another factor in creating business model innovation in the digital age is to pay attention to the main issue of sustainability. Digital technologies have been developed to make our lives easier and give us more time to rest. But in many cases, they have had the opposite effect. These technologies have accelerated our lives, causing countless problems in both personal and social spheres, and they have also had negative effects in the environmental sphere by increasing the incentive for pollution and destruction of natural resources (Hitchcock & Willard, 2015).

The results of this study showed that considering social and environmental factors as prerequisites for achieving economic sustainability is important for companies. Nowadays, customers are observing companies that pay special attention to factors of sustainability such as, humans, the environment, people and society in their products and services. They want to ensure that companies' products are not harmful to human health. How polluting is it for the environment? What assistance do organizations provide to human society in normal and critical situations? Therefore, based on the results of this study, it was found that in the food industries, many managers to address the concerns of their customers in this regard, have sought to develop dynamic capabilities and the use of new digital technologies.

Therefore, on the one hand, in order to provide an appropriate value proposition, businesses need to create and strengthen internal dynamic capabilities in their business in accordance with the needs of the digital age, in order to achieve the sustainability of their business. To achieve this, as a first step, they need to develop the ability to sense the impact of environmental changes on their business.

According to the network theory, businesses must use the participation and commitment of all stakeholders in their internal and external networks to assess and respond to their real needs in economic, social, and environmental domains (Baldassarre et al, 2017). On the other hand, to create and develop a proper value network, it is necessary to well identify the external drivers of digital age developments and use them to achieve sustainability. This is the fourth part of the research. For this purpose, companies need to take the first step in identifying and using digital technologies. The ability to use digital technologies needs to be considered in all three areas: environmental, social and economic.

In addition, consumer behavior in the digital age needs to be examined. Because consumer behavior is changing with generation Z. According to Radjou and Prabhu (2015) Businesses can earn higher revenues by employing low-cost initiatives such as serving as a product, waste reuse, etc. to improve customer loyalty and engagement, especially with the new generation of consumers who are more sensitive to sustainability issues. It should be considered that consumer behavior is not only included in economic issues, but today the social and environmental needs

of consumers have a higher priority. In addition to gaining an economic competitive advantage over their digital competitors, businesses also need to pay attention to their competitive advantages in the social and environmental fields. It is also necessary to provide reports on the results of their social and environmental achievements in addition to economic reports. Particularly in some foreign stock markets, companies have to report their sustainability performance for their shareholders and customers.

Considering that the results of this study are limited to managers' experience and knowledge of the food industries, to increase the generalizability of this study in future research, other industries need to be studied.

### Conflict of interest

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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