



Impact of Perceived Ease of Use and Perceived Usefulness on Behavioral Intention to Use Blockchain in Food Supply Firms: The Mediating Role Employee Attitude

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Abstract

This study aims to investigate the impact of perceived ease of use and perceived usefulness on behavioral intention to use blockchain in food supply and the mediating role of employee attitude—primary data gathered with the help of adopted questionnaire through face-to-face survey from food supply firms. A total of 229 cases were considered for data analysis in order to achieve the research objectives of the present study—gathered data analyzed via structural equation modelling (SEM) in SmartPLS version 3. Findings confirmed the direct effect of perceived ease of use, perceived usefulness, and employee attitude on behavioral intention to use blockchain in the food supply. However, perceived usefulness was found to be more significant on behavioral intention to use blockchain due to higher beta value. Furthermore, the indirect effect of employee attitude on perceived ease of use, perceived usefulness, and behavioral intention to use blockchain positively and significantly suggested a partial mediation effect. For the Blockchain system to gain acceptance, it should be easy to use and be perceived as useful by end users. Therefore, it can be done with the help of user-centred design, initial and advanced staff training, and awareness of the potential benefits of technology.

Keywords: Perceived ease of use, Perceived usefulness, Employee attitude Behavioral intention to use blockchain, Food supply firms

1. Introduction

In today's competitive environment, the effective and adaptive application of the IT and Web technologies that have evolved so rapidly for so long can be neither questioned nor denied to have posed new challenges to the supply chain organisations (Dubey et al., 2023). The major challenge is that the supply chain networks are long and multilayered, engaging several tiers of suppliers, sometimes outsourcing distribution services and the customer base spans across the globe. In addition to this, complexity makes the supply chain longer and implicitly more likely to disrupt, and there is a need to apply monitoring and control over the variability throughout the entire supply chain network. Besides, an increased level of electronic commerce or so-called e-commerce significantly influenced the expectations of customers and their increasing requirements for the speed and flexibility of delivery, along with a greater level of transparency (Tofan & Bostan, 2022; Munir et al., 2024). Similarly, customers also expect sustainable supply chain policies to be enhanced to help minimize negative impacts on the environment. Additionally, the increasing amount of data from a variety of sources has both positives and negatives as more organisations absolutely must take advantage of improved, data-driven analytics in demand forecast, inventory, and risk mitigation. The increasing digitization and advancements of other technologies like automation, artificial intelligence, blockchain, and IoT also impact the supply chain processes (Mohsen, 2023). Therefore, the implementation of these new technologies should be incorporated and merged to increase efficiency and, hence, effectiveness in the provision of services. However, these advanced technologies and the interconnectivity of supply chains also make them vulnerable to cybersecurity threats and data breaches, thus requiring protective measures and policies of data privacy in the long run.

Nowadays, it has been noticed that blockchain technology is used in food supply chains in developing countries of the world, such as Pakistan, for many reasons (Aslam et al., 2021). Firstly, blockchain can keep a transparent and trustworthy record of the whole supply chain of the food industry and can enhance the reliability in tracing foods from farms to the consumer's table. This is particularly the case in developing countries such as Pakistan, where regulative measures in food safety and quality are instantiated as more blockchain will assist in enhancing the reliability of such products among consumers. Furthermore, since the information on the blockchain is almost undisputable, it can aid in reducing the occurrence of food fraud, for example, in cases where products are specially imported or when ingredients are mixed with something of lower quality, which is common in many developing nations where the standards of compliance and the ability to enforce the law might not be as high. Moreover, through using technology in the agriculture sector, the smallholder farmer in the developing country can be able to improve his/her access to markets for his/her supply chain data, thus being able to negotiate better prices as well as obtain financing and engage more in world trade (Ouma et al., 2020; Xiong, 2024). First, it will eliminate fabricant mediators that hold the control of supply chains and paperwork; Second, it can contract, rationalize and make supply chain, transaction, authentication, and validation faster and more reliable, thus increasing efficiency and decreasing cost, which is more appreciable in the developing countries where infrastructure and logistic problems are higher within firms. It also has the potential of increasing food security and safety through better tracking, showing customers or regulators the source and track record of food products to help quickly identify and address contamination issues faster as well as contain any crises (Lv et al., 2023; Cizakca, 2024).

Additionally, the technology can contribute to the process of sustainable working within agriculture sectors through the provision of validated data about organic or fair-trade products, which is highly relevant given the continuously increasing desire for such products in developing countries (Lezoche et al., 2020; Karim and Said, 2024). Based on these possible benefits, behavioral intention to adopt and operationalize blockchain in the food supply chain in the developing country setting, such as the case of Pakistan, may stem from the interest in addressing the existing problems, increasing supply chain trust and transparency, and creating value for the smallholder farmers and businesses.

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Nonetheless, the successful implementation of blockchain solutions will be largely associated with other attributes like infrastructure, legal policies, and digital maturity in the food sector (Martínez-Castañeda & Feijoo, 2023). In the food supply chain industry in the developing country context, some of the challenges noted include food safety, Food traceability and supply chain problems, which might be solved by blockchain. Food supply chain firms in developing countries need to understand factors that impact the behavioral intention of using blockchain technology, especially through the mediating attitude of the employees.

There are a few contributions to the present study. Firstly, past studies have provided an analysis of how previous works have investigated the direct relationship between perceived ease of use and perceived usefulness on behavioral intention to use blockchain technology, mainly in the service domain. Therefore, a study is needed to confirm the findings in the context of manufacturing, such as in food supply chain firms. Secondly, the mediating role of employee attitude in the context of FSC firms in developing countries, particularly Pakistan, has yet to be confirmed analytically in past studies within Pakistan. Thus, the estimation of this relationship will be helpful in shedding light on the factors that would define the technology acceptance in blockchain for the demonstrated industry in a developing country.

2. Literature Review

2.1. Theoretical foundation

Technological Acceptance Model (TAM) was applied to this study. It is used to identify specific determinants that motivate a person to adopt particular technological innovations. TAM indicates that perceived ease of use is the degree to which an individual supposes that using a certain technology or a certain system will be effortless and, in the present context, the extent to which employees in food supply firms suppose that using blockchain technology will be easy (Zaineldeen et al., 2020). Furthermore, according to TAM, perceived usefulness refers to the extent to which an individual will feel that using a specific technology or system will improve their performance (Tahar et al., 2020). At the same time, the proposed study entails the degree to which the employees of the food supply firms will consider blockchain technology as useful in their daily activities and its contribution to the smooth running of the companies. TAM also asserts that perceived usefulness is another significant factor that influences an individual's behavioral intent (To & Trinh, 2021). Therefore, this study seeks to establish the relationship between perceived ease of use and perceived usefulness towards the behaviour intention to use Blockchain technology among employees in organizations while assessing the mediating role of employee attitude.

2.2. Hypotheses development

2.2.1. Perceived ease of use

This study is based on the TAM model. This model suggests that perceived ease of use is one of the best indicators of a human being's attitude towards a certain technology since if they find that it is easy to understand, they are bound to develop a positive attitude and hence express a higher intention of using the certain technology in within firms. Furthermore, when the employees of the food supply chain in a particular industry are of the opinion that this type of technology is easy to use and gentle on the brain or the employees do not need to invest much effort (Grobelaar et al., 2021; Ibrahim & Rasheed, 2024). Similarly, in order to understand how to use the new tool and where and how to apply it, their perception of the technology will be positive. It will thus encourage employees to actively embrace the new technology in today's competitive business environment for long-term sustainability (Porath, 2023; Ruth, 2024).

However, it is also critical to understand that there are certain problems associated with the adoption of this technology within firms (Toufaily et al., 2021; Aydemir, 2024). The steps illustrated in this study suggest that the technical features associated with blockchain technology ease the perceived ease of use and decrease the behaviour intention of its employees in the food supply chain industry. Moreover, there is a negative attitude toward using technology, which users, especially those in the food supply chain, may need help understanding (S. Chen et al., 2021; Iqbal & Abbas, 2024). Besides, there are limitations in the organizations of food supply chains and developing countries are many such as organizational inactivity, resistance to change, competitors, and lack of time and resources that may overcome the perceived ease of use's positive attitude influence on employee behaviour and willingness to use blockchain (Mukherjee et al., 2023). Thus, following hypotheses suggested:

H1: PEU positively related to EA.

H2: PEU positively related to BIUB.

2.2.2. Perceived usefulness

The theory applied in the present study is the technology acceptance model (TAM), which suggests that perceived usefulness, which is the level of belief that an IT will enhance one's performance on the job or personal productivity, has a determinant influence on Technology acceptance within firms especially in developing countries (Garg et al., 2021). In addition, another best practice from the food supply chain industry is when the employees require the blockchain and find it has value and pertinence in their work setting. Then, they will willingly accept it for business operations. Furthermore, the perceived usefulness has a positive impact on the acceptance of blockchain technology among workers, which enhances their behavioral intention to use the technology (Kumari & Devi, 2023; Quader, 2024).

However, there are many problems to understand in this regard. It has been noticed that even if the analysed blockchain technique is rather easily considered to be mainly beneficial for the food supply chain firms, they could not implement this technique. The key reasons behind this are organisational culture, change resistance, starting new equipment, and education among employees. Therefore, they may reduce perceived utility and change employee attitude in such a manner that influences the behavioral intention to use. Thus, following hypotheses recommended:

H3: PU positively related to EA.

H4: PU positively related to BIUB.

2.2.3. Mediating Role of Employee Attitude

In the past, it was suggested that the food supply chain firms believed that blockchain technology was easy to adopt as it was easy to comprehend; hence, adopting the innovation could help change the attitude towards the chain (Friedman & Ormiston, 2022). As a result, it can lead to the positive behavioral intention of using blockchain technology as employees tend to use more applications that they have a positive perception of the employee. However, employee attitude can play a mediating role in the relationship between perceived ease of use and behavioral intention to use blockchain. Nevertheless, recent studies findings suggested that it could be a degree of perceived ease of use to which the enhancing impact of blockchain technology may be constrained by complexities that may only be easily understandable by highly skilled personnel and specifically, the food supply chain is unlikely to be plentiful in this manner in the long run (Taherdoost, 2022).

Moreover, another recent study suggested that those firms in the food supply chain find blockchain technology to be very useful for their activities, thereby creating a desire for the technology with them (Kayikci et al., 2022). In addition, this positive attitude may be reflected in a higher actual behavioral intention to use blockchain technology, and it is expected that individuals will interact more with a system to consider it useful and meaningful within a firm. Thus, by assessing the role of employee attitude, more knowledge on how to create and select applications based on the blockchain and achieve higher adoption rates can be obtained from researchers and practitioners in past studies (Toufaily et al., 2021, Akram et al., 2020). Thus, following hypotheses proposed:

H5: EA positively related to BIUB.

H6: EA mediates the relationship between PEU and BIUB.

H7: EA mediates the relationship between PU and BIUB.

3. Methodology

This paper is based on empirical research to test the factors that influence the behavioral intention to use blockchain technology in the food supply chain firm, which was determined by perceived ease of use, perceived usefulness, and the mediating role of employee attitude. Furthermore, the data was collected through a structured face-to-face of the employees working in middle and upper-managerial positions with the firms of the food supply chain. The sampling frame was developed from the list of employees in different categories sourced from the Human Resource departments of food supply chain firms in the region. Moreover, the overall target was to have 229 respondents participate in the survey. In the present study, the research instruments adopted from the past studies, which sources are discussed in the research instrument section below with references. All the responses received during the study were protected from disclosure to third parties in the following ways: The survey was conducted in a dichotomous format, with respondents receiving information about the purpose and objectives of the research. To ensure conformity to the principles of ethical and responsible research. Lastly, all items shown were added on a five-point Likert scale comprising strongly disagree (1), disagree (2), neutral (3), agree (4), and strongly agree (5) as the ideal scale nowadays.

3.1. Research instrument

The independent variable perceived ease of use five research items was taken from the study of (Giri & Manohar, 2023). Items are “I think operating blockchain for supply-chain activities would be easy for me, I feel that using a blockchain will make interaction with supply-chain activities easier, I think blockchain is a clear and understandable way to manage supply-chain activity, I feel blockchain technology will be easy to use for supply chain activities and I think it will be easy for me to become skilled in using blockchain in managing supply-chain activities”.

The independent variable perceived usefulness also five research items were taken from the study of (Giri & Manohar, 2023). Research items “Using blockchain would improve the performance of supply-chain activities, using blockchain will make it easier to manage supply-chain activities, using blockchain will probably enhance the effectiveness of supply-chain activities, using blockchain in supply-chain activities will allow me to perform effectively and Using blockchain for the supply chain will increase my efficiency”.

The mediating variable employee attitude also five research items were taken from the study of (Kamble et al., 2019). Items are “In my opinion, it is desirable to use BT, I think it will be good for the use BT, I guess using BT is a good idea, Overall, my attitude toward BT is favourable, will feel happy if my company implements BT”.

The dependent variable Behavioral intention to use adopted from research of (Giri & Manohar, 2023). Items are “I intend to use blockchain for managing supply-chain activities in the future, I intend to use blockchain for managing activities, I intend to use blockchain for the supply chain to gain experience in managing activities with a new form of technology, I anticipate the firm will use blockchain technology or an equivalent kind of technology to manage supply-chain transactions, If possible, our firm will use blockchain technology in the future and foresee that our firm will use blockchain in upcoming supply chain management activities”.

3.2. Software Tool

In the present study, SmartPLS version 3 was applied for many reasons. Firstly, a particularly important feature of Smart PLS is the analysis of multifaceted models containing several independent, mediating, and dependent variables. Also, it can examine the direct and indirect effects of the predictors on the variables or the effects of the variables on each other. Secondly, SmartPLS is believed appropriate in the context of the research with the given small to medium number of cases, as in the present study, 229 samples were considered. Lastly, SmartPLS allows for accurate estimation even if the number of cases is somewhat limited compared to what is possible with covariance-based SEM techniques, as suggested by past scholars.

4. Results and Discussion

4.1. Reliability and Validity

The reliability of the measurement can also be referred to as the internal reliability or the dependability of the data. It is interesting to know whether this measurement instrument (for instance, a questionnaire) will produce the same score if the same phenomenon

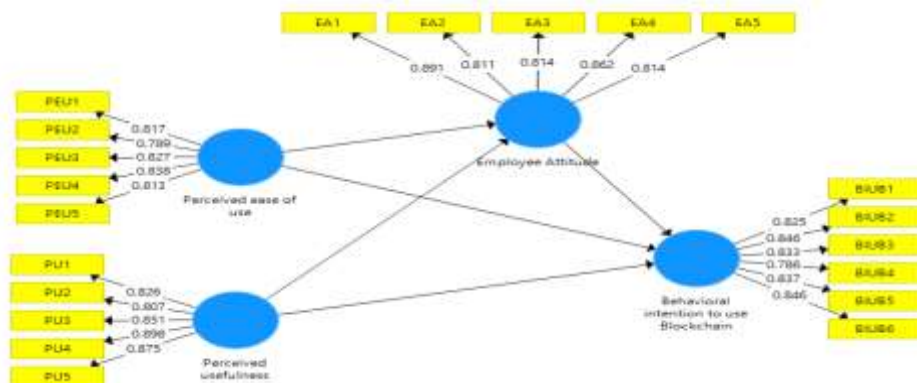
is to be measured at different times but under similar circumstances. That is, reliability is one of the broad categories of estimation that focuses on the extent and control of the conditions.

The reliability of scale can be determined through the value of Cronbach’s alpha and using the values of composite reliability (CR). According to a recent study, it is suggested that Cronbach’s alpha and CR should not be less than .70. It can be noticed in Table 1 that all variables’ alpha values are greater than the recommended value of 0.70 and range from 0.875 to 0.909. Furthermore, the researchers should have looked for the outer loading revealed by the individual items in their respective constructs. Therefore, all values indicated that the items have acceptable internal consistency with a mean value of 0.70 or above to his respective latent construct (See Table 1 & Figure 1).

Similarly, validity is used in different contexts and refers to the consistency of the measure; hence, the reliability of an instrument is high if the measurements are close or consistent in value. It is involved with obtaining accurate and truthful information that would be used to measure something such as perceived ease of use, perceived usefulness, employee attitude and Behavioral intention to use Blockchain. This is one study in which the researchers should have taken the time to estimate the overall average variance extracted (AVE) for each of the constructs being investigated. Thus, the recommendation for an appropriate AVE cutoff point discussed in the earlier sections is 0.50. All variables also qualify for the validity of the study, and values range from 0.667 to 0.726 (See Table 1). Therefore, with these aspects of reliability and validity incorporated, the researchers will be in a position to explain the quality of the measurement instruments used in the study and the level of accuracy of the data used in the conclusion.

Table 1: Reliability and Validity

Factors	Item SPSS coding	Items loading	Cronbach alpha value	Composite Reliability	Average Variance Extraction (AVE)
Perceived ease of use	PEU1	0.817	0.875	0.909	0.667
	PEU2	0.789			
	PEU3	0.827			
	PEU4	0.838			
	PEU5	0.813			
Perceived usefulness	PU1	0.826	0.905	0.930	0.726
	PU2	0.807			
	PU3	0.851			
	PU4	0.898			
	PU5	0.875			
Employee Attitude	EA1	0.891	0.895	0.922	0.704
	EA2	0.811			
	EA3	0.814			
	EA4	0.862			
	EA5	0.814			
Behavioral intention to use Blockchain	BIUB1	0.825	0.909	0.930	0.688
	BIUB2	0.846			
	BIUB3	0.833			
	BIUB4	0.786			
	BIUB5	0.837			
	BIUB6	0.846			



4.2. Hypotheses Testing and Discussion

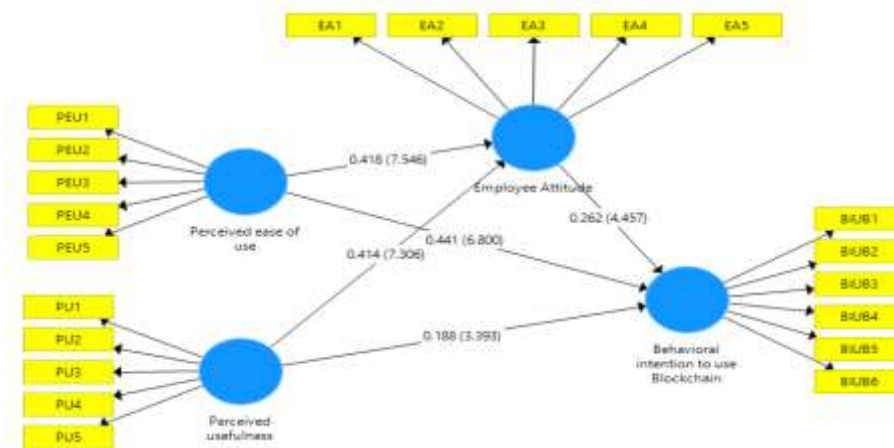
H1, confirmed a positive and significant impact of perceived ease of use on behavioral intention to use Blockchain in food supply chain firms of Pakistan. The Beta value of 0.441 t-value revealed 6.800 respectively (See Table 2 & Figure 2). Therefore, findings validate the claim made by the Technology Acceptance Model, especially on the perceived ease of use in regard to technology adoption. Similarly, this investigation is also aligned with past studies and the idea of the Technology Acceptance Model (TAM). A recent study suggested that perceived usefulness is an essential factor in influencing the usage of technology (Chen & Aklikokou, 2020). In this regard, when users believe that a specific technology is easy to use, they develop a positive attitude toward the use of the technology within firms.

H2, it confirmed a positive and significant impact of perceived ease of use on employee attitude to use Blockchain in food supply chain firms of Pakistan. The Beta value of 0.418 t-value revealed 7.546 respectively (See Table 2 & Figure 2). Therefore, the belief is that when individuals working in an organization see Blockchain technology as being easy to operate, they tend towards a positive attitude towards it within the firm. A recent study also suggested that it is very important because employee attitude has a great influence on the uptake and use of change in organizations, especially the adoption of technologies (Bankins et al., 2024; Saghafian et al., 2021). This supports the declarations of the TAM that perceived usefulness – that is, the extent to which a specific technology can increase a person’s productivity – is one of the most important determinants of the intention to use a particular technology.

H3, confirmed a positive and significant impact of perceived usefulness on behavioral intention to use Blockchain in food supply chain firms in Pakistan. The Beta value of 0.188 t-value revealed 3.393 respectively (See Table 2 & Figure 2). Therefore, this positive and significant correlation suggests that when employees feel that Blockchain is useful in improving their job performance and in the general food supply industry, their perceived usefulness in promoting a positive attitude towards the adoption of the technology is higher. It is also confirmed in light of the TAM that perceived usefulness influences the extent of the adoption of technologies. A recent study recommended that the employees’ ease in using Blockchain technology, or in other words, their perceived ease of using the technology, greatly enhance their attitude towards the use of Blockchain (Kumari & Devi, 2023).

Table 2: Direct effects and Indirect effect

Paths	Value of Beta	Standard Deviation	T-Value	Remarks
Perceived ease of use -> Behavioral intention to use Blockchain	0.441	0.065	6.800	Accepted
Perceived ease of use -> Employee Attitude	0.418	0.055	7.546	Accepted
Perceived usefulness -> Behavioral intention to use Blockchain	0.188	0.055	3.393	Accepted
Perceived usefulness -> Employee Attitude	0.414	0.057	7.306	Accepted
Employee Attitude -> Behavioral intention to use Blockchain	0.262	0.059	4.457	Accepted
Perceived ease of use -> Employee Attitude -> Behavioral intention to use Blockchain	0.109	0.029	3.836	Partial median
Perceived usefulness -> Employee Attitude -> Behavioral intention to use Blockchain	0.108	0.028	3.817	Partial median



H4, they confirmed a positive and significant impact of perceived usefulness on employee attitude to use Blockchain in food supply chain firms in Pakistan. The Beta value of 0.414 t-value revealed 7.306, respectively (See Table 2 & Figure 2). In this regard, for the Blockchain technology to be accepted by the employees in the organization, they have to consider it as being beneficial towards work and the organization so that they modify their attitude towards the use of the Blockchain. A recent study also suggested that if employees see it as having desirable consequences for their work and the organization, they are likely to have a positive attitude towards Blockchain technology adoption (Dehghani et al., 2022).

H5, it confirmed a positive and significant impact of employee attitude to use Blockchain in food supply chain firms of Pakistan. The Beta value of 0.262 t-value revealed 4.457 respectively (See Table 2 & Figure 2). Therefore, the result forms an important indication that it is critically important to understand the role that employee attitude plays in the actualization of the technology adoption process within firms. A recent study confirmed that self-organizing work teams positively impact receptor employees’ perception of attitude in relation to the behavioral intention to use Blockchain. Therefore, it supports the understanding that the intention to use the technology is a direct function of the employee’s attitude towards the technology and, more specifically, the favourable view employees hold towards it (Cetindamar et al., 2021).

H6 & H7, it also suggested the mediating role of employee attitude between perceived ease of use and behavioral intention to use blockchain use and between perceived usefulness and behavioral intention to use blockchain use. The Beta values of 0.109 and 0.108 t-values revealed 3.836 and 3.817, respectively (See Table 2 & Figure 2). Therefore, a partial mediation effect is confirmed. As shown by the results, perceived ease of use and perceived usefulness have significant direct effects on behavioral intention to use Blockchain and significant, though partially mediated, indirect effects through employee attitude. This means that the existing relationship between the perceived ease of use and perceived usefulness and the behavioral intention is not only direct but also mediately through the employee attitude.

5. Concluding Remarks

In this study, the proposed research model, which tested the impact of perceived ease of use and perceived usefulness both on behavioral intention to use Blockchain with employee attitude as a mediator, has also been confirmed by the findings of the study. This study confirmed that the test results demonstrated that all of the variables, including perceived ease of use, perceived usefulness and employee attitude, had positive and significant effects on Blockchain's behavioral intention to use. Therefore, this implies that the specificity of this study towards the food supply chain firms in Pakistan indicated that the perceived ease of use of Blockchain as a transformative technology is the most influential factor in the intention of employees to adopt the change. Furthermore, the study also emphasized the mediating role of employee attitude between the perceived ease of use as well as perceived usefulness and the measure of the dependent variable, which is the behavioral intention to use Blockchain. This study confirmed the indirect effects (partial mediation effect) of perceived ease as well as perceived usefulness on the Behavioural intention to adopt Blockchain through employee attitude.

5.1. Managerial Implications

These implications of blockchain technology are critical when food supply firms want to apply the technology in their organization. Firstly, it points out the fact that, for the Blockchain system to gain acceptance, it should be easy to use and be perceived as useful by end users. Therefore, it can be done with the help of user-centred design, initial and advanced staff training, and awareness of the potential benefits of technology. Secondly, the study also suggests an appropriate attitude towards work on the part of the employees as a key enabler for Blockchain implementation. Human resource departments of food supply firms should consider implementing the following measures to ensure employees adopt the new technology positively. Thirdly, employees should be engaged in the implementation process, the department should clarify their fears, and other stakeholders should show the employees the practical advantages of Blockchain in their operations and the success of the company. Lastly, with a focus on the technological and human elements of Blockchain adoption, food supply firms may enhance the odds of attaining value from its use and truly harness the potential of the new technology presented in supply chains.

5.2. Limitations and Future Research Directions

However, there are some limitations inherent in this study. Firstly, this work involved a cross-sectional research design that obtains information from the respondents at a given period only. More so, undertaking a longitudinal study would help capture the dynamic nature of the relationship between the variables, especially owing to the fact that Blockchain technology is still relatively young and would take some more time before being fully implemented across the food supply chain industry. Secondly, the sample size for this study was restricted to 229 self-generated questionnaires collected from the food supply chain firms of Pakistan. Despite the reasonable representation provided by the sample size, results may be influenced by a need for more variation in responses from firms under investigation; a broader sample that encompasses more organizations from various geographical locations or countries could improve the generalizability of the findings. Lastly, it is also important for this study to note that no moderating variables were included in the analysis that could affect the pattern and strength of connections between the main constructs. This leaves a good opportunity for further research where other factors like organizational culture, top management support, or industry characteristics play significant roles in understanding the dynamics of Blockchain adoption in more detail.

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