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REVIEW ARTICLE

# An overview of technology acceptance and adoption models in the aftermath of COVID-19

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## Abstract

**Purpose:** Technology adoption and its acceptance models have been investigated in different perceptions, encompassing various variables that suit the needs and requirements of the end user. It is important for the decision-makers, think tanks and the technology developers to assess the need, rationale and importance for the technology before its development and also plan to develop, market and make it reach the end user. During COVID-19, technology has heavily helped the global communities to stay connected, educate themselves, get medical help, conduct business, do governance, and develop ideas and many more. In this background, technology adoption and its acceptance, especially after COVID-19, needs to be investigated in detail. **Methodology:** Various factors tend to exert their impact on adoption as well as acceptance of the technology among the customers in terms of technological, personal, social, environmental and economic factors. The current study analyses various technology acceptance models (TAMs) in this research paper and its application in various domains such as education, healthcare, agriculture, Fintech, and security. **Findings:** The current review encompasses a brief discussion of the TAMs while it presented an overview of its applications in various domains, especially after COVID-19 pandemic. This paper has found knowledgeable insights about the impact of COVID-19 upon technology adoption since the pandemic has changed the way how people live, communicate, do business, and thrive. **Implications:** The study also lists out the scope for future studies due to the advancements in technologies and the increasing penetration of technology across the globe. The future studies must focus on advanced technology adoption models as per the ever-changing environment. Some of the potential application areas must be investigated in detail such as cloud computing, IIoT, artificial intelligence, block chain, virtual and augmented reality, machine learning, and deep learning techniques. **Originality:** Although various studies have reviewed technology acceptance and adoption models, the current study is a first-of-its-kind attempt in the aftermath of COVID-19.

**Key words:** COVID-19, Fintech, pandemic, perceived ease of use, perceived usefulness, technology acceptance model, technology adoption
**JEL Classification:** L24, M12

## INTRODUCTION

Technology plays a crucial role in bringing change across a number of domains (Ugochukwu and Phillips, 2018). Change offers new opportunities for the businesses to explore and meet their consumer's requirements while it also threatens the existing and established business models (Lai, 2017). The drastic growth of technologies and the

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disruption of digitization in almost all the industries depend on the acceptance of the customer, since "customer is king." It is important for the decision-makers to ensure that the technology is adopted to the extent as intended since technologies have failed to create an impact in the past (Rajesh and Rajhans, 2014). According to the researchers, technology adoption should not only be approached in the perspective of technology but also the user's attitude and personality (Venkatesh et al., 2014), how far they are socially-influenced (Ajzen, 1985), trust (Gefen et al., 2003) and other conditions (Thompson et al., 1991) too. Numerous factors tend to create an impact on the adoption and acceptance of technology among the customers in terms of socio-economic factors, technological elements, and personal preferences (Dissanayake et al., 2022) including the security (Taherdoost, 2018), convenience, cost, availability, expectations in terms of performance and efforts, social influence (SI) and the favorable environment (Venkatesh et al., 2003), type of the task to be executed, Information and Communication Technology environment at local and global levels and socio-cultural practices (Muriithi et al., 2016). Figure 1 shows the acceptance of technology in US households from 1860 to the year 2019.

Although various studies have reviewed technology acceptance and adoption models, the current study is a first-of-its-kind attempt in the aftermath of COVID-19. COVID-19 pandemic altered the way the businesses operate and it accelerated the adoption of technology among the consumers, organizations, governments, international forums, etc., (Bhookhun, n.d.). Remote working has become the norm while such a drastic technological adoption, adds importance to the current piece of research. With the evolution of new technologies that fulfill tomorrow's technological demands, customization, and digitalization of the products/service offerings for a wide range of audience

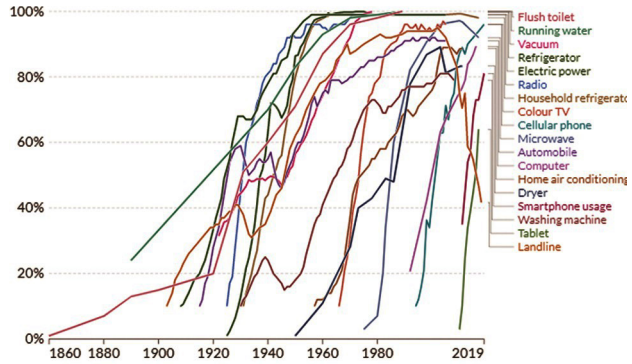


**Figure 1:** Share of US households using specific technologies, 1860–2019
Source: Ritchie and Roser, 2017

have become the new business trend. The scope of the current study has been limited to a specific domains such as education, healthcare, Fintech, security, and agriculture, the future studies are recommended to be conducted covering multiple domains and the acceptance of technology in it during and after COVID-19 in general.

## AN OVERVIEW OF TECHNOLOGY ACCEPTANCE AND ADOPTION MODELS

The acceptance of a technology is generally expressed as the intention of a user to utilize a technology (Şahin and Şahin, 2022). Technology acceptance is generally observed as an element that involves the user in the development of systems (Taherdoost, 2018). In the comprehensive review conducted by (Yadegari et al., 2022), the authors mentioned that it is crucial to understand the demands and the factors that impact the adoption or acceptance of the novel technology. In general, acceptance is defined as *"an antagonism to the term refusal and means the positive decision to use an innovation"* (Simon, 2001). The current section discusses various technology adoption models proposed earlier in brief.

Technology acceptance model (TAM) was conceptualized by Davis (1985) in the year 1985 with a purpose to describe an individual's behavior on the IT. While this TAM model was modified by multiple researchers in different instances. Davis considered perceived usefulness (PU) and perceived ease of use (PEU) in the modified TAM (Davis et al., 1989). While the former details about the probability of utilizing a specific computer technology to ease the user's activities, the latter denotes how far a technology is easy and effortless for a user uses it (Davis, 1989).

In 1991, Ajzen (1991) proposed the theory of planned behavior (TPB) in which the author mentioned that the attitude of an individual on a specific behavior and the subjective norms tend to create an impact on the behavior of the user. In addition to these, perceived behavioral control also plays a vital role upon a specific behavior. Triandis (1977) developed the theory of interpersonal behavior, as an amalgamation of theory of reasoned action (TRA) and TPB, in the year 1977 to describe how an individual exhibits their behavior toward a new technology. This model covers the aspects of personal emotions, social facets, personal habits, and facilitating conditions on behavioral change. In this model, the first stage explains the behavioral changes that occur as a result of the perceptions of an individual and the influences caused by the society. The second stage details about the factors for targeted specified behavioral

change such as affect, cognitive abilities, societal factors, and individual conceptions. Finally, the intentions toward a behavior, prevailing conditions and experiences are discussed in the last stage. In 1995, Taylor and Todd (1995) developed the Decomposed TPB based on three major parameters such as attitude, subjective norms and perceived behavioral control that create an impact on the behavioral intention and the adoption of technology. This theory is predominantly applied in educational sector, marketing and agricultural activities.

According to LaMorte (2019), Prochaska and DiClemente developed transtheoretical model to analyze the changes that occur among people in their health habits. The model was developed based on an individual's decision-making capability in terms of a change process, in line with the intentions of the individual. According to this model, changes occur in a cyclical manner and not instantly. There are six phases of change, as per the model says, such as precontemplation, contemplation, preparation, action, maintenance of action, and termination of the whole behavior. Diffusion of innovation theory was proposed by Rogers (1995) in which the author described about an individual's adoption behavior and how the organization adopts an innovation. According to this theory, various stages are involved before the adoption of a technology such as understanding, persuasion, decision, implementation, and confirmation. Further, this theory also segregated those people who are attempting to adopt the technology into five such as innovators, early adopters, early majority, late majority, and laggards.

Task-technology fit was proposed by Goodhue and Thompson (1995) in which it was stated that when there exists an excellent fit state between the expected performance of a task and the introduced technology, then it is easy for the technology to get adopted in a prevalent manner. This "good-fit" performance of the technology, if meets the expectations and requirements of the end user, it is highly likely to get adopted. Fishbein and Ajzen (1975) developed the TRA in which the authors discussed the factors that influence an individual's behavioral intention. Unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003) was proposed after analyzing the pros and cons of a total of 8 commonly-used technology acceptance and usage models. According to this model, the behavioral change of a user gets affected by four primary factors, namely, the facilitating conditions, SI, performance expectancy, and effort expectancy.

The TAM was revamped by Venkatesh and Davis (2000) in the name of TAM 2 in which the authors detailed on the reasons behind the user's perceptions about a technology and how it is beneficial for them. This model mentioned three phases in the adoption of a technology such as pre-implementation, 1 month post-implementation and 3 month post-implementation. This model primarily focused on the psychological assessment of the work expectations and how appropriate the technology will be, to meet the requirements. This model is considered to have a better explanation in both voluntary as well as involuntary environmental conditions. TAM 2 was further refined by Venkatesh and Bala (2008), in the name of TAM 3, with the introduction of factors that create an impact on PEU of technology. In this study, the authors considered individual factors that tend to create a difference among individuals, SIs, supportive conditions and the IT system characteristics to detail about the key variables, that is, PU and PEU. Parasuraman and Colby (2001) considered the extent of an individual in terms of technology readiness (TR) for adopting a new technology. According to the authors, TR can be defined as *"people's propensity to embrace and use new technologies for accomplishing goals in household and at work."* The model segregated the users into five categories such as explorers, pioneers, skeptics, paranoids, and laggards based on how the users perceive the technology introduced to them.

Bandura (1986) introduced social cognitive theory in the year 1986 in which the author considered social psychology as the basis for the adoption of technology. Three primary factors are detailed in this model to find out the behavioral change in a person such as the present behaviors or habits, cognitive factors or the mental ability, and the surrounding environment in addition to the societal effects. The model establishes a bidirectional interaction between the factors considered. The behavioral aspect considered in this model is similar to PEU factor, predominantly applied in other models as well. The personal factors are inclusive of personality, cognition, and demographic characteristics while the environmental factors include physical and societal ones.

## TECHNOLOGY ACCEPTANCE AND ADOPTION AFTER COVID-19

In the aftermath of COVID-19, the studies on Technology Acceptance and Adoption can be broadly classified as pre- and post-COVID. As shown in Figure 2, the digital technologies have experienced a drastic level of adoption to mitigate the spread of virus, save cost and time, leverage the available resources and so on. The current section discusses about how technology adoption and acceptance has been, in different fields, after COVID-19.

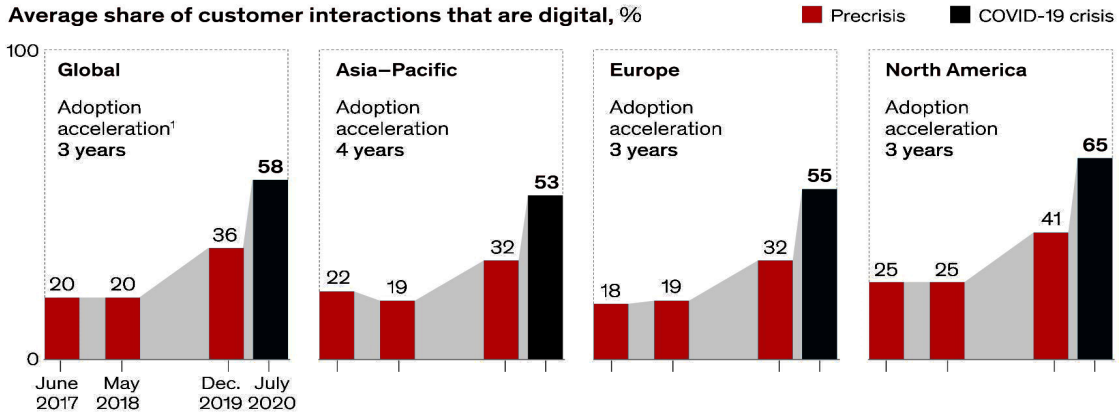


**Figure 2:** Digital customer interactions pre- and post-COVID-19 crisis
Source: McKinsey and Company, 2020

The acceptance of technology after COVID-19 influenced a number of technology-related factors such as efficacy in using the computer, mastery experience and self-learning of the users. Although technology was left as a choice prior to COVID-19, it has become the norm today in a number of fields such as healthcare, education, fintech, agriculture, governance, and businesses, to accomplish the day-to-day tasks (Ishaq et al., 2021).

Various studies (Clipper, 2020; Liu and Miguel-Cruz, 2022; McKinsey and Company, 2020; Saher and Anjum, 2021; Şahin and Şahin, 2022; Sahut and Lissillour, 2023; Valero and Reenen, 2021; Yuan et al., 2022) have emphasized the importance of technology adoption after COVID-19. The adoption of technologies during the period 2021 and 2022 are compared in Figure 3. In literature (Masud Rana et al., 2021), the authors analyzed the factors that influence the intentions of the citizens in terms of e-governance service adoption in public sector firms. This research work made use of UTAUT model and the authors found that the behavioral intention of the users is influenced by multiple factors such as quality of the website, internet experience, performance expectations, SI, and the facilitating conditions. The first two factors have been added newly by this research work.

## Education

In the study conducted earlier (Sadeck, 2022), the authors explored the original TAM and modified TAM constructs to get an overview on why teachers prefer technological to educate the students at primary and secondary levels after hit by pandemic. The study findings inferred that it is possible to challenge the unidirectional impact created by the PEU on PU with the help of a dispositional rationale.

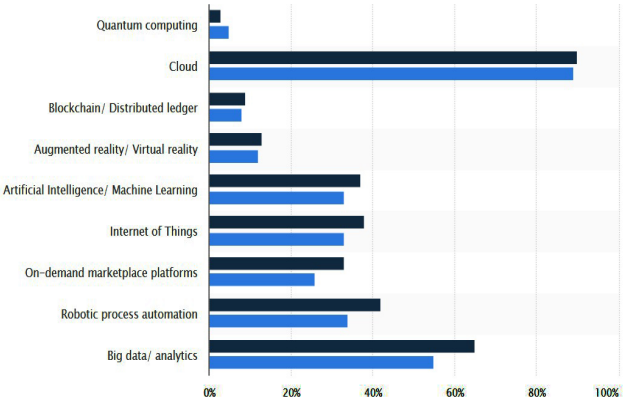


**Figure 3:** Adoption rate of the emerging technologies in global organizations in 2021 and 2022
Source: Sava, 2022

This study established that TAM provides enough flexibility which is a crucial factor in research community. In another study focused on teachers adopting technology, the authors (Şahin and Şahin, 2022) analyzed the data collected from 591 pre-school teachers from a state university. The study outcomes identified the presence of a strong relationship between competence and the PEU whereas "enjoyment" has been found as the crucial construct on intention. The study also found innovativeness has a mediating impact on the relationship mentioned earlier. In terms of technology acceptance, especially after COVID-19, both intrinsic as well as extrinsic motivation play key roles. In the systematic review conducted upon the advancement of TAM model through the pandemic, the researchers (Rosli et al., 2022) found some of the external factors such as self-efficacy (Bandura), subjective norms, experience, and enjoyment were applied frequently by the TAM researchers. The review found that task–technology fit and information system success models (ISSM) were

utilized as supplementary models for the TAM during the pandemic.

### Healthcare

In literature (Walczak et al., 2022), the researchers evaluated the acceptance of telehealth by the general practitioners in Poland during COVID-19 pandemic. This research work intended to explain the parameters that motivate the GPs to make use of the technology with the help of TAM model. The authors found that a significant positive influence was exerted by social (image, decision autonomy, and perception of patient interaction) and technological factors (PEU and PU) in the adoption of novel technology. The aim of the study (Tsai et al., 2021) conducted in Taiwan was to get an overview on the intention of the people to make use of the electronic personal health record platform and evaluate the parameters that impact their intention to make use of the platform. The study found that the behavioral intention of the respondents get heavily influenced by their attitude toward use, PEU, PU, and health literacy followed by privacy and security.

In literature (Krisdina et al., 2022), a hybrid model was proposed by the researchers as a combination of TAM and ISSM models to analyze the parameters that impact the acceptance of e-healthcare facilities by the users. The study found that enhanced care, PU, PEU, attitude, information quality, and satisfaction significantly impact the intentions of the users toward technology acceptance. In the study conducted earlier (Bernardo and Seva, 2022), an extended UTAUT model was adopted to formulate the Health Crisis Technology Adoption Model to investigate the parameters that impact the adoption of telehealth technology among senior citizens during COVID-19 pandemic. The study found that the factors such as low effort, support, motivation, perception of trust, saving time, and cost influence technology adoption in healthcare.

In literature, the authors (Sharma et al., 2022) analyzed the key parameters that impact the adoption of telehealth services by the patients. The researchers used TAM as a base and found that the intention of the users toward technology adoption is decided by various factors such as affordability, social norms, reliability, schemes, offers, hedonic motivation, and convenience. In the extended TAM based study conducted on telemedicine technology, the authors (Jing and Yang, 2022) analyzed the factors that influence the public decision to adopt to the technology after the pandemic. In this study, Partial Least Square approach was followed and the outcomes clarified that the attitude plays a significant and direct impact on continuous intention of the technology. Further, PU, PEU, satisfaction, and self-efficacy positively influence the technology adoption.

### Fintech

The adoption of technology in Fintech services has increased tremendously during the pandemic. Although this domain has already used technology before COVID-19, the upsurge in the prevalent application of the technology is fascinating. Fintech has grown not only in banking services, but also insurance, wealth and asset management, financial services and e-commerce (Asian Development Bank Institute, 2022).

In literature (Das and Das, 2022), the researchers analyzed the way how Fintech applications function, among the bank customers in Assam, India. The study analyzed the factors which influenced the adoption of Fintech services using the TAM model. The study found government support, trust, PU, attitude, and SI as the positive drivers of adopting Fintech technologies. However, the study also found that the perceived risks (PRs) heavily impact the trust on the technology. In literature, the authors (Puriwat and Tripopsakul, 2021) developed an Integrated Expectation-Confirmation and Health Belief Model (ECHBM) to detail about the adoption of contactless technology and its continuous usage even in the aftermath of COVID-19. The study was conducted among 142 respondents in Thailand and validated through SEM approach. According to the researchers, PU, perceived susceptibility, perceived seriousness, and satisfaction are the primary factors that significantly influence the continuous usage of this new technology. In comparison, the effect of perceived susceptibility was higher than the satisfaction factor.

With the help of enhanced TAM, the authors (Shahzad et al., 2022) analyzed the impact of factors that influence the behavioral intention among financial portal users. The investigation outcomes infer that the consumers' trust, PEU, and customer innovation make a substantial impact on the attitude of the users towards adoption of Fintech technologies. However, the study also concluded that there was no significant influence of PU on the attitude of the users toward technology adoption and the user's behavioral intention. In the study conducted earlier (Yan et al., 2021), UTAUT was used to analyze the role played by Mobile Financial Service platforms in building resilience during the pandemic. The study found that SI, perceived trust, and perceived value exert a strong influence on the user's intention to use (ITU) the technology whereas PR, performance expectancy, and

effort expectancy tend to influence the users' perceived value about the MFS platforms.

### Security

Technological disruption across the domains can be useful for the consumers, only if it is secure and ensure user privacy. There arise a necessity to secure the information systems of individual, organizational, and national levels from the cyber attackers. In this background, the literature (Abdalla et al., 2021) focused on the factors that create an impact on the acceptance of cyber security standards among the Malaysian public-listed companies. According to the findings, expected-related benefits and PEU exhibit significant impact upon the technology acceptance to ensure the cyber security standards. In the study conducted earlier, the authors (Brar et al., 2022) used extended TAM to develop a new cloud-centric IoT-based disaster management framework and also a multimedia-based prototype was developed with the help of real-time geographical images. The study considered PU, PEU, attitude, and behavioral intention and the results found that trust and PEU exhibit a medium level influence on the behavioral intention of the users on the technology. Although cryptocurrency has revolutionized the way, how economy works, there is still a lag in the acceptance of block chain-based cryptocurrency among the users. In literature (Sagheer et al., 2022), the impact of technology awareness on the behavioral intention of the crypto users through perceived factors (PEU, PU, and risk) was evaluated. The investigation identified that the perceived factors (such as PEU, PU, and risk) have a mediating role in the relationship between behavioral intention and technology awareness.

### Agriculture

The application of technology in the field of agriculture has a lot of advantages in terms of cost-efficient agricultural practices, less production costs, early diagnoses of the plant diseases, high yield, prediction of climatic conditions, pest control measures, etc. However, technology adoption in agriculture has been to a less extent.

In literature (Mohr and Kühl, 2021), the authors applied TAM as well as TPB models to evaluate the behavioral factors that create an impact on the adoption of Artificial Intelligence (AI) in agricultural practices. As per the outcomes, perceived behavioral control exhibits a notable impact on the behavioral intention of the consumers, in this case, farmer's personal attitude toward the artificial intelligence systems in agricultural practices. The researchers (Jimenez et al., 2021) attempted to validate the TAM extension model that was designed for FARMER 4.0 which was an e-learning application in the agricultural sector. According to the results, the quality of the content enacts a major role in the PU factor among the farmer's ITU the tool while experience (EXP) and self-efficacy (SE) also influence the perceptions about the PEU. In the review conducted by (Dissanayake et al., 2022), the authors detailed about the methods and theories in technology acceptance domain while the pros, cons and application areas of each model were also discussed in detail. In line with the Extended TAM2 model, the authors (Okoroji et al., 2021) conceptualized a model in which they analyzed the parameters that create an impact on the adoption of mobile applications for agricultural practices among smallholders. These mobile apps are highly helpful for the farmers to provide information on financial services, agricultural methods, access to markets, supply-chain, and so on. This study found that SI, PU, information/awareness (IA), and ITU exert a positive influence on the actual use of mobile applications whereas PR and perceived cost negatively impact the adoption of these mobile applications.

## DISCUSSION

The current review encompasses a brief discussion of the technology acceptance and adoption models and also detailed about a few domains in which the concept of technology acceptance has been extensively studied. According to (Billanes and Enevoldsen, 2021), ten factors exert a significant impact on the decision of the users to adopt to a technology such as *"knowledge, awareness, policy, SI, demographics, self-efficacy, trust, enjoyment, PR, and compatibility."* Alike other research domains, technology acceptance and adoption too have evolved in the aftermath of COVID-19 due to the heavy penetration of digital technologies. The acceptance of IIT (Intelligent Information Technology) based on artificial intelligence and advanced network communication systems has been investigated earlier (Park et al., 2022) in which the results infer that IIT's acceptance rate is high. Among the studied variables, "*voluntariness, positive image of the technology, performance expectancy, relative advantage, radical innovation, and experience of use"* are the most fascinating predictors that impact the acceptance of IIT. In the future, studies should be conducted focusing advanced technology adoption models since the environment has changed dynamically due to the advent of cloud and edge computing, industry 4.0, IIoT (Industrial Internet of Things), artificial intelligence, block chain, virtual and augmented reality, machine learning and automation, 5G/6G, bioengineering, clean and sustainable energy generation, Web3, etc., (McKinsey and Company, 2022).

## CONCLUSION

In this research paper, the authors made an attempt to understand the application of technology acceptance and adoption models after the COVID-19 pandemic. Although there have been studies conducted earlier in this domain, it is important to approach the domain after the pandemic since the latter has revolutionized the day-to-day activities across the globe, especially the functioning of the businesses. COVID-19, though threatened the very existence of human race, it also provided multiple opportunities to come back even better than ever. It is especially applicable for the adoption of technology in various domains that were never considered once, as a potential area of application, such as Fintech, telemedicine, e-learning, remote work, e-commerce, governance, and so on. The current study is limited in terms of its focus on overview about the technology adoption and acceptance models while the future studies must focus on domain-specific technology adoption so that the results can provide better insights about the customers' requirements to the decision makers, technology developers, governments, entrepreneurs, etc.

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## CONFLICTS OF INTEREST

This is to bring to your kind consideration that this research work has no conflicts of interest.

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