

Trends and Development Solutions: Internet of Things (IOT) Market in Vietnam

Nguyen Xuan Ha¹, Dang Minh Tuan², Tran Duc Can³, Nguyen Thi Lan Huong⁴,
Nguyen Huu Xuyen⁵

¹Hanoi University of Science and Technology, Vietnam

²CMC Institute of Science and Technology, Vietnam

³University of Economics - Technology for Industries, Vietnam

⁴Hanoi Industrial Textile Garment University, Vietnam

⁵National Institute of Patent and Technology Exploitation, Vietnam

Corresponding Author: Nguyen Xuan Ha

ABSTRACT

Internet of Things (Internet of Things) market development trends has an important role in the process of building a technology roadmap and technology innovation roadmap. The development of the IoT will impact the consolidation of technologies and blur the lines between the physical, digital and biological realms. In Vietnam, the development of the IoT market has been interested by the Government, but the domestic supply is still limited, mainly depends on the source of technology imported from abroad, so the IoT market is still in its infancy, not really developed. This article will identify and analyze the development trend of the IoT market, and then propose solutions to develop the IoT market to serve the development of the roadmap for IoT application technology innovation in accordance with the strategy of change number of Vietnam. The paper is part of the research results of the topic "Construction technology map and technological innovation roadmap in developing and applying IoT in Vietnam", code: ĐM.40.DA/19.

Keywords: IoT, IoT market

1. INTRODUCTION

At first, IoT was understood quite simply, to refer to indoor objects and devices such as televisions, refrigerators, washing machines, gas cookers, ... equipped with technologies such as wifi, bluetooth, RFID sensors, etc. .. to help them connect.

Then there are various interpretations of IoT. According to the International Telecommunication Union (ITU, 2015), the IoT connects objects in both intelligent and sensible ways, through the technical development of object recognition technologies via RFID radio waves, sensor technology, smart technology and nanotechnology. IoT is a global infrastructure for information society, providing advanced services by connecting objects (both real and virtual) based on the existence of information, interoperability of that information and based on communication technologies. By exploiting the ability to identify, collect data, process data and communication technology, IoT systems provide services for many different types of applications, simultaneously, ensuring security and privacy. From there, the IoT can be considered a technology trend and a development trend of society, especially in the context of the fourth industrial revolution is taking place strongly.

Up to now, in general, there are still many different perspectives about IoT, but the concepts are basically about connecting objects over the Internet. In studies of IoT, the concept of IoT of ITU is most cited and referenced by researchers. IoT is understood that when everything is connected to each other through the Internet, users can control all their objects over the network with just

one smart device. IoT has some characteristics such as: the ability to communicate anytime, anywhere, anytime; the ability to locate devices; the device's ability to exchange information via the

Internet or internal LAN. Therefore, with the development of IoT we can connect with everything; supervise everything; control everything; find everything when it is needed and manage everything.

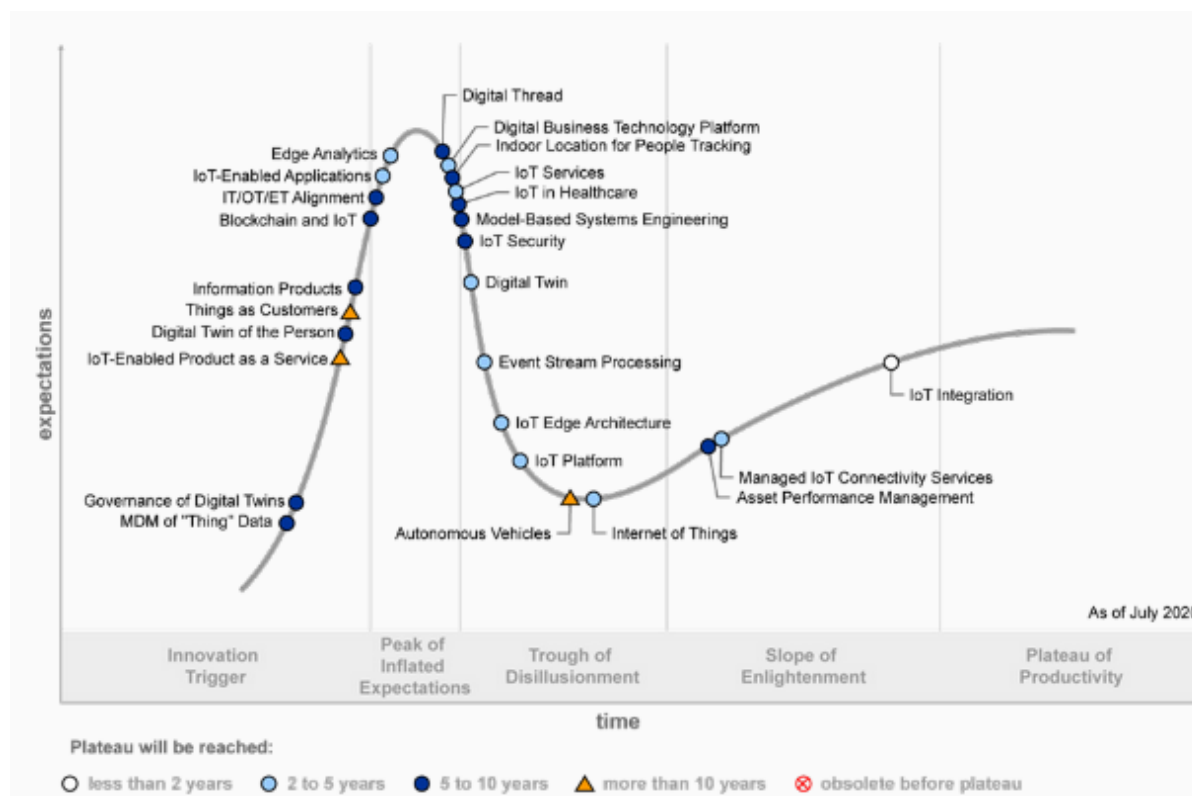


Figure 1: Location of IoT and related technologies
Source: Gartner, 2020

IoT can create a new industrial revolution, transforming the world economy and human life. The IoT will create opportunities for all industries to benefit, increasing data transmission and Internet communication. Therefore, all businesses and industries can use those data to analyze and decide their strategies in the future. Over the years, Gartner has consistently made research and predictions about the development of a technology known as the Hype Cycle (Figure 1). The Hype Cycle consists of five phases: start-up of technology; the climax of the hype about technology's expectations; concave at the end of the hype; the beginning of the climb goes up when the problems are clarified; stable development. Gartner recommends waiting for the technology's ripe stages to put it into practice.

IoT is considered the most breakthrough technology and has many opportunities in the future. The greatest power of the IoT is its ability to turn data into action without the need for intermediary entities. The fact that the IoT stands at its highest point is the result of many globally influential activities. In it, there must be the initiatives and moves of the world's largest technology and industry firms in North America and Europe. Thus, according to Gartner predictions, IoT will develop strongly in the next 5-10 years, and then go into stable development. At that time, the application and development of IoT will bring many economic benefits to organizations and countries participating in investing in IoT development. The growth of the IoT is underpinned by a number of related technologies. Some key areas such

as: data aggregation / virtualization tools; IoT network edge architecture; integrated IoT; IoT services; low-cost, self-developed user electronic circuits; machine learning; product data management.

2. RESEARCH METHODS

The authors have inherited the researches published at home and abroad on the IoT market, developing the IoT market. Especially some announcements: of the International Telecommunication Union (2015), Gartner (2018, 2020), Ericsson Mobility Report (2017), Research Company Rand Europe (2019), Consulting Firm Accenture (2018); Vietnamese Ministry of Information and Communications, Vietnam Ministry of Science and Technology, and some information from experts and consulting companies in Vietnam have been published at websites such as: <https://techinsight.com.vn>, <https://iotvietnam.com/>, <https://ifactory.com.vn/>, <https://bkaii.com.vn/>, <https://solutions.viettel.vn>, <https://www.cisco.com/>.

In addition, to clarify the published data on IoT, the IoT market, the authors have collected, selected and analyzed the information obtained through the seminars held in Vietnam. in 2019 and 2020; At the same time, using interview results in 2020 from a number of experts working at German research institutions, businesses, and universities such as German Aerospace Center, Ostbayerische Technische Hochschule Regensburg, Technical University of Darmstadt.

3. RESEARCH RESULTS

According to Ericsson Mobility Report (EMR, 2017), by 2021, it is expected that there will be 28 billion connected devices, of which 15 billion are connected to IoT, including M2M (Machine-to-Machine) equipment such as smart meters, road sensors, retail locations, and consumer electronic devices such as televisions, DVRs, wearables; the remaining 13 billion

are mobile phones, laptop PCs, and tablets. The world will spend about 1,300 billion USD on the IoT (IDC, 2018). The added value brought about by the IoT will reach about 1,900 billion USD by 2020 (Gartner, 2018).

According to McKinsey (2018), by 2025, IoT will contribute to the global economy of 11,000 billion US dollars. In 2021, it is expected that the number of subscribers will reach 9.1 billion. This number of subscribers is higher than the population because each person can own many devices. In IoT connections, there are SIM / eSIM subscriptions embedded in the device and also devices such as consumer electronics that do not require a SIM (Non-SIM). The IoT is going strong. 50% of businesses have started implementing IoT projects with the expectation of providing revenue opportunities for many industries, and those solutions start to commercialize at a very rapid rate. Utilities, transportation, smart building, agriculture, and retail are the leading industries in IoT application

In 2020, IoT can bring huge potential revenue to industries around the world at about 1.4-14.4 trillion USD (equivalent to GDP of the European Union) (Rand Europe, 2016). Not only that, many basic economic industries can increase investment in the IoT ecosystem with the total investment in IoT solutions estimated at \$ 6 trillion (Business Insider Intelligence, 2018). In particular, manufacturing enterprises can increase investment by 35% in the use of smart sensors. The transport industry will have more than 220 million connected cars. The defense industry can spend \$ 8.7 billion on unmanned vehicles and about 126,000 military robots will be shipped. Agricultural production can install 75 million IoT devices, mostly sensors placed in the soil to monitor acidity, temperature and other metrics to help farmers increase crop yields. The infrastructure sector can increase investment by \$ 133 billion for IoT systems.

Many other areas also increase investment in the IoT and IoT ecosystems

that can cover most industries in three main regions: Governments, businesses, and consumers, with an estimated 24 billion devices connected to the Internet and participating in the IoT ecosystem. As a result, the IoT can generate significant growth for the global economy. If the US invests more than 50% in IoT technology to expand its network of connections, it can generate profits of up to \$ 7.1 trillion, contributing to higher GDP 2 , 3% in 2030 compared with investment in other projects. Meanwhile, Germany could reach a profit of 700 billion USD and increase its GDP up to 1.7%; The UK could reach a profit of \$ 531 billion and raise GDP by 1.8%; China could reach a profit of \$ 1.8 trillion and raise its GDP to 1.3 percent by 2030 if investing in IoT is similar to that of the US, and the IoT market can reach revenue of around \$ 7,100 billion by 2020 (Accenture, 2017).

The IoT market is still in its early stages of development, Cisco has predicted

that the economic value generated by this market could be \$ 19,000 billion by 2020, which includes direct and past impacts. cutting costs, increasing productivity ... Therefore, it is not simply based on sales of additional products and services (Cisco, 2018). By 2020, IoT devices could reach about 26 billion IoT devices and products (Gartner, 2018). Service providers that can generate incremental revenue in excess of \$ 300 billion, are primarily services. The IoT can deliver \$ 1.9 trillion worth of global economic value in 2020. In the IDC report on the growth prospects of IoT for the period 2013-2020, at the end of 2013, 9.1 billions of IoT installations - with IP connectivity and communicating without human interaction. IDC predicts that with a growth rate of 17.5%, by 2020 the world may have 28.1 billion connections (Table 1).

Table 1. The IoT development of regions around the world

	2013	2014	2015	2016	2017	2018	2019	2020	2013-2020 CAGR (%)
Asia Pacific	2,8	3,6	4,4	5,4	6,4	7,6	8,9	10,1	20,1
Central Europe and Eastern Europe	0,3	0,3	0,4	0,5	0,6	0,7	0,8	0,8	15,0
Latin America	0,2	0,2	0,3	0,2	0,4	0,4	0,5	0,6	17,0
Middle East / Africa	0,3	0,4	0,4	0,5	0,5	0,7	0,7	0,8	15,0
North America	3,1	3,8	4,5	5,2	5,9	6,5	7,0	7,5	13,5
West Europe	2,4	3,1	3,7	4,5	5,4	6,3	7,3	8,3	19,4
Total	9,1	11,4	13,7	16,3	19,2	22,2	25,2	28,1	17,5

Source: IDC, 2018

Regarding the forecast of developed areas in the world, IDC has assessed for each major region in the world and said that, while everywhere in the world has begun to implement IoT solutions, development area Development is leading and will continue to lead the way for the massive growth of the IoT in 2020. Investing in information, communication and technology is one of the key factors to develop the IoT market in the future. IoT is thriving as consumers, businesses, and governments realize the benefits of the platform. IoT can boost the economy strongly in the coming time, experts of Business Insider have made several forecasts about the future of IoT (Business Insider Intelligence, 2018):

- IoT will be the largest device market in the world. In 2019, the number of IoT devices could double the total number of smartphones, PCs, tablets, and wearables.
- IoT can bring \$ 1,700 billion in value added to the global economy in 2019. This includes hardware, software, installation costs, management services and economic value added
- The value of IoT devices could reach 6.7 billion USD in 2019. While hardware revenue accounts for 8% (about \$ 50 million), software makers and infrastructure companies benefit more from IoT shares.
- The growth of IoT brings greater efficiency and lower costs in homes,

workplaces and cities in the future. However, the use of electronic devices in security systems is still a problem.

- The IoT platform lacks a common technology and standard for compatibility and use with devices. Currently, there are very few standards (or regulations) for devices running on these platforms. The most pressing issue is to standardize IoT platforms and address current security issues.
- The serving objects of the IoT ecosystem are: businesses, governments, and consumers. In particular, businesses receive the most IoT solutions, focusing on the following goals: Reduce operating costs, increase productivity and expand into new markets or develop new products. The enterprise sector may have 11.2 billion connected devices by 2020. Investment in IoT solutions is about USD 3 billion for the period 2015-

2020. IoT helps Government focus on solutions to increase productivity, reduce costs, and improve the quality of life of the people. There are about 7.7 billion connected devices in the government sector by 2020, with an investment of about 2.1 billion USD. Consumers are behind businesses and governments in getting IoT solutions. However, consumers can buy a large number of devices and invest a substantial amount in the IoT ecosystem, which has about 5 billion connected devices, with a spending of \$ 900 million.

Development of IoT is also interested by many corporations around the world and promoting research. The number of patents and patent transfer markets in the sectors / industries has increased in recent years (Table 2).

Table 2: Number of IoT-related patents by public sector technology and the strengths of companies

Technology	Number of patents	Companies leading in the number of patents	The companies receive the transfer mainly
Net	81.319	Samsung, Qualcomm, Huawei, LG, ZTE, Intel	Avago, Google, Autoconnect Holdings LLC, Qualcomm, Cisco
Sensor	47.207	Samsung, Korea Electronics Telecomm, State Grid Corporation of China (SGCC), Siemens, LG, Philips	Google, Avago, Autoconnect Holdings LLC, Samsung
Security	42.943	Samsung, Qualcomm, Intel, Huawei, LG, Ericsson	Avago, Google, Autoconnect Holdings LLC, Qualcomm, Cisco
Energy management	28.095	Intel, Samsung, Qualcomm, State Grid Corporation of China (SGCC), LG, Siemens	Avago, Google, Samsung, Xenogenic Development LLC, Qualcomm, Rateze Remote Mgmt LLC
Data analysis	24.068	Samsung, Qualcomm, Korea Electronics Telecomm, Sony, ZTE, Huawei	Autoconnect Holdings LLC, Avago, Cisco, Google, Hewlett Packard Enterprise
Data saving	7.008	Samsung, Intel, LG, IBM, Hitachi, State Grid Corporation of China (SGCC)	Avago, KIP SMRT P1 LP, Google, Autoconnect Holdings LLC, Hewlett Packard Enterprise
Data processing	6.893	Samsung, Sony, Microsoft, IBM, Panasonic, NEC	Autoconnect Holdings LLC, Avago, Google, Hewlett Packard Enterprise, Eagle Harbor Holdings LLC
Cloud computing	4.674	Samsung, Intel, Microsoft, IBM, Google, Zongcheng Li	Autoconnect Holdings LLC, Samsung, Google, KIP SMRT P1 LP, Nokia

Source: Relecura Inc (2017)

In Vietnam, developing the IoT market has also received the attention of the Government, businesses and science and technology organizations in recent years. According to Bach Tan Sinh and Dang Thi Hoa (2019), the IoT ecosystem includes the main actors: Government (promulgating policies, promoting development through public investment); businesses / startups / development communities (providing

technology solutions for software, connectivity infrastructure, hardware, services ...); market; and their relationship with each other. The IoT market in Vietnam is attracting many technology companies to participate in research and production. Some examples of IoT development are: Mimosa Tech commercialized the solution for precision farming; Hachi is a solution that helps to build an automatic personal garden

at home; BKAV and Lumi are two leading companies in the smart home market; Abivin was one of the first businesses to collect data on vehicles in traffic and based on digital maps, optimized for vehicles. In fact, most of the current IoT application systems in Vietnam are originated from foreign enterprises, and domestic enterprises are basically focusing on applications on mobile phone platforms. Small and mobile computers that have not fully exploited the intelligence of the IoT system (Ministry of Science and Technology, 2019). In addition, businesses are hesitant to apply IoT because: poor infrastructure (31%), inadequate staff (20%), lack of budget (44%) and uncertainty on the benefits and impact of IoT on businesses (48 %) (Cisco, 2018).

Thus, although there is great potential for the IoT market in Vietnam to develop, there are still certain difficulties for the development of the IoT market in Vietnam, which are caused by: policies have not kept pace with the rapidly growing IoT market; Vietnamese enterprises are not really ready to apply because of high initial investment costs, limited ability to master technology and capacity (Nguyen Huu Xuyen et al, 2020); Vietnamese people's acceptance of the new and changing habits of consumers is still slow; IoT connectivity standards are lacking, asynchronous IoT connections create sudden large amounts of traffic, especially when IoT technology requires interoperability between devices; Security issues are not really guaranteed. Besides, the IoT market in Vietnam has not yet developed strongly because the supply capacity of domestic enterprises is not high; Research and development capacity of universities and research institutes is still limited, intermediaries of consultancy, legal assistance and technology transfer connection are small in number and their operations are not highly professional.

4. CONCLUSION AND RECOMMENDATION

To develop the IoT market on the basis of synchronization of legal environment, telecommunications infrastructure, human resources and in accordance with the roadmap of IoT technology innovation, associated with "The National Digital Transformation Program to 2025, with a vision to 2030" according to the Prime Minister's Decision No. 749 / QĐ-TTg of June 3, 2020, in the coming time, Vietnam needs:

Firstly, perfecting the legal environment, creating favorable conditions for the development of the IoT market. Currently, the construction of the current legal environment is still very slow, failing to keep up with emerging social needs, especially in new areas when implementing digital transformation. Specifically, there is a lack of a legal framework for sharing economic development; sharing and opening data of government agencies and businesses; protection of personal data, private information; issues of rights and ethics when applying artificial intelligence and this hinders the digital transformation process (Ministry of Information and Communications, 2019). Therefore, it is necessary to build a culture that encourages innovation, accept risks for new products, solutions, business models, and management methods when the legal provisions are not really complete and clear. Next, step by step complete the legal framework for research, development, testing and application of new products, processes, and new business models into socio-economic development reality; reviewing and studying points that are not suitable for the development trend and IoT application to supplement and amend the system of legal documents on creative startups, intellectual property, trade, investment, business to facilitate national digital transformation and develop new products, services, business models based on digital technology, the Internet and cyberspace; at the same time studying,

proposing amendments and supplements to legal documents on information technology and communication such as Law on Electronic Transactions, Law on Information Technology, Law on Telecommunications to ensure State investment and mobilize resources from enterprises and society to implement the national digital transformation program.

Secondly, improving technology capacity in enterprises, supporting enterprises to innovate business models, production processes, products to improve productivity and improve competitiveness based on IoT application platforms; consulting and assisting enterprises in building a roadmap for digital transformation, facilitating the connection of capital and technology sources with international markets; supporting Vietnamese enterprises to raise awareness of the potential of IoT to soon have orientations and roadmaps to deploy IoT applications in production and business, create opportunities for businesses to apply IoT to optimize operations, improve innovation capacity, contribute to increasing revenue and competitive advantage in the market; accelerate the support of innovative startups, startups based on IoT research results to form science and technology businesses (Nguyen Huu Xuyen et al, 2019); supporting businesses in digital transformation, applying 5G technology, building an institutional framework to pilot application of new business forms such as non-cash payments, electronic payment, peer-to-peer lending, sharing economic models.

Thirdly, propagating to raise awareness of people, businesses and civil servants about the role and benefits of developing the IoT market for the economy, society and national competitive advantage. Especially, it is necessary to effectively implement the Prime Minister's Decision No. 21/QĐ-TTg dated January 6, 2021 approving the project "Training and developing human resources in information security for the period of 2021-2025".

Accordingly, it is necessary to implement training solutions on information security for state agencies and organizations; information security training upon request from these agencies and organizations; training in management, profession and information security skills for leadership and management teams; updating and improving information security and information technology techniques according to standards, program frameworks and information security skills requirements issued by the Ministry of Information and Communications; elaborate regulations on information security skills, standards, criteria, professional requirements and information security skills for full-time officials; speed up the training of teachers and researchers on information security and IoT in educational institutions and in scientific research and technology development.

Fourthly, promoting the process of linking and cooperating between educational institutions, research institutions and businesses. It is necessary to develop a priority mechanism for enterprises that support activities in training and scientific research, building an ordering mechanism with enterprises in training and scientific research, supporting quality and efficient training institutions. To prioritize investment in a number of universities with effective scientific research and high technology transfer in the higher education system. In addition, it is necessary to implement productivity training and fostering programs at a number of universities and vocational training institutions on the basis of close connection with the needs of some businesses and industrial parks, specific high-tech zones; organize programs and training courses on solutions to improve productivity, digital transformation, smart manufacturing, smart transportation, smart cities, contribute to supporting enterprises to improve their capacity to access the Fourth Industrial Revolution according to Directive No. 16 / CT-TTg in 2017 of the Prime Minister.

Fifthly, improving the capacity of intermediaries to support the growing IoT market. Therefore, in the coming time, it is necessary to improve the capacity of intermediaries (Technology Exchange; Technology Transfer Promotion and Support Center; Intellectual Property Valuation Support Center; Innovation Support Center; Technology Incubator) in providing brokerage, consultancy, technology transfer promotion, evaluation, appraisal of prices and technology appraisal services; providing connection services to assist parties in technology-related transactions in the technology market (support services for research and development, commercialization of technology; intellectual property services, standards, metrics, quality; investment consulting, trade promotion, ...). Thus, the intermediary not only provides advice, brokerage, legal assistance, and information provision, but also helps market participants realize the value of IoT technology, promoting organizations to be able to access, use, and buy and sell IoT technology to serve their needs and production and business activities; making an important contribution to the commercialization of IoT research results, improving the quantity and quality of IoT technology transactions in the technology market.

REFERENCES

1. The Ministry of Science and Technology (MOST, 2019), Vietnam's Science and Technology, Science and Technology Publishing House, Vietnam.
2. The Ministry of Information and Communication (MIC, 2019), Scheme Convert countries, Hanoi, Vietnam.
3. The Prime Minister (2020), Decision No. 749 / QD-TTg dated June 3, 2020, approving the Conversion Program countries by 2025 and orientation to 2030, Hanoi, Vietnam.
4. The Prime Minister (2021), Decision No. 21 / QD-TTg dated 01/06/2021 on approving the project "Training and development of human resources information security phase from 2021 to 2025, Hanoi, Vietnam.
5. The Prime Minister (2017), Directive No. 16 / CT-TTg dated 04 March 05 2017 on the strengthening of the capacity to access the industrial revolution Fourth, Hanoi, Vietnam.
6. Bach Tan Sinh and Dang Thi Hoa (2019), the Internet connects all things in Vietnam: Situation and solution development, Journal of Science and Technology of Vietnam, the month 2/2019.
7. Gartner (2018), Understanding Gartner's Hype Cycles: <https://www.gartner.com/en/documents/3887767>
8. Gartner (2020), Five Trends Drive the Gartner Hype Cycle for Emerging Technologies: <https://www.gartner.com/smarterwithgartner/5-trends-drive-the-gartner-hype-cycle-for-emerging-technologies-2020/>
9. Business Insider Intelligence (2018), The Internet of Things Report, Insider Inc, New York.
10. Rand Europe Research Firm (2016), Development forecast of IoT to 2020, UK.
11. Relecura Inc. (2017), Technology Landscape and IP commercialization Trends IoT - Internet of Things, India
12. Ericsson Mobility Report (EMR, 2017), IoT platform, Stockholm, Sweden
13. Cisco (2018), The Internet of Things: 5 Predictions for 2018 by Maciej Kranz, America
14. McKinsey (2018), The Internet of Things: How to capture the value of IoT, Copyright © McKinsey & Company
15. Accenture (2017), IoT Platforms: https://www.accenture.com/t20170314T010317Z_w_/us-en/_acnmedia/PDF-47/Accenture-IoT-Platforms-Web.pdf, America
16. IDC (2018), IDC FutureScape: Worldwide IoT 2018 Predictions, USA
17. Nguyen Huu Xuyen et al (2020), Vietnam's Policy on Supporting Enterprises in Technology Mastering in the Fourth Industrial Revolution, Journal of Investment and Management; 9(2): 40-46, Science Publishing Group.

18. Nguyen Huu Xuyen et al (2019), Solution to develop innovative start-up enterprise in Vietnam, 1-2/2019, East West.

<https://www.mic.gov.vn>,
<https://www.most.gov.vn>

19. Web sites: <https://techinsight.com.vn>,
<https://iotvietnam.com/>,
<https://ifactory.com.vn/>,
<https://bkaii.com.vn/>,
<https://solutions.viettel.vn>,
<https://cisco.com/>.

How to cite this article: Nguyen Xuan Ha, Dang Minh Tuan, Tran Duc Can et.al. Trends and development solutions: internet of things (IOT) market in Vietnam. *International Journal of Research and Review*. 2021; 8(3): 520-528.
