



Revolutionizing Indonesia's financial landscape: The impact of information technology on the growth of financial technology start-ups



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Abstract The revolutionary development of information technology has affected all aspects of human life, including finance, and has played a pivotal role in transforming financial transactions and creating new opportunities. This study aims to identify the revolutionary impact of information technology on the financial sector, especially in encouraging the birth of financial technology start-ups. The study was conducted qualitatively by collecting data from various relevant sources. The results of the study show that information technology has changed the way financial transactions are conducted, enabled the adoption of new financial innovations, and created new opportunities for financial technology start-ups in Indonesia. The increased accessibility, efficiency, and security provided by information technology have accelerated the growth of financial technology start-ups in Indonesia. The implication of this study is the need for support from the government and other stakeholders in creating a conducive environment for the growth of the financial technology sector in Indonesia.

Keywords: information technology, financial technology, financial services, growth, start-up

1. Introduction

Information technology plays a crucial role in the financial services industry (Hasan et al 2020). Information technology encourages the growth of financial technology for investment (asset management, securities trading), financing (credit, leveraged investment underwriting), protection (insurance, derivative hedging), and transactions in the financial sector (payments, cash management, securities exchange, clearing, and services assets). Advances in information technology can improve operational efficiency, service quality, and transaction security (Mosteanu et al 2020). Information technology can also intensify innovation in the digital financial industry (Gomber 2017).

Information technology is a significant resource for achieving the business vision and can dramatically drive innovation and play a crucial role in most economic activities (Haseeb et al 2019; Noor et al 2022). Information technology in business organizations will reduce costs, increase productivity, and reduce overhead demands for workers (Jasim and Raewf 2020). The emergence of technology-based financial services began with the laying of the transatlantic cable by the Atlantic Telegraph Company in 1866 to provide financial infrastructure and the introduction of the Automated Teller Machine (ATM) by Barclays Bank in 1967 (Burke 2021). The use of ATMs is a form of modern evolution in financial services.

The integration of technology in financial transactions has a positive impact on the financial services industry (Bilan et al 2019). It leads to (1) process automation, reducing manual labor and increasing efficiency; (2) lower information acquisition cost, making it more accessible and cost-effective; and (3) enhanced accessibility and efficiency, eliminating intermediaries and streamlining the production and distribution processes (Tham 2019). The increase in the use of information technology in financial services was reinforced by a study conducted by Google, Temasek, and Bain & Company entitled "E-conomy SEA 2019," where the valuation of the digital economy based on information technology in Indonesia in 2019 reached \$40 billion and is predicted to reach \$130 billion by 2025 (Google 2020).

The study shows a positive trend in the existence of this business sector as a means to create economic growth that can increase gross domestic product, which is supported by a large number of internet users in Indonesia. According to the findings of a survey conducted by the Association of Indonesian Internet Service Providers (APJII) during the 2021-2022 timeframe, the number of internet users in Indonesia reached 210.03 million. The survey also revealed that the highest proportion of internet users belonged to residents with a monthly income ranging from IDR 5 million to IDR 15 million, with a



penetration rate of 96.83 percent (Bayu 2022). The high number of internet users in Indonesia is a supporting factor for the use of information technology as a basis for increasing the national economy by growing start-up financial technology.

The topic of fintech start-ups has not been thoroughly explored (Anagnostopoulos, 2018). A study by Giaretta and Chesini focuses on fintech start-up financing, but only in developed countries and not in developing countries (Giaretta and Chesini 2021). Hence, this study aims to examine the impact of information technology on fintech start-ups in Indonesia, in the context of the global growth of fintech start-ups. Globally, 305 million start-ups are launched each year (Get2Growth 2020). The United States has the most start-ups in the world, with 71,153, followed by India with 13,125 start-ups, and the UK ranks third with 6,220 start-ups. Of all start-ups, 7.1% run business activities in the fintech sector, 6.8% are in the life sciences and healthcare sector, and 5.0% are engaged in artificial intelligence (Minaev 2022). As of January 2023, these numbers have increased, with the number of start-ups in the United States rising to 72,560, India to 13,905, and the UK to 6,396 start-ups (Ruby 2023). Fintech companies are typically high-tech start-ups or established financial institutions that have evolved into new business models, leading to an increase in the number of fintech start-ups over time (Hornuf and Haddad 2019).

This study is urgent because start-ups have multiple effects on the economy (Li et al 2020). Start-ups play a crucial role as intermediaries in providing networking services, financial support, and training initiatives to individuals and entrepreneurs, thereby contributing significantly to the development of entrepreneurship. The existence of start-ups is vital for the nation's economic growth and many benefits, such as creating job opportunities and creating innovation, so that it has a positive impact on economic growth and helps overcome social problems caused by income inequality and poverty (Kee et al 2019). The rise of start-up financial technology based on information technology will help realize social welfare for the community as a state goal stated in the preamble of the 1945 Constitution.

2. Material and Methods

This research attempts to answer the question of how the existence of information technology can encourage financial technology start-ups in Indonesia. For this reason, according to McCusker and Gunaydin, this study is classified as qualitative descriptive research with literature data as the primary data source. (McCusker and Gunaydin 2015). The research gap was obtained by comparing information technology developments and the number of fintech start-ups in Indonesia registered with the Financial Services Authority. Technical data collection is done through document or literature study, including official documents published by state institutions, articles, and other scientific works (Noor 2023). Literature study is one of the data collection techniques in qualitative research (Gill et al 2008). The data analysis process involved qualitative methods, following the classification of the data. The analysis encompassed several stages, including data reduction, data presentation, and drawing conclusions.

3. Results and Discussion

3.1. The Existence of Information Technology in Financial Technology

Information technology has an impact on all aspects of human life, including education, health, manufacturing, government, transportation, communication, financial services, and more. Information technology is defined as the combination of information, which is a signal or character representing data, and technology, which refers to the methods and processes used to complete tasks (Merriam-Webster 2023a). Information technology is a means of conveying information, represented by signals or characters, through the use of technology. According to Tan et al., information technology refers to the utilization of various tools related to information and communication technology, including computer networks, software, and hardware, which are essential for establishing internet connectivity (Tan et al 2009). In essence, information technology involves the application of technical means to communicate data through computer hardware and software connected to the Internet to increase productivity for both individuals and organizations (Dalleh et al 2020). It is expected to serve as a tool to aid work, improve productivity, and enhance efficiency across all aspects of life, including financial services.

The use of information technology in financial services will have a positive impact on financial service provider companies, including minimizing costs, product development (service improvement, creation of new services, and product differentiation), marketing tools, assisting in decision-making, and expert systems based on intelligent computer programs or artificial intelligence (Noor et al 2021; Anderton 1995). The positive impact of information technology in financial services will create various kinds of innovations in financial services through the development of information technology itself.

Several types of information technology are commonly used in fintech start-ups. In fintech start-up payment systems, the technology used includes QR Codes, both static and dynamic, as well as near-field communication (NFC) and blockchain technology (Latifah 2019). In addition to the aforementioned three types of technology, fintech start-ups also leverage other technologies such as cloud computing, mobile phones, artificial intelligence, machine learning, and blockchain/distributed ledgers. These technologies enable the seamless provision of financial products or services to customers, ensuring convenience and accessibility across various devices and locations (Tania Ziegler et al 2021). Apart from using these

technologies in the operations of fintech start-ups, they also use other technologies according to developments in information technology and the needs of fintech start-up companies.

3.1.1. Quick Response Code (QR Code)

QR Code is a two-dimensional matrix technology that uses a grid of black modules on a white background to store thousands of bits of information, designed to be scanned by smartphones (Tiwari 2017). QR codes can store up to 7,089 digits and 4,296 alphanumeric characters, including letters, punctuation marks, and mathematical symbols (Suryaningrum 2022). QR codes were first introduced by Denso Wave in 1994 and were initially used for tracking vehicles in the Toyota car industry in Japan (Soon 2010). With the advancement of information technology and mobile technology, QR Codes became widely used in 2011. They can hold a variety of data, such as text, URLs to websites or videos, map coordinates, and telephone numbers (Teuta Cata 2013).

There are two kinds of QR codes, namely, static and dynamic (Deineko et al 2022). A static QR code contains a link on a web page that is fixed and cannot be changed. QR Code is suitable for applications that generate many codes, such as those used for merchant IDs. Meanwhile, the dynamic QR code contains a short link that redirects to another homepage and can be repeated. This QR code is used in payment services. A dynamic QR code is used during a transaction, where the merchant can enter the nominal value based on the transaction value, allowing the QR code to be unique for each transaction.

In Indonesia, to use the QR codes in financial services, especially payments, one must obtain permission from Bank Indonesia, the regulator, and the supervisor of the payment system. To create legal certainty in the use of the QR Code in payment traffic, Bank Indonesia issued Regulation of Members of the Board of Governors No. 21/18/PADG/2019 concerning the Implementation of the National Standard Quick Response Code for Payments. The standardized QR code is called QRIS (Quick Response Code Indonesian Standard), which brings together various QRs from various payment system service providers, including GoPay, OVO, Dana, ShopeePay, WeChatPay, and Uangku. To maximize the use of QRIS, on January 1, 2020, Bank Indonesia obliged all noncash payment service providers to use the QRIS system. The application QRIS uses two models, the customer-presented model and the merchant-presented model. In the customer-presented transaction model, the buyer makes the payment by showing the QRIS to the merchant. In the merchant-presented model, the merchant displays his QRIS to the buyer.

The number of QRIS users has increased significantly from year to year. In 2021, the number of users was only 11.5 million, but in October 2022, the total number of QRIS users reached 25.2 million people with a transaction value of IDR 29.7 trillion, an increase of 298% compared to the previous year. In terms of merchants receiving QRIS, in 2022, the number will reach 21.6 million entities with a total transaction volume of 281.7 million times, an increase of 182% compared to the previous year (Dewi 2022). The high number of users and volume of QRIS transactions show that QRIS' presence as part of information technology has driven the growth of fintech start-ups.

3.1.2. Near Field Communication (NFC)

NFC is a technology that can transmit information digitally over short distances, such as between smartphones and other devices, via radio waves (Merriam-Webster 2023b). NFC operates at a frequency of 13.56 MHz and facilitates communication between either two active devices or an active device and a passive device. Active devices are powered by batteries, while passive devices draw energy from the electromagnetic fields generated by active devices. In NFC, communication is always established between the initiator and the NFC target (Dominikus and Aigner 2007), without using the Internet. This technology was developed by Philips and Sony in 2002 and combines radio frequency identification (RFID) technology with interconnection (Zardecki and Pendleton 1989). NFC technology facilitates seamless wireless communication over short distances among various devices, including mobile devices, personal computers, consumer electronics, and smart objects such as NFC tags, NFC readers, and other NFC-enabled mobile phones (López-de-Ipiña et al 2007). NFC technology provides a simple solution for its users to exchange information, access content, and access services in an intuitive, touch-based way (Bravo et al 2008) This NFC technology is beneficial because it does not require much power and has fast connectivity.

In application, NFC technology only operates in a short distance or less than ten centimeters. NFC-enabled devices facilitate data transfer through three distinct modes: First, in the read/write mode, NFC-enabled smartphones act as the active component, establishing an interaction zone with passive tags. Second, in peer-to-peer mode, NFC-enabled devices enable users to exchange information directly between their devices. Last, in card emulation mode, NFC devices function similarly to tags, allowing them to be used for digital payment services via smartphones. By bringing the receiving device in close proximity, transactions can be initiated seamlessly (Hamzah et al 2019). NFC-enabled mobile payments enable the exchange of information between consumer smartphones and merchant point-of-sale terminals simply by touching or waving the mobile device in close proximity to the terminal. This seamless interaction allows for convenient and secure transactions between consumers and merchants (Chen 2008).

The existence of NFC technology not only saves time to complete payments because it is done in 15 to 30 seconds but also allows a two-way exchange of information. This makes NFC a fast and secure mobile payment adoption model without an internet connection. In Indonesia, people's interest in using NFC technology as a basis for mobile payments is very high (Ariansyah 2015). Evidence of this is the adoption of NFC technology on TCash (Tarigan and Sadeli 2022). In 2018, TCash (which changed its name to LinkAja in 2019) was recorded as the most widely used electronic money application in Indonesia, with 15 million users, followed by GoPay, with 5 million users (Databoks.katadata.co.id 2018). These facts show that NFC technology plays a role in increasing the development of mobile payments, which then affects improving the people's economy.

3.1.3. Blockchain and Distributed Blockchain Ledger

Blockchain technology has had a major influence on the development of start-up financial technology. As evidenced by the numerous definitions of blockchain (Wamba et al 2020), there is no unified view when defining this technology. According to one definition put forward by Victoria Louise Lemieux, "Blockchain is a distributed transaction database in which different computers called nodes work together as a system to store a series of bits that are encrypted as a unit or block and are then linked together" (Lemieux 2016). There are several keywords that indicate the meaning of blockchain, including "distributed or decentralized ledger," "trust, security, and transparency," "blockchain," "peer-to-peer," "Bitcoin or cryptocurrency specific references," "disruptive technology," "transfer of value," and "infrastructure" (Rutland 2018; Hawlitschek et al 2018; Sun et al 2018; Scott et al 2017; Cai and Zhu 2016; Hassani et al 2018; Ivaschenko et al 2016; Beck et al 2017).

The term "blockchain" is sometimes interchanged with the term "distributed ledger technologies" (Halaburda 2018). This is because blockchain is a special form of distributed ledger that has the prominent feature of a transaction database that is shared with network members and can be updated by consensus by recording timestamps using unique cryptographic signatures that can be preserved in audit history and can be audited for all transactions (Swan 2017). From a financial and economic perspective, blockchain is a software network protocol that makes it possible to transfer money, assets, and information securely via the Internet without the need for third-party intermediaries (Swan and de Filippi 2017).

The use of blockchain technology in financial and economic activities has evolved from blockchain 1.0 to blockchain 2.0, followed by blockchain 3.0 (Swan 2015). Blockchain technology 1.0 is the beginning of using blockchain as a tool for decentralizing money and payments. Lendra Capital calculates and maps the various potential uses of blockchain technology in different fields, including finance. In finance, blockchain technology is applied to currencies, private and public equity, bonds, derivatives, commodities, mortgage/loan records, service records, crowdfunding, and microfinance (Lendra Capital 2014). Blockchain 2.0 is the second level of blockchain technology related to market decentralization. The use of blockchain 2.0, among others, refers to the emergence of Bitcoin 2.0, the Bitcoin 2.0 protocol, smart contracts, and smart property. Several projects developed based on blockchain 2.0 technology, among others, were carried out by Ripple (<https://ripple.com/>), Mastercoin (<http://www.mastercoin.org/>), and BitShares (<http://bitshares.org/>). Blockchain 3.0 refers to blockchain applications in government, health, science, literacy, culture, and the arts (Swan, 2015). Blockchain technology has a transformative impact on the progress of financial technology by creating various types of products, increasing the efficiency of financial services, providing convenience, and reducing risks in finances based on information technology.

3.1.4. Cloud Computing Technology

Historically, cloud computing differed from other information technologies in that it was a service-building block focused on service delivery. For this reason, "cloud computing" is an umbrella term for anything that involves the delivery of hosted services over the Internet (Attaran and Woods 2019). The internet is the primary means of connecting cloud computing stakeholders, whose existence enables the delivery of information technology resources (such as server applications, storage, databases, networking, software, and analytics) to users via network infrastructure (Odun-Ayo et al 2018). The term "cloud" refers to data stored through these activities online, not on a computer's hard disk. Meanwhile, "computing" is defined as computer-related activities that involve processing or storage (Bordonaba-Juste et al 2020). Services such as sharing computing resources between multiple computers on a network or providing remote hosts on a network are forms of cloud computing.

This internet-based and highly accessible technology greatly benefits organizations because it reduces IT resources and time spent managing them, especially for small businesses or start-ups. Research shows that small businesses can save up to 70% of their IT budget if they transfer their IT organization to the cloud, which also provides data backup in case of failure (Singh et al 2010). Cloud computing affects the financial dimension, internal processes, learning, and growth (Chang et al 2021).

Cloud computing is a tool to increase company growth because it can connect with various business factors. Five things encourage cloud computing to provide maximum benefits: increased global collaboration, reduced opportunity costs, scalability, access to the global market, and access to international venture capital (Ferri et al 2020). The use of cloud computing technology will increase flexibility, be cheaper, reduce costs that are not fixed costs, and improve service and

support for customer acquisition (Attaran and Woods 2019). These factors can improve performance and show that cloud computing provides great benefits to companies.

3.1.5. Smartphone Technology

Smartphones are one of the new information technologies that have an influence on human life in the current era. In the past, telephones were only used to make calls, but as technology advances, telephones can not only be used to make calls but can also be used to make video calls, access the internet and browse the web, take photos, upload them to the web, playback music and videos, and so forth. In the business world, its existence determines the success of the company, so if it is not used, it will be a factor inhibiting its success (Dillon and Morris 1996). In an era of rapid technological change, such as smartphone technology, information technology plays a significant role in determining user needs and reducing business risk. Smartphone technology, according to experts, is a critical evolution in information technology that benefits all stakeholders by improving products and services and meeting consumer expectations (Aldhaban et al 2015).

According to Kaplan, a smartphone is a handheld computer capable of performing many additional functions in addition to making calls (Kaplan 2012). Smartphones can perform many functions, such as a computer that has a touch-screen interface, can access the internet, and can run applications. Thus, a smartphone is a personal device owned by one user with multipurpose benefits equipped with an internal processor, GPS sensor, camera, microphone, speaker, and screen. The ability of smartphones to run various kinds of applications and be used according to the wishes of their users has made smartphones grow well in all corners of the world. In 2022, Indonesia will become the fourth-highest smartphone-using country in the world, with smartphone users reaching 192.15 million, below the United States with 249.29 million users, India with 647.53 million users, and China with 910.14 million users (Sadya 2023).

In Indonesia, the presence of smartphones as a base for digital banking transactions is growing well. In 2022, it grew by 28.72%, worth IDR 52,545.8 trillion, and is expected to grow by 22.13% in 2023, worth IDR 64,175.1 trillion (Asmaaysi 2023). The data show that smartphone technology has facilitated millions of people in Indonesia to conduct financial transactions conveniently.

3.1.6. Artificial Intelligence

Artificial intelligence (AI) technology is one of the most monumental inventions of this century, as it can duplicate human intelligence that can think and even act (Hassani et al 2020; Makridakis 2017). The basic structure of this technology is built using various algorithms, data, and computing power (B. Li et al 2019). The algorithms used include decision trees, neural networks, and machine learning. Data are the main ingredient that drives AI technology. Algorithms use data to learn and make decisions while computing power processes and analyses large amounts of data. The development of hardware such as graphics processing units (GPUs) and cloud computing further enhances the progress of AI technology.

This technology originated from the idea of Alan Mathison Turing, a British mathematician and computer scientist who, in the 1950s, proposed the concept of machines that can think and learn like humans (Mijwel 2015). The term AI officially appeared at the Dartmouth Conference held in 1956 (Nazihovna and Reakt 2022). In its early days, this technology only focused on developing programs that could mimic human intelligence, such as the ability to play chess and solve problems related to mathematics. However, with the advancement of computer hardware and big data technology, AI can now perform a wide range of human-assigned tasks with high accuracies, such as recognizing images, voices, and human data, and has a significant impact on various fields of human life, such as healthcare, customer service, and financial services (Makridakis 2017).

AI in financial services will make it easier for financial service providers to serve their customers, such as providing AI-based chatbots and virtual assistance. In addition, AI can also be used to recognize consumer behavior, make informed investment decisions, develop products and services, and provide tools for back-end process automation, such as fraud detection engines, to improve compliance and risk management. Such AI capabilities will reduce costs and increase the accuracy of tasks that would otherwise be performed by human labor. For this reason, Indonesia established the National Artificial Intelligence Strategy 2020–2045 in 2020 (BPPT 2020). The International Data Corporation Asia-Pacific states that by 2022, the most aggressive industries in adopting AI include banking, government, manufacturing, and retail. The most common use cases are fraud analysis, business innovation and automation, product recommendations, public security, and virtual customer service agents (International Data Corporation 2022). These data show that AI technology affects the financial services industry and has the potential to develop in the future.

3.1.7. Machine Learning

Machine learning (ML) is a part or subfield of artificial intelligence (AI) that focuses on creating algorithms that can learn from and make predictions on data. ML systematically applies algorithms to synthesize fundamental relationships between data and information. ML and AI are related but distinct. ML provides the mathematical basis for AI, enabling it to imitate human behavior. AI uses language comprehension and conversational capabilities to continually improve through

experience, assisted by machine learning algorithms. Thus, similar to humans, machine learning uses data to develop the ability to carry out more advanced tasks. Arthur Samuel defined machine learning as the discipline that enables computers to learn without being explicitly programmed (Alzubi et al 2018; El Bouchefry and de Souza 2020). Machine learning, according to Tom M. Mitchell, is "a computer program that improves its performance on tasks T, as measured by performance measure P, through experience E" (Mitchell 1997). Based on these definitions, machine learning, as a field within artificial intelligence, focuses on developing algorithms that have the capability to learn from data and utilize that knowledge to make accurate predictions and decisions. This is achieved by utilizing statistical models and algorithms to examine large amounts of data, uncovering patterns and relationships, and allowing machines to learn and make decisions or predictions without explicit programming.

ML is familiar in everyday life, including searching for information about weather forecasts, searching for info on Google services, and determining which emails are worthy of entering the inbox and which are spam and do not need to be considered examples of ML work in everyday life. Mohri et al. argue that machine learning is a computational technique that utilizes historical data to improve its ability to perform positive tasks or make more accurate predictions (Mohri et al 2018). With these capabilities, in the financial field, ML technology can detect fraud and analyse large transactions at once, as well as learn about a person's typical spending patterns. If an unusual transaction occurs, it will be rejected and indicate potential fraud. In addition, ML can minimize financial risk through credit scoring, insurance underwriting, and portfolio optimization (Mashrur et al 2020). In Indonesia, ML technology is used by Grabkios, among others, to run the business activities run by Kudo Digital Solutions (Diantika and Firmanto 2019).

Information technology can offer several advantages to financial technology companies. However, these technologies do not guarantee success, and the "struggle" does not end with the use of new technologies. Entrepreneurs must use new technologies as tools, embrace innovation and new ideas, and approach success.

3.2. *The Growth of Financial Technology Start-Ups in Indonesia*

Information technology has significantly impacted the modernization of financial services, enabling them to be conducted efficiently and quickly. The growing utilization of technology in the financial sector has increased the possibility of businesses using it to provide financial services to customers. This integration of financial services and technology is referred to as "fintech." According to Burke, the 2008 global financial crisis contributed to the rise of fintech by diminishing confidence in traditional financial services, leading to the emergence of new financial start-ups that offer services and products previously monopolized by banking institutions (Burke 2021). The advent of smartphone technology, such as the iPhone, has also encouraged the growth of fintech.

The origin of fintech has a long history, stemming from technological advancements that started in developed countries. Hazik Mohamed and Hassnian Ali claim that fintech has undergone four stages, fintech 1.0, 2.0, 3.0, and 3.5 (Mohamed and Ali 2019). Fintech 1.0 (1866-1987) saw the introduction of Morse code in the banking industry through telegraph technology (C2FO 2021). The shift from analog-based to digital-based technology marked the fintech 2.0 era in 1988-2008 (Nicoletti 2020). The emergence of various financial services and fintech start-ups is propelled by advancements in information technology, particularly in fintech 3.0. This era is characterized by the rapid development of technologies such as artificial intelligence (AI), big data databases, distributed computing, cryptography, and mobile internet access, which have paved the way for innovative financial solutions and applications (Altan and Hatipoğlu 2020). Fintech 3.5 represents a significant shift where the boundaries between fintech and traditional banking are becoming increasingly blurred, and digital service platforms are taking center stage. This transformation is driven by the adoption of blockchain networks and the integration of NFC (near-field communication) technology in mobile payment systems. These advancements have paved the way for more seamless and secure financial transactions, redefining the landscape of financial services (Ratecka 2020). These facts show that fintech has come a long way and is strongly influenced by technological developments. Fintech will continue to grow and develop in the future following technological developments that have affected all aspects of human life.

The growth of fintech is influenced by technological advancements. Six types of fintech activities are identified in the US Fintech Market Report by René M. Stulz, including payments, digital lending, digital banking, digital investment management and personal finance, blockchain, and insurtech (Stulz 2019). Lee and Yong Jae Shin also recognized six fintech businesses: payments, wealth management, crowdfunding, lending, capital markets, and insurance services (Lee and Shin 2018). In Indonesia, fintech services are referred to as "digital financial innovation (IKD)." According to POJK.02/2018 issued by the Financial Services Authority, IKD (Digital Financial Innovation) refers to the transformation of business processes, models, and financial instruments to deliver innovative value within the financial sector using digital technology. It encompasses a wide range of activities, such as transaction settlements, capital mobilization, investment management, fund distribution, insurance services, market facilitation, digital financial support, and various other financial activities.

Based on the definition and scope of IKD (Information Technology-based Digital Financial Services), various financial services leveraging information technology are classified as IKD. The Indonesian Financial Services Authority (OJK) has identified sixteen categories of fintech companies that offer either financial or nonpayment financial services, such as aggregators, financial planners, blockchain-based platforms, innovative credit scoring providers, online distress solution

providers, Regtech firms, insurance broker marketplaces, tax and accounting platforms, insur-tech companies, property investment management platforms, E-knows your customer platforms, and wealth-tech firms. All fintech start-ups fall under the regulatory and supervisory oversight of the OJK.

The fintech industry in Indonesia is flourishing. According to data from the Indonesian Fintech Association (AFTECH), established in 2016 as the representative association for innovative digital financial service providers, as of April 3, 2022, there were 314 fintech start-up companies operating in the payment, lending, investment management, and business information sectors (AFTECH 2022). It should be noted that these data include both registered and unregistered fintech start-ups with the OJK. Furthermore, the OJK has categorized fintech start-ups into different types, as illustrated in the following table:

Table 1 Types of fintech start-up in Indonesia.

No.	Type of Fintech Start-Up	Total
1	Aggregator	31
2	Credit Scoring	19
3	E- KYC	6
4	Financial Planner	5
5	Financing Agent	8
6	Funding agent	2
7	Insurance Hub	1
8	Insurtech	2
9	Online Distress Solution	1
10	Property Investment Agent	1
11	Regtech-PEP and Regtech E-Sign	3
12	Tax and Accounting	2
13	Transaction Authentication	6
14	Wealth Tech	1
15	Fintech Lending	102
16	Securities crowdfunding	10
Total		200

Source: Processed Primary Data, 2023

In addition to the types of fintech start-ups mentioned earlier, there are also fintech start-ups that focus on payment systems, known as e-payments. Bank Indonesia reported that in July 2022, the value of transactions using electronic money reached IDR 35.51 trillion. This figure shows an increase of 9.22% compared to the previous month, where the transaction value reached IDR 32.51 trillion. The total value of shopping transactions with electronic money in July 2022 was also higher than that in the same period in the previous year, reaching IDR 25.39 trillion. Meanwhile, the volume of shopping transactions using electronic money in July 2022 reached 606.96 million, an increase of 6.81% compared to June 2022, which reached 568.26 million. When compared to the same period in the previous year, the volume of transactions using electronic money in July 2022 increased by 46.16%. In terms of credit card transactions, in July 2022, the transaction value was recorded at IDR 26.43 trillion, a decrease of 0.71% compared to the previous month, which reached IDR 26.62 trillion. Meanwhile, the value of debit card transactions in July 2022 reached IDR 712.99 trillion, an increase of 12.95% compared to the previous month, which reached IDR 631.22 trillion (Jayani 2020).

The development of financial technology start-ups must be facilitated and supported by policymakers by creating a good ecosystem, including legal certainty and protection for users, without which both fintech start-ups will not be able to grow properly. In fact, fintech start-ups have great potential for helping national economic growth through job creation and easy access to capital. A conducive ecosystem is a must for fintech start-ups to thrive and become a driver of national economic growth.

4. Final Considerations

The information technology revolution in Indonesia's financial landscape has had a major impact on the growth of financial technology start-ups. The transformative power of technology, coupled with a supportive regulatory framework and



collaboration, has the potential to revolutionize the financial sector, foster financial inclusion, and drive economic progress in Indonesia. Continued efforts to attend to the financial technology ecosystem and provide a supportive regulatory environment will be critical to sustaining the growth and impact of financial technology start-ups in Indonesia.

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Ethical Considerations

Not Applicable.

Conflict of Interest

The authors affirm that they have no conflicts of interest to disclose.

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