Are consumers' food purchase intentions impacted by blockchain technology?

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Abstract

Frame of the research: *As the demand for food authenticity and traceability continues to grow, Blockchain technology (BCT) will likely play a key role in supporting consumers' food purchase intentions as it enables them to access end-to-end traceability of the food supply chain through their mobiles.*

Purpose of the paper: *The study aims at exploring consumer awareness of BCT and the main factors influencing their intention to adopt BCT when shopping for groceries. The study verifies a structural model based on an integrated version of the TAM with Technology Principles Knowledge (TPK) and Blockchain Guarantee (BG) constructs.*

Methodology: *A survey based on a structured questionnaire was digitally shared among a sample of consumers. 392 responses were collected. PLS-SEM was used to verify the proposed model on the sample of knowledgeable consumers (N: 120).*

Results*: The level of knowledge of BCT is very low (31% of the sample). Perceived usefulness (PU) and perceived ease of use (PE) influence the attitude-intention to adopt the path. Knowledge of the technology's principles impacts PU, PE and importance given to blockchain guarantee, while the latter positively affects attitude. Indirect effects are all verified.*

Research limitations: *Due to the novelty of the phenomenon, the sample is small as the study focused only on knowledgeable consumers, limiting the general applicability of results. Cross-cultural studies may improve our knowledge.*

Managerial implications*: Our results are useful to food supply-chain operators - especially manufacturers and retailers - willing to provide consumers with easy-to-use and innovative solutions during shopping. To this end, results show that BCT may suit consumers' requests for guaranteed authenticity and traceability.*

Originality of the paper: *BCT studies mainly focus on the firm, while data or insights on consumers are scarce.*

Key words: *blockchain technology; consumers' purchase intentions; blockchain guarantee; technology principles knowledge; technology acceptance model; structural equation modelling*

1. Introduction

Consumers are increasingly concerned with the authenticity, traceability, and safety of food products. Therefore, tracing and verifying the origin and production phases of food products have become critical activities for all companies involved in the supply chain to offer consumers

a guarantee. To cope with traceability issues and to safeguard transparency, blockchain technology (BCT) is particularly useful for its capacity to store food data in chronological order, thus making subsequent tampering impossible (Galvez *et al.*, 2018). Indeed, transparency, trust, traceability, auditability, efficiency, and immutability have been identified as the main characteristics of BCT (Grover *et al.*, 2019). Consumers can benefit from BCT as this technology can provide updated and verifiable information about the origin and delivery routes of the food they purchase (Treiblmaier and Garaus, 2023). Blockchains allow end-to-end food chain traceability as "*information is tied digitally to each individual product, creating a digital record to prove provenance, compliance, authenticity, and quality. This information follows the product throughout the supply chain and is accessible to every stakeholder*" (Bumblauskas *et al.*, 2020, p. 1). Consumers are thus enabled to access the timeline of food through their mobiles. Hence, although still unexplored, BCT has the potential to revolutionise society and provide consumers with improved information and wearable product traceability (Behnke and Janssen, 2020). This has led some authors to far-sightedly consider blockchain as "the tech most likely to change the next decade of business" (Tapscott and Tapscott, 2016, p. 2). According to Custom Market Insights (CMI, 2022), the Blockchain Technology Market size is expected to hit around USD 69 Billion by 2032, poised to grow at a compound annual growth rate (CAGR) of 68% from 2023 to 2032. Moreover, according to a survey conducted by Statista (2024) on a sample of senior executives and practitioners in 2021, 45% of respondents stated that their companies were working on secure information exchange as a use case based on blockchain technology, making it the most popular use case of the technology, but only 31% used it to track and trace the product supply chain. Considering that consumers are increasingly sensitive to and informed of what they buy and eat (Liu *et al.*, 2019), and that many of them use technology to find out information about food items and/or the retailers or brands that sell them, the possibility of extending the use of BCT is a genuine opportunity. This is impacting the food industry, leading retailers, manufacturers and all supply chain players to introduce better strategies to reduce information asymmetry, particularly concerning labelling and traceability systems. In Europe, for instance, heavy usage of antibiotics as well as gene feeding and poor information about farming conditions have generated criticism among the public opinion. Thus, providing consumers with a technology such as Blockchain empowers them to easily get information about the product's origin and any feeding methods involved, thus reassuring consumers when they purchase food (Sander *et al.*, 2018). Market information asymmetry can sometimes let suppliers or retailers undertake opportunistic behaviours, making consumers pay the economic, sanitary and health-related consequences of this. This is why a Blockchain-traceability system has the potential of being welcomed by consumers (Lin *et al.*, 2021). Though labelling schemes already provide consumers with useful information, implementing a food traceability system could enhance the transparency of the food industry, since all supply chain stages can be monitored, thus offering consumers a continuous reliable flow of information (Fuzesi *et al.*, 2020).

However, to effectively implement BCT, it is important to develop consumer awareness of both the existence of this technology and the benefits related to its use, besides mapping the determinants that influence its acceptance by end-users. However, the extensive literature on BCT strongly addresses the aspect of "firms", paying particular attention to analysing benefits and impact on the supply chain (Gurtu and Johny, 2019) or on any specific players involved, such as retailers (Saxena and Sarkar, 2023). The paucity of research studies focusing on consumer intentions to adopt BCT when purchasing food is at the root of this study. As a matter of fact, "*individual actions toward such advanced technology are imperative to be observed to evaluate its scalability*" (Kumar *et al.,* 2022, p. 2). Albeit highlighting a potential relevance of blockchain technology for consumers - especially for food purchases - for the qualitative evaluation of products (Liu *et al.*, 2019), for food traceability (Treiblmaier and Garaus, 2023; Behnke and Janssen, 2020), and for managing the relationship with procurement chain suppliers (Xu *et al.*, 2020), there is little use of BCT on the part of users (Liu and Ye, 2020). Some recent studies have underscored how the risk of data breach and violation of their personal data makes consumers reluctant to adopt this disruptive and innovative, but still unfamiliar, technology (Raddatz *et al.*, 2023). To explore this aspect in detail, due to the novelty of the BCT phenomenon, an integrated version of the Technology Acceptance Model (TAM) with some technological aspects such as the role of technology principles knowledge (TPK) and blockchain guarantee (BG) may provide a wider explanation of consumer motivation to use BCT when shopping for food. Technology principles knowledge is key to indirectly stimulating consumer intentions to adopt BCT when shopping for food. In addition, this is performed by exploring the mediation effect of blockchain guarantee (BG). Within this framework, considering that few studies or insights on the consumer's side of the phenomenon are currently available, this study contributes to the literature by exploring the level of consumer awareness of Blockchain, specifically determining consumer perception of it when shopping for food.

A survey based on a structured questionnaire was digitally shared among a sample of consumers to verify the proposed model. Data were subsequently processed through structural equation modelling techniques. To our knowledge, no studies have been conducted on Italian consumers to date in this regard, despite their highly recognised level of concern about the provenance and quality of the food they eat/buy (Menozzi *et al.*, 2015). The acceptance of emerging food technology varies depending on the technology and across countries (Ashraf *et al.*, 2014), requiring focus on a specific cultural context.

The paper contributes to the literature on technology management and consumer behaviour, evidencing the importance of integrating the TAM model with constructs supporting the principles of the technology and service attributes, such as BG. The results obtained may also be useful to managers of manufacturing and retailing companies, as well as to other supply chain players operating in Italy, who are willing to anticipate consumer needs and provide solutions in this regard, fully aware of the factors that may lead to adopting BCT.

Our research questions are the following: Do Italian consumers know about Blockchain? Do they plan on using it when purchasing food? What is the role of TPK and BG in affecting consumer adoption of Blockchain in a TAM perspective?

The paper is structured as follows. After a brief description of the evolution of the literature on blockchain, the theoretical framework and hypotheses supporting the proposed model are described, followed by the methodology used to fulfil the study. The research design, measurements and model validity sub-paragraphs are provided before presenting the results obtained and discussed in the light of the related theoretical and managerial implications. The paper closes by discussing limitations and further research avenues.

2. Blockchain: a literature in evolution

Blockchain technology can be implemented in several sectors, such as the financial one, or the services sector and so on. However, at its early stage of diffusion, this technology has mainly been applied in the food supply chain sector, since it provides value for both retailers and producers, but also for the end consumers. The phenomenon, which immediately acquired a particular interest and application in cryptocurrencies and financial services, and then in the information technology and B2B relationship literature (Alt, 2020), has subsequently been considered - among other technologies - for its disruptive impact on several business models (Jain *et al.*, 2021).

Actually, BCT can be used to store and share data relative to all players involved in the supply chain; provide wide visibility to who is performing what activities, where, and when (Kshetri, 2018); to bypass intermediaries and auditors, enabling lower costs and increased efficiency (Kshetri, 2018; Tonnissen and Teuteberg, 2019); and to prevent fraud.

The benefits of BCT are not confined only to food supply chain traceability. Indeed, the increasing search for environmental sustainability calls for foods with a lower environmental impact, and this is strictly connected to the introduction of effective traceability technologies ensuring the integrity of the information provided.

Focusing on the retail industry, a few studies have explored the facilitating role of blockchain in the industry (e.g., Chakrabarti *et al.*, 2017; Chen *et al.*, 2020; Miraz *et al.*, 2020), without, however, considering the primary role blockchain can play in managing the relationship between retailers and consumers. Nevertheless, the importance of blockchain in consumer marketing is ascertained (Jain *et al.*, 2021). This is confirmed by the recent study of Kumar *et al.* (2022), which sheds light on the importance blockchain technology may have in providing information about the product's origin, and in tracking its history in the pre-purchase phase. However, the spread of blockchain in current consumption and purchasing processes is strongly limited by poor knowledge of the existence and benefits of the technology possessed by consumers. Wang and Scrimgeour (2022) evidenced the current knowledge gap regarding consumer adoption of

blockchain food traceability. They explored the influence of several factors on consumer adoption of blockchain food traceability in New Zealand, finding out that consumer adoption of blockchain food traceability was significantly influenced by two innovation-adoption features, precisely perceived incentives and perceived complexity, as well as their expertise in food traceability. This is why our study proposes a model offering a framework in which consumer knowledge of how blockchain technology works and the guaranteed benefit associated with adopting it constitute key antecedents to support its adoption, as described in the next paragraph.

3. Theoretical framework and hypotheses

The technology acceptance model (TAM) is widely used in asserting user acceptance of an innovation in a given context. It has recently been adopted to analyse the innovative blockchain technology (Liu and Ye, 2021). The framework was introduced by Fred Davis in 1985 in his doctoral thesis as an evolution of the Theory of Reasoned Action (TRA) (Ajzen and Fishbein, 1975). Davis stated that the use of an information system (and the acceptance of a technology) derives from the user's attitude towards that system, Attitude is a major determinant, which is, in turn, determined by two constructs, namely Perceived Usefulness and Perceived Ease of Use.

According to Kulviwat (2007), Perceived Usefulness (PU) is a person's belief regarding the perceived likelihood that the technology will benefit the person in performing a given task, increasing the possibility of adopting it in the future. In our model, PU of Blockchain when purchasing food concerns all aspects related to traceability and provenance ascertainment. Indeed, having easy access to a technology that allows them to determine the status and quality of a food item when shopping for food is assumed to be useful and desirable for consumers. Therefore, we can postulate the following hypothesis:

H1: Perceived Usefulness positively impacts Attitude towards Blockchain adoption when purchasing food.

Perceived Ease of use (PE) is defined as "The degree to which an individual believes that using a particular system would be free of physical and mental effort" (Davis, 1993, p. 477). It can also express the effort required by the individual to benefit from a given technology and, in the literature, it is recognised as the second most important variable for predicting the intention to adopt a certain kind of technology. It affects perceived usefulness and attitude directly, and through these variables it indirectly impacts intention to use. Indeed, if a given technology is perceived as easier to achieve a certain goal, then it will also be perceived as more useful (Ursavaş, 2022). Perceived Ease of Use generally represents how easy and enjoyable a new technology is perceived to be. Indeed, the easier and more enjoyable a technology is, the more likely consumers may be inclined to adopt it. Additionally, according to Davis (1985), the more consumers perceive an innovation to be easy to use, the more they will find benefits from using it and, therefore, the innovation will be perceived as more useful as well. Two further hypotheses are then derived:

H2: Perceived Ease of Use positively affects Attitude towards Blockchain adoption when purchasing food.

H3: Perceived Ease of Use positively affects Perceived Usefulness.

This study uses an integrated version of TAM, in which the Technology Principles Knowledge construct activates a positive attitude towards the investigated technology - and, in so doing, the intention to shop for food using blockchain technology - through the mediating effect of PU, PE and BG. Knauer and Mann (2020) introduced this construct in the TAM model, considering it as referring to the tendency people display when looking for new information about an innovation, before actually using it. Translating this concept in the specific context of the current study (the role of technology when purchasing food), consumers who have already heard about Blockchain and who already know its features and potential benefits are likely to perceive the technology to be useful, easy and enjoyable. Indeed, knowing the benefits that arise from using a decentralised technology in a context - as shopping for food - where information asymmetries are always present, positively impacts user perception of Blockchain.

The following hypotheses are developed:

H4: Technology Principles Knowledge positively affects Perceived Usefulness.

H5: Technology Principles Knowledge positively affects Perceived Ease of Use.

Decentralisation and the unchangeable features of Blockchain are essential in reassuring consumers when it comes to purchasing food items, since having all the information available about a food item and knowing its history in terms of origin and production stages, without the risk that anyone in the supply chain can modify them, can lead consumers to feel safer and guaranteed in performing the shopping task. Rainero and Modarelli (2021) performed an analysis assessing consumers' poor knowledge and perceptions on BC and the scarce usage level. They also found evidence that consumption habits could change through security and certainty antecedents, induced knowledge provided by external technological intervention. As the level of trust in a technology is determined by the quality of the technological infrastructure (Koenig-Lewis *et al.*, 2010), we can postulate a positive impact of knowing how blockchain technology works in guaranteeing consumers, as posited by the next hypothesis:

H6: Technology Principles Knowledge positively affects Blockchain guarantee.

The role of technology as a tool to guarantee consumers has been supported in the literature (Robertson *et al.*, 2012). In the specific context of this study, the trust protocol of blockchain guarantees consumers (Rejeb *et al.*, 2020) and acts as a boundary condition (Behnke and Janssen, 2020). The higher the level of perceived guarantee played by a technology solution, the more positive is the attitude of a consumer in using a technology such as Blockchain - where all information about the given products are provided and immutable - when buying food.

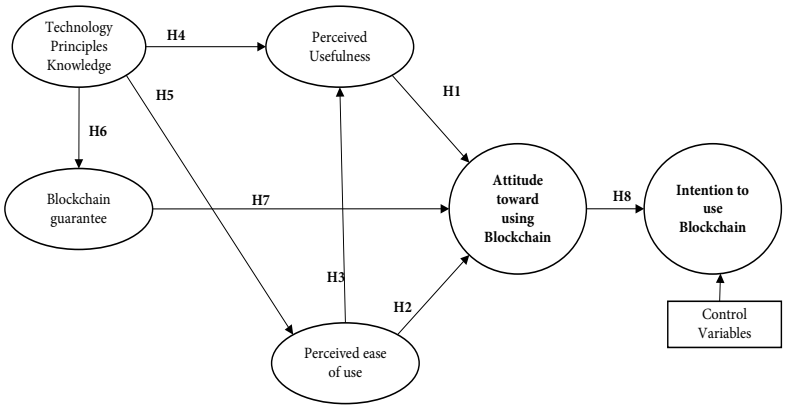
H7: Blockchain Guarantee positively impacts attitude towards using Blockchain technology.

Lastly, Attitude towards using Blockchain is the main factor that influences consumers to adopt a given technology. Theoretically speaking, a positive attitude is positively related to intention to use a technology (Davis, 1985). Other studies on different types of technologies found this relationship to be empirically significant. Therefore, we would like to verify the same path when blockchain technology is employed:

H8: Attitude towards using Blockchain positively affects Intentions to use Blockchain technology when shopping for food.

Due to the novel topic, demographics may greatly improve the model's performance. Accordingly, we included gender and age to the theoretical model to extend our results. Figure 1 illustrates the overall model we aim to verify.

Fig. 1: Theoretical model



Source: our elaboration

4. Methodology

4.1 Research Design

A deductive approach based on a quantitative method was designed to verify the proposed model and relative hypotheses. A survey based on a structured questionnaire was developed on a Google form and shared among potential users of blockchain technology when shopping for food products in November 2022. The link to the online questionnaire was shared on a number of Facebook groups interested in discussing food and grocery retailing. Consumers potentially involved in sharing their opinions about products, and in showing a significant interest in retailers' innovation were invited to participate. To strengthen dissemination of the questionnaire, fifteen consumer associations officially recognised

by the Italian government (mise.gov.it) were contacted; of these, only the "Movimento Difesa del Cittadino" committed itself to sharing the questionnaire with all its associates. To avoid potential biases, no reward was given to respondents.

The structured questionnaire comprises two main parts: the first investigates the main demographic characteristics of respondents, while the second measures the constructs proposed in the theoretical section.

In one month, we collected 392 responses - demographics are reported in Table 1.

Tab. 1: Demographic characteristics of respondents

Measure	Items	N (392)	n (120)
Blockchain knowledge (Do you know about the blockchain technology?"	Yes	120 (30.61%)	
	No	272 (69.39%)	
Gender	Male	109 (27.81%)	79 (65.83%)
	Female	283 (72.19%)	41 (34.17%)
Age	18-25 years old	99 (25.26%)	71 (59.17%)
	26-35 years old	60 (15.31%)	18 (15.00%)
	36-50 years old	135 (34.44%)	14 (11.67%)
	51-65 years old	89 (22.70%)	16 (13.33%)
	Over 65 years	9 (2.30%)	1 (0.83%)

Source: our elaboration

The first aim of our study is to understand the level of knowledge of blockchain technology among consumers. Considering the overall sample, initial information emerging is that only one over three respondents know about the existence of blockchain technology. Although the overall sample was mainly female (72.19%), the reduced sample based on respondents knowledgeable about blockchain was mainly male (65.83%), showing wider awareness of the emerging phenomenon in men. Similarly, while the overall sample presented a heterogeneous distribution in age groups - only the eldest cluster was poorly represented - the representativeness of the age groups of those who know about blockchain technology decreases as age increases.

As the scope of the study is to investigate how blockchain may influence the intention to shop for food with the support of blockchain technology, the following empirical analysis is developed only on respondents who know about blockchain. Thus, the empirical analysis was conducted on 120 questionnaires.

4.2 Measurements

Table 2 presents the main measures derived from literature on consumer behaviour. Questions were adapted to the context of our study. Items were translated into Italian to simplify the response of participants in the survey. Data were measured through a five-point close-ended Likert scale.

The scale of Technology Principles Knowledge (TPK), comprising three items, was derived from the previous study of Knauer and Mann (2019),

as well as from the construct of Blockchain Guarantee (BG), comprising four items. Perceived Usefulness (PU) and Perceived Ease of Use (PE) were adapted from the original scale developed by Davis (1985) and from the recent study of Kumar *et al.* (2022). Attitude towards the use of Blockchain (A) and the Intention to use Blockchain while shopping for food (I) scales were derived and adapted from Albayati *et al.* (2020).

Tab. 2: Measures

Construct	Items	Standardized factor loading	T-statistics
Technology Principles Knowledge	TPK1: I know how the Blockchain technology works.	0.885***	22.487
	TPK2: I know the advantages of a decentralized technology as the Blockchain in comparison to a centralized one.	0.902***	39.156
	TPK3: I have already heard of Blockchain applications in food retailing.	0.789***	18.005
Blockchain Guarantee	BG1: I would be in favor of using the Blockchain technology to know the traceability of a food item after a food hazard.	0.853***	25.078
	BG2: I would be in favor of buying a new product if I could be assured that it does not contain virus or bacteria (e.g., Salmonella).	0.769***	12.871
	BG3: I think Blockchain technology ensures the integrity of the provided information about a food item.	0.867***	29.630
	BG4: The usage of the Blockchain in food retailing makes me feel safer when I purchase a food item.	0.797***	18.890
Perceived Usefulness	PU1: I think that using the Blockchain technology to track information about a food item is useful.	0.842***	25.256
	PU2: I think that the Blockchain technology can help me understand the real provenance of a food item.	0.850***	27.195
	PU3: I think that the usage of the Blockchain technology can help me understand the quality of a product compared to another.	0.837***	27.930
	PU4: I think that the usage of Blockchain can speed the process of choosing a product compared to another.	0.708***	14.038
	PU5: I think that the data immutability characteristics of the Blockchain is important in the food retailing sector.	0.848***	31.555
Perceived Ease of Use	PE1: I think that scanning a QR code Blockchain based with the smartphone to access real time information about a food item does not require much time.	0.723***	12.128
	PE2: I think that learning how to use the Blockchain technology in the food retailing sector through scanning a QR code is easy.	0.895***	40.694
	PE3: I think that the usage of the Blockchain through QR code is clear and intuitive.	0.909***	46.890
	PE4: I think it is easy for me to find the information I am looking for about a food item through the Blockchain traceability system.	0.811***	20.704
Attitude towards using blockchain	A1: I am in favor of using the Blockchain technology to track food items history.	0.934***	42.073
	A2: I think that the usage of a QR code Blockchain based to track information of food items is a good idea.	0.955***	78.588
	A3: It makes sense to use the Blockchain technology to track food items history.	0.951***	65.984
Intention to use blockchain for shopping	I1: I would be in favor of using the Blockchain technology when I go grocery shopping.	0.907***	45.539
	I2: If I had access to the Blockchain technology, I would use it.	0.937***	74.300
	I3: I will use the Blockchain technology in the future.	0.824***	18.012

Note: *** p-value < 0.001

Source: our elaboration

4.3 Empirical model and measure validity

To validate the internal and external validity of the measures used for the empirical analysis, we performed a confirmatory factor analysis (CFA).

To ascertain the internal reliability of constructs, both values of Composite Reliability (CR) and Cronbach's alpha must be higher than the 0.7 threshold (Hair *et al.*, 2016). As confirmed by data presented in Table 3, all constructs are internally reliable. This is confirmed by the values of standardised factor loadings (see table 2), which are higher than 0.6 and statistically significant. Convergent validity was assessed by the values of the Average Variance Extracted (AVE), which are greater than 0.5 (Hair *et al.*, 2016).

Tab. 3: Constructs reliability and validity

	Cronbach's alpha	Composite reliability (CR)	Average variance extracted (AVE)
Attitude toward the block-chain	0.942	0.963	0.896
Intention to use block-chain	0.869	0.920	0.793
Perceived Ease of Use	0.855	0.903	0.702
Perceived Usefulness	0.877	0.910	0.670
Blockchain Guarantee	0.840	0.893	0.677
Technology Principles Knowledge	0.822	0.895	0.740

Source: our elaboration

Applying the Fornell and Larcker criteria (results proposed in Table 4), we confirmed the discriminant validity of the measurement model. Correlations among construct pairs are lower than the square root of AVE, confirming the discriminant validity.

The discriminant validity of constructs included in the measurement model was also confirmed by the heterotrait-monotrait ratio (HTMT), all values being lower than 0.9 (Henseler *et al.*, 2015).

Tab. 4: Discriminant Validity: Fornell-Larcker criterion and Heterotrait-Monotrait ratio

	Age	A	Gender	I	PE	PU	BD	TPK
Age	1.000	0.069	0.024	0.093	0.125	0.096	0.095	0.064
A	-0.068	0.947	0.051	0.685	0.731	0.787	0.768	0.374
Gender	0.024	0.050	1.000	0.065	0.068	0.128	0.120	0.071
I	-0.090	0.627	0.060	0.891	0.685	0.730	0.723	0.383
PE	-0.115	0.657	0.018	0.602	0.838	0.707	0.668	0.409
PU	-0.049	0.730	0.024	0.650	0.624	0.819	0.888	0.540
BG	-0.088	0.685	0.001	0.624	0.572	0.774	0.823	0.521
TPK	-0.029	0.332	-0.048	0.325	0.342	0.473	0.441	0.860

Note: Values along the main diagonal (bold) are the square root of the AVEs. Off diagonal values are the correlations between constructs, and HTMT ratios are above the diagonal.

Source: our elaboration

Finally, values of the variance inflation factor (VIF) for latent constructs lower than 3 indicate that the measurement model does not present potential collinearity issues (Hair and Sarstedt, 2021). Values are reported in Table 5.

Tab. 5: Collinearity statistics for the inner model (VIF)

	Age	A	Gender	I	PE	PU	BD	TPK
Age				1.005				
A				1.007				
Gender				1.003				
I								
PE		1.693				1.132		
PU		2.842						
BG		2.577						
TPK					1.000	1.132	1.000	

Note: Variance inflation factor (VIF)

Source: our elaboration

5. Empirical model results

Due to the small sample size, the Partial Least Square Structural Equation Model technique (PLS-SEM) was implemented, as it is considered more reliable with small sample sizes and complex models (Hair *et al.*, 2018). A bootstrap routine with 5,000 iterations was implemented to provide standard errors and t-statistics of the relationship among constructs and achieve stable results (Henseler *et al.*, 2009). The software SmartPLS 4.0 was used to develop the structural model and assess paths among constructs (Ringle *et al.*, 2022). The results are presented in Figure 2. The calculated model widely explains the theoretical model, the amount of variance explained by dependent variables being modest for perceived ease of use (R^2 =0.109) and Blockchain Guarantee (R^2 =0.188), moderate for the intention to use blockchain during food shopping (R^2 =0.381) and perceived usefulness (R^2 =0.457), and strong for the attitude toward blockchain (R^2 =0.611).

5.1 Structural model predictive power

To evaluate the out-of-sample predictive power of our empirical model, we performed a 10-fold cross-validation with a single repetition using the PLSpredict procedure (Shmueli *et al.*, 2016) and the cross-validated predictive ability test (CVPAT - Sharma *et al.*, 2023). This approach mimics the real-life scenario where the PLS model will be used to make predictions, rather than relying on an average across multiple models, thus improving the reliability of predictions (Shmueli *et al.*, 2019). The Q^2 value is an indicator of the model's predictive power or relevance for out-of-sample data. Hair *et al.* (2019) recommend that the Q^2 value should be greater than 0 to explain the predictive relevance of the PLS path model. Additionally, the metrics (MAE) and the Root mean square of error (RMSE) assess the predictive fit of the model and its error.

Analysing the manifest variables (MV) (Table 6), the $Q^2_{predict}$ values are all above zero, indicating that items have predictive relevance. Furthermore, the error analysis performed by comparing the Root mean

square of error (RMSE) and the metrics (MAE) among the PLS-SEM and the Linear Model (LM) shows that PLS fits better than the linear model apart for BG2, BG3, BG4 and PU4. However, the small bias among the two values indicates that the model predicts well enough (Shmueli *et al.*, 2019).

Tab. 6: PLSpredict assessment of manifest variables (original model)

	Q^2predict	PLS- EM_RMSE	PLS-SEM_MAE	LM_RMSE	LM_MAE
A1	0.121	0.843	0.642	0.869	0.671
A2	0.058	0.785	0.597	0.811	0.626
A3	0.073	0.813	0.622	0.842	0.645
BG1	0.151	0.840	0.642	0.842	0.647
BG2	0.069	0.806	0.582	0.802	0.561
BG3	0.146	0.875	0.685	0.853	0.654
BG4	0.110	0.840	0.699	0.793	0.643
I1	0.075	0.808	0.594	0.824	0.640
I2	0.057	0.727	0.520	0.751	0.556
I3	0.060	0.799	0.595	0.821	0.624
PE1	0.043	1.050	0.832	1.067	0.827
PE2	0.078	0.838	0.651	0.855	0.685
PE3	0.050	0.847	0.666	0.862	0.689
PE4	0.069	0.797	0.605	0.823	0.627
PU1	0.202	0.710	0.538	0.733	0.565
PU2	0.115	0.794	0.623	0.811	0.630
PU3	0.074	0.769	0.612	0.775	0.620
PU4	0.060	0.856	0.706	0.855	0.686
PU5	0.205	0.822	0.623	0.824	0.636

Source: our elaboration

The analysis of the predictive power of latent variables (LV) shows the good predictive power of the inner structural equation model. All $Q^2_{predict}$ values are higher than 0. The findings show that BG ($Q^2_{Predict}$=0.179) and PU ($Q^2_{Predict}$=0.209) constructs have a strong predictive power, while they are acceptable for PE ($Q^2_{Predict}$=0.092), ATT ($Q^2_{Predict}$=0.098) and INT ($Q^2_{Predict}$=0.081).

Tab. 7: Latent Variables predictive power

	Q^2predict
Blockchain Guarantee	0.179
Perceived Ease of Use	0.092
Perceived Usefulness	0.209
Attitude toward the block-chain	0.098
Intention to use block-chain	0.081

Source: our elaboration

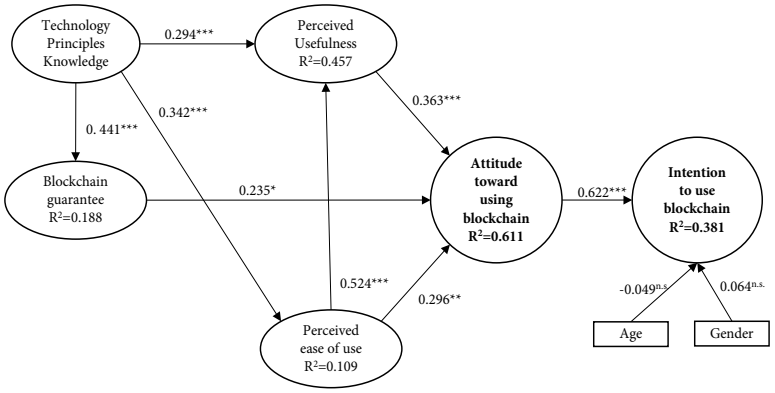
5.2 Structural model results

The results of the structural equation model confirm all the postulated hypotheses (Fig. 2). The perceived usefulness and the perceived ease

of use directly influence the attitude toward the use of blockchain ($\beta_{PU\rightarrow A}$=0.363, t-value=2.976; $\beta_{PE\rightarrow A}$=0.296, t-value=2.912), assessing the first two hypotheses. Moreover, perceived ease of use shows a direct and positive effect on perceived usefulness, in line with H3 ($\beta_{PE\rightarrow PU}$=0.524, t-value=7.759). The technology principles knowledge has a positive impact on perceived usefulness ($\beta_{TPK\rightarrow PU}$=0.294, t-value=3.779), perceived ease of use ($\beta_{TPK\rightarrow PE}$=0.342, t-value=3.511), and blockchain guarantee ($\beta_{TPK\rightarrow BD}$=0.441, t-value=6.543). Hypotheses 4, 5, and 6 are confirmed. The impact of blockchain guarantee on the attitude toward using blockchain is also direct and positive, as postulated in H6 that is confirmed ($\beta_{BD\rightarrow A}$=0.235, t-value=2.176). Finally, we also confirm H8 as the attitude toward blockchain positively influences the intention to use blockchain during food shopping ($\beta_{A\rightarrow I}$=0.622, t-value=7.263).

Although the sample discussion showed that young males were more knowledgeable about the blockchain phenomenon, none of the control variables present a significant impact on the intention to use blockchain for shopping ($\beta_{Age\rightarrow I}$=-0.049, t-value=0.702; $\beta_{Gender\rightarrow I}$=0.064, t-value=0.404).

Fig. 2: Structural model results



Note: *** p-value < 0.001; ** p-value < 0.01; * p-value < 0.05; n.s. = not significant effect.

Source: our elaboration

5.3 Indirect effects

Table 8 presents the results of the analysis by estimating indirect effects. The perceived usefulness shows a strong and significant indirect impact on the intention to use blockchain during shopping. The perceived ease of use has both a direct and indirect impact on the attitude toward blockchain by means of perceived usefulness. Furthermore, the construct evidences a positive and indirect impact on the intention to use blockchain, mediated by attitude.

By acting on the perceived ease of use, technology principles knowledge indirectly influences both perceived usefulness and attitude toward blockchain. The indirect relationship between technology principles knowledge and attitude is also mediated by blockchain guarantee.

Tab. 8: Indirect effects

Indirect effects	Standardized factor loading	T-statistics	P values
PU → A → I	0.226***	3.205	0.001
PE → PU → A	0.190**	2.686	0.007
PE → A → I	0.184*	2.431	0.015
TPK →PE →PU	0.179**	2.814	0.005
TPK → PE → A	0.101*	2.288	0.022
TPK →BG → A	0.104*	2.010	0.044

Note: *** p-value < 0.001; ** p-value < 0.01; * p-value < 0.05.

Source: our elaboration

6. Discussion and implications

The study proposes an innovative perspective on the emerging blockchain phenomenon. Blockchain, a wide database maintaining and continuously updating data about searches, orders, behaviours, and any potential record available about a subject, is a technology of doubtless potential in consumer marketing (Jain *et al.*, 2021). BCT can be very useful for consumers as a tool that provides information about the product's origin (Kumar *et al.*, 2022), traces the product's path along the agri-food supply chain (Xu *et al.*, 2020), and provides reassurance and guarantee especially when consumers shop for food products, traditionally considered as experience or credence goods (Caswell and Mojduszka, 1996). Within this context, the results of the present study contribute to the literature by presenting the perspective of consumers in adopting blockchain in their shopping process. Our findings support the view of blockchain technology as "*an evolutionary breakthrough that empowers a consumer-centric mentality*" (Rabby *et al.*, 2022, p. 266), and contribute to the paucity of studies exploring BCT in the food industry (Vu *et al.*, 2023).

6.1 Discussion of the results

The first result emerging from the data collection highlights that blockchain technology is known only to 30% of the population. Thus, although it is becoming a trending topic for scholars and practitioners (Grover *et al.*, 2019), most consumers not only ignore its potential usage - in traceability and purchasing process simplification, among others - but they completely ignore its existence. Our findings extend previous studies on consumer acceptance of BCT (e.g., Treiblmaier and Garaus, 2023), focusing only on consumers aware of this innovative technology. Conversely, those who know about blockchain technology consider it a useful and easy-to-use tool to facilitate their shopping process for food. From a theoretical perspective, results confirm that, among aware consumers, blockchain acceptance and practical usage is well anchored in the Technology Acceptance Model (Davis, 1985). In line with previous results within the technology acceptance and usage literature, the direct

and indirect positive relationships between perceived usefulness, perceived ease of use, attitude and usage intentions are confirmed by our survey.

The study's findings show that blockchain technology may be a useful informational tool for food customers who, thanks to their wearable devices, may quickly and easily access food information. Customers show an overall predisposition to use new technologies to access information. Today, access to a digitised world of information by scanning QR codes has become common and widely accepted by consumers. This allows both retailers and food product manufacturers to have new forms of communication and the creation of knowledge to the benefit of their customers. The latter can find guarantees and safeguards in BCT, satisfying their needs for authenticity and safety. This confirms recent studies on the potential of BCT to support the traceability of food products and to protect the consumer in his purchasing process (e.g., Treiblmaier and Garaus, 2023; Behnke and Janssen, 2020). But that is not all of it. In fact, spreading BCT and adopting it are key to supporting supply chain players and, among them, especially farmers, manufacturers, and retailers' policies aimed at lowering the environmental impact of their activities. In this regard, BCT can be the essential technological infrastructure to ensure integrity of the information provided. Thus, BCT may be a key tool for agri-food supply-chain operators (Panghal *et al.*, 2023; Xu *et al.*, 2020).

6.2 Theoretical implications

Disruptive blockchain technology is gaining relevance in the literature. However, to date, most studies have focused on analysing how blockchain can improve supply chain relationships, only residually analysing its impact on users (Liu and Ye, 2021). Thus, this study contributes to the emerging theoretical scenario on BCT by analysing the main drivers leading consumers to adopt BCTs in their shopping process. The food context was selected for this purpose, both due to the growing attention that blockchain is taking in the agricultural and retail sectors (Grover *et al.*, 2019), and because food is a frequent but attentively purchased product category (Liu *et al.*, 2019). The results corroborate previous findings of Knauer and Mann (2019), showing that people have a tendency to look for new information about innovation, before using it - the so-called Technology Principles Knowledge. Our findings confirm that TPK acts positively on perceived usefulness, perceived ease of use, and blockchain defence. Moreover, this study extends the TAM model in BCT with the novel construct of blockchain defence. This variable tests consumers' opinion about the ability of blockchain to serve as a guarantee concerning food traceability. Results show that when blockchain technology is perceived as a guarantee for the consumer, ensuring the integrity of food information, it leads to a wider intention to use blockchain for food shopping. Finally, findings show a strong positive relationship between attitude and intention, confirming consumer interest in blockchain, as resulted in the recent study by Kumar *et al.* (2022).

6.3 Managerial implications

Our findings are also beneficial for food supply chain operators, particularly manufacturers and retailers who are interested in offering consumers convenient and innovative solutions when they shop. An initial piece of relevant information concerns the small percentage of consumers aware of the potential of blockchain technology. To support and spread the use of technology, manufacturers and retailers should inform consumers of the main functions and methods of use of the technology. Dedicated communication messages aimed at enhancing the role of guarantee developed by BCT and wider interaction with all operators of the food blockchain may bring consumers closer to this technology. To this end, virtual and physical shops can be effective platforms in spreading technical information on the technology easily and straightforwardly, studying, for instance, integrating displays, bands, and tapes capable of supporting the trial and of interacting with mobile phones. Furthermore, the results indicate that BCT can meet the demand of consumers who are looking for food authenticity and traceability. Subsequently, the findings of the study provide practical suggestions for retailers implementing blockchain technology in their Web and mobile selling interfaces, as well as for policymakers increasingly called to protect people from food fraud. Additionally, as highlighted by Behnke and Janssen (2020), standardisation of technology across supply chain operators allowing internal and external traceability processes is still on the go, providing consumers with systems that are still not very user-friendly and easily accessible.

Finally, policymakers and governments are called to support dissemination of blockchain technology to guarantee citizens from untrustworthy diffusion of personal data and potentially problematic usage of blockchain. Indeed, direct access via personal devices could lead to an unconscious bias concerning the risk of sharing files and personal information or the risk of a data breach of sensitive data (Raddatz *et al.*, 2023). Thus, data sharing and blockchain guarantees become highly interesting topics for institutions aimed at protecting their citizens.

7. Limitations and further research

Although the paper offers a first empirical study on consumer acceptance and adoption of blockchain technology in their shopping intentions for food, future studies are required to extend these exploratory results. First, due to the lack of literature exploring consumer use of blockchain, we cannot corroborate the study's findings with previous results available in the literature. Hence, one limitation of this study concerns the general application of results.

Furthermore, the sample comprises respondents of a single country - Italy - while further studies should validate results in countries with a higher technology adoption rate, as well as in countries with a lower technology adoption rate. Moreover, extant literature analyses the differences present in EU and Asian traceability systems and rules (Quian *et al.*, 2020),

evidencing the importance of cross-cultural studies. Moreover, due to the novelty of the phenomenon among consumers, the sample is small as the study only focused on knowledgeable consumers. Future studies should investigate potential barriers and the perspectives of those who do not know the technology.

References

AJZEN I., FISHBEIN M. (1975), "A bayesian analysis of attribution processes", *Psychological Bulletin*, vol. 82, n. 2, pp 261.

ALBAYATI H., KIM S.K., RHO J.J. (2020), "Accepting financial transactions using blockchain technology and cryptocurrency: A customer perspective approach", *Technology in Society,* vol. 62, 101320.

ALT R. (2020), "Electronic Markets on blockchain markets", *Electron Markets,* vol. 30, pp. 181-188

ASHRAF A.R., THONGPAPANL N., AUH S. (2014), "The application of the technology acceptance model under different cultural contexts: the case of online shopping adoption", *Journal of International Marketing,* vol. 22, n. 3, pp. 68-93.

BEHNKE K., JANSSEN M.F.W.H.A. (2020), "Boundary conditions for traceability in food supply chains using blockchain technology", *International Journal of Information Management,* vol. 52, 101969.

BOUKIS A. (2020), "Exploring the implications of blockchain technology for brand-consumer relationships: a future research agenda", *Journal of Product and Brand Management,* vol. 29, n. 3, pp. 307-320.

BUMBLAUSKAS D., MANN A., DUGAN B., RITTMER J. (2020), "A blockchain use case in food distribution: do you know where your food has been?", *International Journal of Information Management,* vol. 52, 102008.

CASWELL J.A., MOJDUSZKA E.M. (1996) "Using informational labeling to influence the market for quality in food products", *American Journal of Agricultural Economics,* vol. 78, pp. 1248-1253.

CHAKRABARTI A., CHAUDHURI A. K. (2017), "Blockchain and its scope in retail", *International Research Journal of Engineering and Technology,* vol. 4, n. 7, pp. 3053-3056.

CHEN J., CAI T., HE W., CHEN L., ZHAO G., ZOU W., GUO L. (2020), "A blockchain-driven supply chain finance application for auto retail industry", *Entropy*, vol. 22, n. 1, pp. 95.

DAVIS F. D. (1985), *A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results.* Massachusetts Institute of Technology.

DAVIS F.D. (1993), "User acceptance of information technology: system characteristics, user perceptions and behavioral impacts", I*nternational Journal of Man-machine Studies,* vol. 38 n. 3, pp. 475-487.

DIONYSIS S., CHESNEY T., MCAULEY D. (2022), "Examining the influential factors of consumer purchase intentions for blockchain traceable coffee using the theory of planned behaviour", *British Food Journal,* vol. 124, n. 12, pp. 4304-4322.

FÜZESI I., CSORDÁS A., SHKODRA R., FELFÖLDI J. (2020), "Consumer acceptance of blockchain-based traceability systems in food supply chains", *Agrárinformatika/Journal of Agricultural Informatics,* vol. 11, n. 1, pp. 9-23.

GALVEZ J.F., MEJUTO J.C., SIMAL-GANDARA J. (2018), "Future challenges on the use of blockchain for food traceability analysis", *Trac Trends in Analytical Chemistry,* vol. 107, pp. 222-232.

GARAUS M., TREIBLMAIER H. (2021), "The influence of blockchain-based food traceability on retailer choice: the mediating role of trust", *Food Control,* vol. 129, 108082.

GROVER P., KAR A.K., JANSSEN M., ILAVARASAN P.V. (2019), "Perceived usefulness, ease of use and user acceptance of blockchain technology for digital transactions-insights from user-generated content on Twitter", *Enterprise Information Systems,* vol. 13 n.6, pp. 771-800.

GURTU A., JOHNY J. (2019), "Potential of blockchain technology in supply chain management: a literature review", *International Journal of Physical Distribution and Logistics Management*, vol. 9, pp. 881-900

HAIR J.R., SARSTEDT M., (2021), "Explanation plus prediction-The logical focus of project management research", *Project Management Journal,* vol. 52, n. 4, pp. 319-322

HAIR J.F., RISHER J.J., SARSTEDT M., RINGLE C.M. (2019), "When to use and how to report the results of PLS-SEM", *European Business Review*, vol. 31 n.1, pp. 2-24.

HAIR J.F., SARSTEDT M., RINGLE C.M., GUDERGAN S.P. (2018), *Advanced issues in partial least squares structural equation modeling (PLS-SEM).* Thousand Oaks, Sage, CA.

HAIR J.R., J.F., SARSTEDT M., MATTHEWS L.M., RINGLE C.M. (2016), "Identifying and treating unobserved heterogeneity with FIMIX-PLS: Part I-method", *European Business Review,* vol. 28, pp. 63-76.

HENSELER J., RINGLE C.M., SARSTEDT M. (2015), "A new criterion for assessing discriminant validity in variance-based structural equation modeling", *Journal of the Academy of Marketing Science,* vol. 43, pp. 115-135.

HENSELER J., RINGLE C.M., SINKOVICS R. R. (2009), "The use of partial least squares path modeling in international marketing", In *New challenges to international marketing*. Emerald Group Publishing Limited.

JAIN D., DASH M.K., KUMAR A., LUTHRA S. (2021), "How is blockchain used in marketing: a review and research agenda", *International Journal of Information Management Data Insights*, vol. 1, n. 2, 100044.

KNAUER F., MANN A. (2019), "What is in it for me? identifying drivers of blockchain acceptance among German consumers", *The Journal of The British Blockchain Association*, vol. 3, n.1, pp. 1-16.

KOENIG-LEWIS N., PALMER A., MOLL A. (2010), "Predicting young consumers' take up of mobile banking services", *International Journal of Bank Marketing*, vol. 28 n. 5, pp. 410-432.

KSHETRI N. (2018), "1 blockchain's roles in meeting key supply chain management objectives", *International Journal of Information Management,* vol. 39, pp. 80-89.

KULVIWAT S., BRUNER II G.C., KUMAR A., NASCO S.A., CLARK T. (2007), "Toward a unified theory of consumer acceptance technology", *Psychology and Marketing,* vol. 24, pp. 1059-1084.

KUMAR N., UPRETI K., MOHAN D. (2022), "Blockchain adoption for provenance and traceability in the retail food supply chain: a consumer perspective", *International Journal of E-Business Research,* vol. 18, n. 2, pp. 1-17.

LIN X., CHANG S.C., CHOU T.H., CHEN S.C., RUANGKANJANASES A. (2021), "Consumers' intention to adopt blockchain food traceability technology towards organic food products", *International Journal of Environmental Research and Public Health,* vol. 18, n. 3, p. 912.

LIU N., YE Z. (2021), "Empirical research on the blockchain adoption-based on TAM", *Applied Economics,* vol. 53 n. 37, pp. 4263-4275.

LIU R., GAO Z., NAYGA R.M., SNELL H.A., MA H. (2019), "Consumers' valuation for food traceability in china: does trust matter?", *Food Policy,* vol. 88, 101768.

MENOZZI, D., HALAWANY-DARSON R., MORA C., GIRAUD G. (2015), "Motives towards traceable food choice: A comparison between French and Italian consumers", *Food Control,* vol. 49, pp. 40-48.

MIRAZ M.H., HASSAN M.G., SHARIF K.I.M. (2020), "Factors affecting implementation of blockchain in retail market in Malaysia", *International Journal of Supply Chain Management*, vol. 9, n. 1, pp. 385-391.

PANGHAL A., MANORAM S., MOR R.S., VERN P. (2023), "Adoption challenges of blockchain technology for reverse logistics in the food processing industry", *Supply Chain Forum: An International Journal*, vol. 24, n. 1, pp. 7-16.

QIAN J., RUIZ-GARCIA L., FAN B., VILLALBA J.I.R., MCCARTHY U., ZHANG B., YU Q., WU W. (2020), "Food traceability system from governmental, corporate, and consumer perspectives in the European Union and China: a comparative review", *Trends in Food Science and Technology,* vol. 99, pp. 402-412.

RABBY F., CHIMHUNDU R., HASSAN R. (2022), "Blockchain technology transforms digital marketing by growing consumer trust", *Transformations Through Blockchain Technology: The New Digital Revolution,* pp. 265-289.

RADDATZ N., COYNE J., MENARD P., CROSSLER R. E. (2023), "Becoming a blockchain user: understanding consumers' benefits realisation to use blockchain-based applications", *European Journal of Information Systems,* vol. 32 n. 2, pp. 287-314.

RAINERO C., MODARELLI G. (2021), "Food tracking and blockchain-induced knowledge: a corporate social responsibility tool for sustainable decision-making", *British Food Journal,* vol. 123, n. 12, pp. 4284-4308.

REJEB A., KEOGH J. G., TREIBLMAIER H. (2020), "How blockchain technology can benefit marketing: six pending research areas", *Frontiers in Blockchain,* vol. 3.

RINGLE C.M., WENDE S., BECKER J.M. (2022), "SmartPLS 4.", Oststeinbek: SmartPLS GmbH, http://www.smartpls.com.

ROBERTSON N., MCQUILKEN L., KANDAMPULLY J. (2012), "Consumer complaints and recovery through guaranteeing self-service technology", *Journal of Consumer Behaviour,* vol. 11, n. 1, pp. 21-30.

SANDER F., SEMEIJN J., MAHR D. (2018), "The acceptance of blockchain technology in meat traceability and transparency", *British Food Journal,* vol. 120, n. 9, pp. 2066-2079

SAXENA N., SARKAR B. (2023), "How does the retailing industry decide the best replenishment strategy by utilizing technological support through blockchain?", *Journal of Retailing and Consumer Services,* vol. 71, 103151.

SHARMA P.N., LIENGAARD B.D., HAIR J.F., SARSTEDT M., RINGLE C.M. (2022), "Predictive model assessment and selection in composite-based modeling using PLS-SEM: extensions and guidelines for using CVPAT", *European Journal of Marketing,* vol. 57 n.6, pp. 1662-1677.

SHMUELI G., RAY S., ESTRADA J.M.V., CHATLA S.B. (2016), "The elephant in the room: Predictive performance of PLS models", *Journal of Business Research,* vol. 69 n. 10, pp. 4552-4564.

SHMUELI G., SARSTEDT M., HAIR J.F., CHEAH J.H., TING H., VAITHILINGAM S., RINGLE C. M. (2019), "Predictive model assessment in PLS-SEM: guidelines for using PLSpredict", *European Journal of Marketing,* vol. 53 n. 11, pp. 2322-2347.

TAPSCOTT D., TAPSCOTT A. (2016), "The impact of the blockchain goes beyond financial services", *Harvard Business Review,* vol. 10, n. 7, pp. 2-5.

TONNISSEN S., TEUTEBERG F. (2019), "Analysing the impact of blockchain-technology for operations and supply chain management: An explanatory model drawn from multiple case studies", *International Journal of Information Management,* vol. 52(C), 101953.

TREIBLMAIER H., GARAUS M. (2023), "Using blockchain to signal quality in the food supply chain: The impact on consumer purchase intentions and the moderating effect of brand familiarity", *International Journal of Information Management,* vol. 68, pp. 102514.

URSAVAŞ, Ö.F. (2022), "Technology Acceptance Model: History, Theory, and Application", In *Conducting Technology Acceptance Research in Education*. Springer Texts in Education. Springer, Cham.

VAN RIJSWIJK W., FREWER L. J. (2012), "Consumer needs and requirements for food and ingredient traceability information", *International Journal of Consumer Studies*, vol. 36, n. 3, pp. 282-290.

VU N., GHADGE A., BOURLAKIS M. (2023), "Blockchain adoption in food supply chains: A review and implementation framework", *Production Planning and Control,* vol. 34 n. 6, pp. 506-523.

WANG H., ZHANG M., YING H., ZHAO X. (2021), "The impact of blockchain technology on consumer behavior: A multimethod study", *Journal of Management Analytics,* vol. 8, n. 3, pp. 371-390.

WANG O., SCRIMGEOUR F. (2022), "Consumer adoption of blockchain food traceability: effects of innovation-adoption characteristics, expertise in food traceability and blockchain technology, and segmentation", *British Food Journal*, (ahead-of-print).

XU J., GUO S., XIE D., YAN Y. (2020), "Blockchain: A new safeguard for agri-foods", *Artificial Intelligence in Agriculture,* vol. 4, pp. 153-161.

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