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## TECHNOLOGY QUALITY MANAGEMENT OF THE INDUSTRY 4.0 AND CYBERSECURITY RISK MANAGEMENT ON CURRENT BANKING ACTIVITIES IN EMERGING MARKETS - THE CASE IN VIETNAM

**Abstract:** Industry 4.0 and digital technology has been affecting banking activities in most of bank system in emerging markets, esp. in Vietnam, one of the countries having high economic growth in ASEAN nations; so, quality management of technology issues and cyber security management are rising. There are main technologies in 4.0 revolution to process information including: Big Data database technologies, Cloud Computing, Machine Learning, IoT, AI, Business Intelligence, Data Mining and Blockchain Technologies. These technologies are successively implemented in developed and improved security procedures IT and cybersecurity risk management. Also changes to the operating environment IT can occur suddenly and without warning, such as under the COVID-19 international emergency. As the critical sector financial is adapting to expanded remote operations, there is the potential for increased vulnerabilities and potential amplification of the effect of cybersecurity threats. Therefore, organizations need to own the ability to make in new ICT and cybersecurity investments to quickly and effectively adapt to address unforeseen circumstances for better quality management of technology.

**Keywords:** Cybersecurity risk management; technology quality management; ICT technology law; e-commerce; blockchain; technology era; banking activities; Fintech; cloud technology; virtual or digital currency, policies, sustainable development, Industry 4.0

### 1. Introduction

The dynamic development of electronic internet banking observed in recent years is conditioned by technical progress that is constantly taking place in many different areas, both in the field of computer equipment and other devices used by Internet users to contact the global network as well as in the

development of ICT techniques and networks, which are provided to clients by financial institutions. According to the data provided by banks, customers of banking services are increasingly willing to use the facilities offered in this way for remote access to the bank. In addition, financial institutions offering electronic banking are reporting a decrease in operating costs and an increase in

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profitability associated with an increase in the number of online accounts and a simultaneous decrease in the use of traditional physical services of the bank's branch. On the other hand, for both banks and online banking clients, these are not only benefits. On the basis of data from financial institutions, it follows that with the development of electronic online banking, the number of cases of cybercrime is steadily increasing. The commercial banking systems in recent years have played an important role in developing all aspects of the economy. Among vital reasons for their growth are the development of technology 4.0 and digital technology applying in bank system.

Besides, we recognize that the role of banking technology and IT is pushing the employee productivity at commercial banks. This paper will analyze two aspects of banking technology revolution, both positive and negative sides.

Then, the roles and values of Fintech in banking activity also need to be clarified, as well as Fintech, cloud and digital technology for banking sustainable growth also need to be discussed.

Also, there are arguments on risk analysis and management in emerging markets such as Vietnam, Myanmar, Indonesia, ASEAN, Latin America, Africa, etc. It is one of the main purposes of this study.

The structure of this study is: first, introduction, then the research issues, reviewing and comparing previous studies. Next, part 3 will include methodology and data and part 4 will present the main research results. Section 5 provides us with some policy discussion, conclusions and recommendations that will be covered in section 6 while section 7 proposes IT solutions for risk management and operational risk and part 8 discusses cybersecurity risk management - practices on the example of National Institute of Standards and Technology U.S. Department of Commerce (NIST).

Based on the above analysis, quality management goals of technology in the industry 4.0 will be ensured partially.

## 2. Research contents

### 2.1 Research issues

Main research scope is:

**Research issue 1:** Technology revolution 4.0 and digital banking directions in bank system in a developing economy (the case of Vietnam) and quality management issues.

**Research issue 2:** Risks and mitigation measures, risk management in Technology Industry 4.0 and cybersecurity risk management.

This paper also examines the following hypotheses:

**Hypothesis 1:** Digital banking will help to increase economic values for banking and the whole economy.

**Hypothesis 2:** Legal framework for digital banking and Technology Industry 4.0 need to be improved and adapted to the development and ICT requirements.

**Hypothesis 3:** Cybersecurity risk management should be constantly matched in organizations and international standards should be introduced.

Huy, D.T.N, Dat, P.M., & Anh, P.T (2020) confirmed bank risk management is vital and need to be enhanced in Vietnam. Next, Vu Quynh Nam, Duong Thi Tinh, Dinh Tran Ngoc Huy et al (2021) stated it is better to enhance RMIS -risk management information system in firms. And Huy, D.T.N (2013) also mentioned risk can be measured by beta in Vietnam industry.

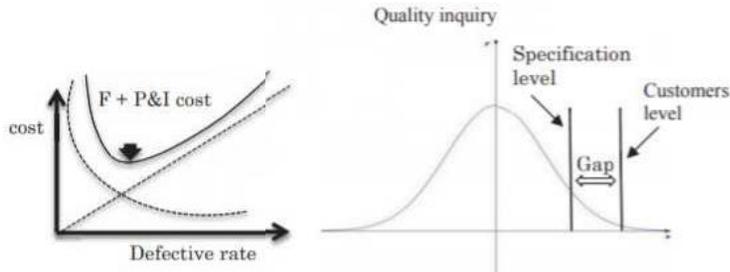
### 2.2 Previous studies

First, Revell (1987) stated that e-technology is a vital component for the structure of bank system in many developed nations. Technology (tech) application on banking since 1950s up to now shows that wholesale

is faster than retail banking in applying tech. Degryse and Ongena (2004) discussed lessons as following: Banking M&A deals might be optimal way to enter another market due to information asymmetries in Europe. Dangolani (2011) proved that IT helped banking in several ways: Saving clients time and cutting down costs.

Beside, some authors stated that IT can help banks with operation cost decreasing. While other mentioned banks with Internet impacts expanded products channels. Applying new technology can help banks to be more flexible.

Then, Nakura and Ohashi (2013) stated in the figure 1 that if we want to increase quality, the cost might increase a lot.



**Figure 1.** Quality Inquiry in Japan case

Next, Niazman (2015) mentioned that banks could use cloud computing to reduce cost of employee, software and hardware. Huy, D.T.N, Loan, B.T.T, & Anh, P.T (2020) mentioned vital roles of commercial banks. And Huy, D.T.N (2015) mentioned good management standards in corporations.

So far, many studies have been done in this technology and banking area, however, this article provides specific recommendations for emerging markets such as Vietnam based on an analysis of lessons learned by digital banking in countries around the world including USA, China, Japan, etc.

Beside, Nawafleh (2015) found that E - banking affected by demographical features as obstacles.

### 3. Methodology

Appiahene et al. (2019) presented results showing that applying IT are good for banking operation evenn though depo sit and investment might not be good. In short, It impact on firms might be done with the help of DEA combined with machine learning algorithms.

This research paper uses qualitative research and analysis methods, logical analysis, deduction and synthesis to provide direction and solutions, dialectical materialist methods combined with historical materialistic methods in assessing phenomena, things, economic objects, and inductive interpretation methods and evidences in the economy to contribute to economic reality.

Then, Parameshwar et al. (2019) pointed Fintech has reduced the savings of traditional banks. And Carbó-Valverde et al. (2020) shows that investment of bank on IT will have good impact on end users and increase their use of financial services, not only productivity.

In addition, this paper uses general data analysis methods and draws lessons from other countries to comment on the results, then propose policies based on these analyzes.

## 4. Main Findings

### 4.1- Overview of technology revolution 4.0 and bank system

Since 2002 up to now, Vietnam banks has paid attention much to technology and IT solutions applying banking transaction system. POS, Credit and Debit cards, deposit ATM machine has contributed to economic transactions.

During technology era 4.0, Banks nowadays connect more with business and individual clients through technological foundation with high security and password in these transactions.

Foreign banks such as Citibank, Shinhan bank, HSBC...establish their own security banking network and create friendliness and

trust worthiness for their customers. Whereas local banks also step by step upgrade their online banking transaction system.

Technology science 4.0 has helped Vietnam banks take care more of technological innovation in their banking transaction system and their internal management programs.

One of the different features of technology 4.0 is data protection and higher security level. The second thing is the application of AI in banking activities (Artificial Intelligence). Third, people today has involved more and more in mobile banking, internet banking, home banking, or banking via laptop, tablets,...

Then, lets look at some targets of IT application in banking in Vietnam shown in table 1 below.

**Table 1.** Vietnam bank targets (source: Vietnam ICT Index report 2017)

Order	Target	Unit	2017	2016
1	Banks receive Information security certificate ratio	%	43.8	27.6
2	Banks implement corebanking ratio	%	100	100
3	Automation Core banking	%	78.1	75.9
4	CRM	%	53.1	48.3
5	Risk management s ystem	%	59.4	65.5
6	ERP	%	50	65.5
7	Deposit online for individuals	%	90.6	89.7
8	Pay online bills for individuals	%	93.8	93.1
9	Pay salary online f or employee	%	87.5	82.8
10	Mobile banking	%	100	93.1
11	SMS banking	%	93.8	96.6

From the above table, we see that level of implementing Risk management system, CRM and ERP still be moderate.

### 4.2 Opportunities and Threats of Technology revolution

In fact, we also perform a SWOT analysis on technology 4.0 and digital banking as follows.

Opportunities:

- Digital banking and Core banking is developing much and hence, all

bank branches interconnect more. Also, the speed of data transfer is faster as well as transaction speed.

- It effectively conducts effective online payment channels for users for water, electricity, mobile, internet, utilities bills;
- It provides credit to the economy faster;
- Digital technology revolution can benefit banks through cloud

technology, saving big data and internet of things.

Threats:

- High unemployment due to rising automation in banking;
- Cybersecurity and attack may be rising which lead to thousands of data losses;
- Risk happening if users losses their access key to accounts;
- High risks if hackers enter platform and steal online data.

Strengths:

- When transaction costs may be lower because of digital banking, interest rate may be lower and bring benefits to clients (borrowing, payment, other transactions,...).
- If regulated and controlled well, can help to increase output, e-commerce, online payment and GDP growth;
- It is fast and safe for bank clients, for example, they can use mobile banking which recognizes their fingerprint.

Weaknesses:

- Need to establish sound legal framework and regulation;
- It needs high security software to protect data.
- It presents some risks as below analysis.

#### 4.3 Risk Analysis of digital banking

When we accept technology in novation adoption in banking activities, for instance, cloud technology, banks need to make assessment on risks of cloud and of transactions stopped and security of loosing important data. Banks need risk management plans for that.

Also, when banks increase online transactions via digital technology, there will be higher risk of hackers and viruses, so they need to prevent and handle risks happening.

#### 4.4 Regulation and policies of digital technology in banking in some countries

In Korea, from 2010 up to now the government has shifted from a perspective that encourages cooperation between ICT (Information and Communication Technology) and other major industries such as automotive, shipbuilding, construction and textiles, to a perspective that it is good to provide tax incentives to companies that invest in products related to digital security. 90% of Korean businesses use information security products and 41% use information security services. Small and medium-sized businesses are most in need of government assistance. It is in the Korea that Internet banks such as K Bank, Toss Bank,... operated under both Banking Act and The Internet Only Bank Act in 2018 and became the most effective Fintech businesses in the country.

In the US, there is Blockchain regulations and in Europe, cryptocurrencies businesses have to register with authorized financial agencies. Cryptocurrencies taxation is another matter taking into account. In Japan, in April 2017, cryptocurrencies are under Payment Service Act, market will adjust itself and some cryptocurrencies exchange businesses will be suspended if people loss much money (see an example of Coincheck lost 400 m USD in tokens).

In summary, in some emerging markets, digital currency might be considered by central banks and needs regulations.

In Europe, to make it safer and higher security, The Delegated Regulation on strong customer authentication (EU) 2018/389) which will enter into force on 14 September 2019 will require online payment and internet banking with credit cards having

3 components: knowledge (password or PIN), possession (token or mobile) or inherence (fingerprint or voice or facial features to identify payers).

The European Parliament resolution of 26 May 2016 on virtual currencies (2016/2007 (INI) emphasizes the importance of

commensurate regulatory approaches at European Union level in order not to block innovation or burden it with unnecessary costs at an early stage, and at the same time seriously Address the regulatory challenges that the widespread use of virtual currencies and DLT can pose. Dated on 10/4/2018, A Declaration for establishing a European Blockchain Services Infrastructure (EBSI) signed by Norway and 21 State Members, that will support the cross-border digital public services, security and privacy highest standards (Gwoździewicz et al., 2020b).

## 5. Discussion and future research directions

### Experience and lessons from banking technology in Japan:

Japan is a global leader in Bitcoin and cryptocurrencies development, who has legal framework regulating cryptocurrencies activities and utilizes technology for innovation in such financial products. However, around 6. 2million-worth of cryptocurrency was hacked from exchange accounts, according to Japanese news source Nikkei.

For a model of technology innovation acceptance, we can refer below.

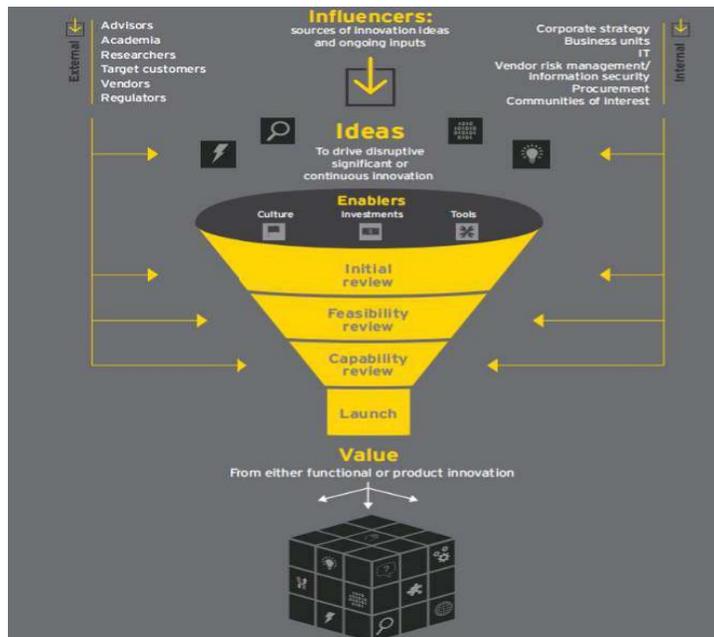


Figure 2. Technology innovation adoption (source: EY 2017)

### Experience and lessons from banking technology in other countries:

Hac, L.D., Huy, D.T.N, Thach, N.N et al (2021) stated banks in Vietnam has critical roles in economy. Moreover, Hang, T.T.B, Nhung, D.T.H., Huy, D.T.N et al (2020) specified risk activities are necessary in economy. Then, Nguyen Thi Hang, Dinh

Tran Ngoc Huy (2021) specified roles of risk management in banking sector need to be upgrade.

Many big companies including banks has applied and used cloud technology to manage better data, faster and more efficient, as well as facilitate better CRM and ERP solutions.

**Roles of Fintech in bank system:**

Financial technology (Fintech) has changed the way clients perform transaction with banks and financial service firms. Under 4.0 technology revolution, in developed countries, customers can do many things with their mobile or smart phones, for instance, they can deposit money with smart phones or call for investments with mobile.

Fintech also facilitate banking services and loans for low-income people and households who have been ignored by traditional banks.

It also created a platform in which third parties can join interbank network to provide financial services. These are advantages of Fintech.

What if bank customers lose their ATM cards...With Fintech, they can easily access their funds without ATM cards lost.

**Beside, there are some management issues:**

Innovation such as Cloud technology is considered to use in medium to big companies in Vietnam including commercial banks. The cloud technology will help Vietnam banks to increase speed and productivity as they can process thousands of data in a second, i.e faster; however, what if any risk in cloud technology and transactions stop, Vietnam banks also need to manage these risky scenes.

Another issue is the legal framework and regulation for Fintech and technology innovation applying in banking and other financial services because of the importance of banking, financial service and monetary field.

**6. Conclusion and policy recommendations**

In this section, we conclude that Vietnam as well as other emerging markets need to analyze two sides of digital technology adoption and follow a proper process of technology innovation acceptance. In general, digital technology innovation such as Fintech and cloud might enable banks to process data

quicker, save big data, and prove better customer insights as well as making decision quickly. On the contrary, digital technology in banking also impose some threats such as increasing time working with PC (and hence, less time for physical exercise and some office diseases such as headache, stress, feeling isolated...) and risk of data lost due to hackers, terrorists and viruses.

Last but not least, after recognizing both good and bad sides of digital technology, a risk management plan will need to prepare in advance as presenting follows.

Therefore, we recognize roles of technology quality management in banking sector including IT quality will help to reduce operation risks, as well as enhancing quality of banking processes during industry 4.0 very much. That's why in the below part, we propose plans or solutions for IT risk management.

**7. Proposal on IT risk management and operational risk**

Any IT problem that happens, whether with an application, network, new system, vendor or hacker, is likely to increase the risk for the business. European Parliament Resolution (2017) on the fight against cybercrime emphasizes the rapid increase in the number of ransomware, botnets and unauthorized breaches of computer systems, affecting not only the security, availability, and integrity of their data personal protection, protection of privacy and fundamental freedoms, but also on the integrity of the infrastructure of financial structures, such as banks or stock exchanges. Gartner reports (Digital Transformation Innovation, 2020) predict that from 2020, over 25% of cyber attacks identified in enterprises will affect Io T and this percentage will increase. The desire to obtain information on new ICT technologies and business development plans will increase, which may cause increased cyberattacks on networks and information systems

(Gwoździewicz et al., 2020a). Therefore, a comprehensive view of IT-based risk must put the front and center of the business into any framework or policy. Business risk includes everything (both internal or external) that affects brand, reputation, competitiveness, financial value or end status (i.e. efficiency, efficiency and its general success). In connection with the aforementioned development of ICT and Industry 4.0, in recent years the amount of data stored in the cloud on external servers usually shared free of charge of specific disk capacities, has been dynamically growing. Institutions and companies whose effective functioning is currently based on the above-mentioned cloud and Big Data technologies estimate that by 2020 the amount of data stored in this way on external servers will increase many times, which will mean an increase in the capacity of data storage devices, including large disk capacity which, connected in the cloud with servers enabling communication via the Internet, will create a kind of external data warehouses, which is currently referred to as Big Data.

## **8. Cybersecurity risk management. Practices on the example of NIST U.S.**

Therefore, in recent years, the improvement of cybersecurity risk management processes no longer concerns only electronic online banking, but many other areas of information services and related information flow and transactions. In connection with the dynamic development of new online media and information services, e. g. related to the development of social networking sites, cybersecurity risk management processes are constantly developed and improved in this field. In the processes of improving cybersecurity risk management in the field of archiving large information collections, data transfer, and settlement of transactions made through social networking sites, new ICT, blockchain technologies and Industry 4.0 are increasingly used, including Big Data

technologies being developed and constantly improved. Conducting financial operations implemented in cloud computing as well as using large data sets located in the so-called Big Data platforms are just some areas of cyberspace in which dynamic development determines the need for analogous progress in the improvement of security instruments for the transfer and storage of classified data. The main idea of improving these security systems should be to ensure that natural persons and the business entities and institutions created by them provide the highest possible level of guarantee for the safe use of new technologies, e.g., when using electronic banking services, making online purchases or sharing information with friends around the world. In this way, the trust of electronic banking clients will grow, also in the matter of personal data protection in cyberspace. In connection with the above, ensuring the legal protection of personal data in cyberspace is increasingly recognized as an inseparable factor in the issue of cybersecurity in the development of the information society. The security of classified information is increasingly recognized as a determinant of the effective development of the national economy.

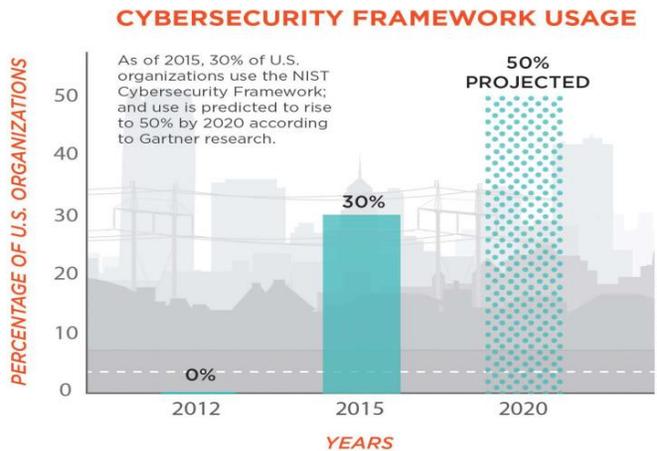
Currently, in the U.S., the governmental institution NIST (National Institute of Standards and Technology, U.S. Department of Commerce) is constantly working on creating an appropriate framework for managing cybersecurity risk. Given that banking is part of the critical infrastructure services sector in every country in the world, the current US government proposals can serve as an example of how to improve this framework in developing countries. According to statistics, 30% US organizations use this cybersecurity framework, and estimated up to 50% in 2020 (Cybersecurity Incentives Policy White Paper, United States of America Federal Energy Regulatory Commission).

The document Cybersecurity Incentives Policy White Paper issued by the Federal Energy Regulatory Commission United

States of America (June 18, 2020) indicates, that one of the key issues in the discussed topic is investments in cybersecurity of IT infrastructure. This paper discusses the importance of infrastructure security, including the Commission and staff’s efforts to incentivize infrastructure security to date, and why there is a need to adopt a new approach to incentivize cybersecurity investments. The CIP Reliability Standards now consist of 13 standards specifying a set of requirements that registered entities must follow to ensure the cyber and physical security of the bulk power system. There are currently 10 active cybersecurity standards and two cybersecurity standards to be effective in the near future. The CIP Reliability Standards, viewed as a whole, constitute a defense-in-depth approach to cybersecurity based on an assessment of risk. The CIP Reliability Standards are objective-based and allow responsible entities to choose compliance approaches best tailored to their systems. One is e.g. (CIP-013-1: Supply Chain Risk Management), requires entities to

mitigate cybersecurity risks by implementing security controls for supply chain risk management of BES Cyber Systems.

Another approach would be to base the eligibility for incentives on a framework other than the CIP Reliability Standards, specifically the cybersecurity framework developed by NIST (NIST Framework). This approach would still consider the CIP Reliability Standards as a basis for granting cybersecurity incentives, while allowing utilities to employ alternative approaches to assessing risk under the NIST Framework. It would also offer the flexibility of non-prescriptive implementation options to encourage utilities to exceed the CIP Reliability Standards. Also, the NIST Framework is based on and updated with cybersecurity best practices and is consistent with other federal cybersecurity risk management initiatives for the 16 U.S. critical infrastructure sectors (Cybersecurity Incentives Policy White Paper).



**Figure 3.** Cyber Security Framework

Source: <https://www.nist.gov/industry-impacts/cybersecurity-framework> (analysis on 10/09/2020)

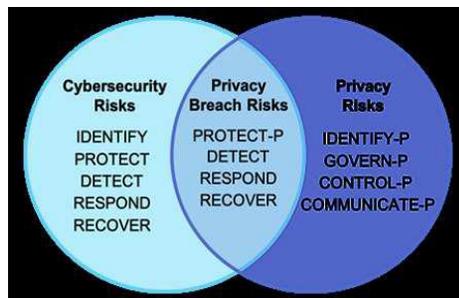
The NIST Framework contains many types of security controls. These five types of controls represent the majority of security controls included in the NIST Framework and include the following: (1) automated and continuous

monitoring; (2) access control; (3) data protection; (4) incident response; and (5) physical security of cyber systems. These 5 types of security controls can be the basis for any organization to implement cybersecurity

risk responses. Cybersecurity and privacy have both unique and overlapping risk management needs, as illustrated by Figure 4.

Having a general understanding of the different origins of cybersecurity and privacy risks is important for determining the most effective solutions to address the risks. The use of these models together institutionalizes organization-level and system-level preparation by:

- 1) Facilitating communication across the organizational risk management levels;
- 2) Encouraging the organization-wide identification of common controls and the development of organizationally tailored control baselines;
- 3) Reducing the complexity of the IT infrastructure;
- 4) Providing additional methods to identify, prioritize, and focus resources on high-value assets commensurate with risk (Cybersecurity Program Annual Report).



**Figure 4.** Overlap of risks

Source: 2019NIST/ITL Cybersecurity Program Annual Report, August 24, 2020, p. 7

Finally, we want to summarize above results: Our findings will be a risk management plans to encounter with cybersecurity and IT risks and risks coming from digital technology. Its second result is two sides of the phenomenon: digital technology innovation such as Fintech and cloud might enable banks to process data quicker, save big data, and prove better customer insights as well as making decision quickly. On the contrary, digital technology in banking also impose some threats. In addition to, we identified that the security of classified information such as Big Data is increasingly recognized as a determinant of the effective development of the national economy. Beside, this paper also has limitations, for example, it does not propose recommendations for negative aspects of technology in industry 4.0 (for instance, the automation will reduce the involvement of human resources and reduction of laborers).

But anyhow this study has novelty values such as it suggests cybersecurity framework and risk management, after analyzing operational and IT risks in banking.

Huy, D.T.N, Nhan, V.K., Bich, N.T.N (2021) confirmed risk management is important in Vietnam economy. And Huy, D.T.N, An, T.T.B et al (2021) stated for banking sustainability, they need to improve risk management.

And last but not least we suggest direction for future research, for instance, what are pros and cons of technology revolution in industry 4.0 in emerging markets such as Vietnam, Myanmar, Cambodia, Phillipines, Malaysia, Indonesia, Thailand, Laos, Asian Pacific, Middle East, China, Russia, Africa and Latin America, etc.

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