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## Chapter 6

### **The Application of Information and Communication Technologies (ICT) in Agriculture: Present Status, Opportunities, and Challenges in Vietnam**

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#### **Abstract**

The application of information and communication technologies (ICT) is becoming a global trend in the agricultural sector. ICT provides the basis of “precision agriculture,” which meets retailers’ and consumers’ growing demand for food safety. Since 2010, the Vietnamese government has implemented various policies and programs to promote “high-tech” agriculture. However, the application of ICT in agriculture is still in its early stages, being practiced only in a limited way. This paper reviews the literature on ICT application in agricultural practice in both developed and developing countries, with the goal of examining the background of ICT application, what type of ICT is being used, and its effects. This paper then discusses the potential for and challenges to the adoption of ICT in the Vietnamese agricultural sector.

**Keywords:** Vietnam, ICT, high-tech agriculture, precision agriculture

#### **1. Introduction**

Agriculture has long been an important economic sector in Vietnam. Although the country’s rapid industrialization has resulted in a sharp decrease for the agricultural sector in terms of GDP and in terms of labor engaged in agriculture, it is still considered to be a sector with comparative advantage over other countries in the region<sup>2</sup>. Vietnam has maintained its position as one of the world’s largest exporters of rice, coffee, pepper, and cashew nuts since the 1990s. In addition to these “traditional” crops (although they were first development as late as the 1990s), Vietnam’s production and export of fruits, vegetables, and other industrial crops such as rubber and cassava have also increased in

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<sup>2</sup> Agriculture accounted for 24.5% of Vietnamese GDP in 2000 and 15.3% in 2017, while labor in the agricultural sector declined from 55.1% in 2005 to 40.2% in 2017. (Retrieved from the website of the General Statistics Office of Vietnam:

[https://www.gso.gov.vn/Default\\_en.aspx?tabid=766](https://www.gso.gov.vn/Default_en.aspx?tabid=766), accessed in January 2019)

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recent years. Since 2016, in fact, the export value of fruits and vegetables has exceeded that of rice .

Thanks to the efforts of central and local governments, Vietnam has experienced various technological improvements and innovations in agricultural production. Copious new varieties of rice and other key products—as well as farming methodologies for growing them—have been developed and diffused by extension centers. The government has also been keen to promote the introduction of new types of agricultural production systems, one famous example being the VAC (*Vuon, Ao, Chuong*, meaning “garden, pond, livestock”) integrated farming system which was promoted in the 1990s.

One of the latest areas the government is keenly promoting within the agricultural sector is the application of “high-technology.” There are some attempts by private enterprises to invest in a European farming system that would produce high land productivity products (typically the result of hydroponic vegetable production in “high-tech” greenhouses). Although the government’s legal documents are ambiguous about what types of technologies, farming systems, or products they intend to promote, these enterprises have become the target of government support for the application of high-tech agriculture.

However, investment in capital-intensive, high-tech greenhouses alone does not guarantee the high quality, yield, and added value that the laws stipulate. Production management must be further improved in order to increase quality: added value also comes from controlling water input, amounts of sunlight, and growing speeds. In pursuing such “precision agriculture,” it is crucial to have precise information about various factors affecting production. Given that many large-scale participants in “high-tech agriculture” in Vietnam, including Vin Group, Hoa Phat Steel, and Truong Hai Automobile, do not have experience in agriculture, collecting and analyzing information related to production factors, production methodologies, climate, market, etc., will be the key to their success.

Therefore, the application of information and communication technologies (ICT) in agriculture will also be vital. Use of ICT has become a global trend, especially in Europe. On the one hand, it helps meet the quality and safety requirements of powerful retailers; on the other, it helps solve the worsening problem of labor shortages in agriculture. Similar situations may affect Vietnam in the near future. Therefore, this paper aims to discuss the present situation, as well as the future prospects and challenges in the application of ICT in Vietnamese agriculture. The following section

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reviews the some countries' experiences in using ICT in agricultural and related sectors. Section 3 introduces some enterprises that are engaged in businesses related to ICT application in Vietnamese agriculture. In the concluding section, the paper points out the challenges to diffusing ICT application more broadly into agricultural production.

## **2. Global trends in ICT application in agriculture**

Knowledge, information, and data are acknowledged to be increasingly important factors in pursuing more efficient and environmentally sustainable agricultural production. In developed countries with established information-related infrastructure, the effect of computer applications in agriculture was discussed as early as the 1980s. Some American studies in the 1980s found that the use of computers in agriculture was strongly associated with farmers' (or farm managers') education levels and with the size of the farm (see Putler and Zilberman, 1988; Batte et al., 1990). Little seemed to have changed even after the internet came to be widely used at the beginning of the 2000s (Batte, 2010). However, with the recent development of information collection and sharing devices that do not require a high education level or large investment, such as mobile phones, farmers no longer face barriers in the adoption of digital technologies.

There are some global trends associated with the application of ICT in agriculture. More advanced digital devices, software (including mobile phone applications), so-called "platforms," and related business models have been invented and become widely used by individual farmers, corporate farms, scholars, and ICT enterprises. Accordingly, there are some studies on their practices and effects on ICT application in agriculture.

### **2.1 Precision agriculture**

Urban consumers' increasing demand for pollution-free, safe foods, the establishment of private standards by dominant retailers in Europe and the United States, and the proliferation of e-commerce have all contributed to ICT being used to increase transparency about agricultural products' production processes from farm to table. Even in developing countries like India, China, and Brazil, some enterprises have started to collect and provide producers with precise information on soils, water, weather, and greenhouse conditions in order to tailor their production to market demand (Mondal and Basu, 2009). These "precision agriculture" technologies, which use tools such as

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sensors and cameras with GPS modules and GIS (geographic information system) software, also help smallholding farmers improve production efficiency. Some enterprises sell single devices and software for precision agriculture, while others provide technology packages that include integrated technology services with more advanced features like online sensors, remote sensing, yield monitoring systems, etc.

## **2.2 Information availability and sharing among farmers**

Distance learning programs for agriculture provided by higher education organizations have long been available, conducted by correspondence, open universities, teleconferencing, and multimedia programs. Contemporary programs using a web-based “e-learning” method on computer or even mobile phone are expanding even in developing countries (Passerini and Granger, 2000; Abdon and Raab, 2005; Aker, 2010). As well as providing a traditional, one-way, method for specialists to provide farmers with information, ICT is being utilized by farmers to share information and knowledge with specialists and other farmers (Ballantyne, 2009), to acquire market information (see the many African cases reviewed in Mammo, 2015), and even to obtain weather information (CTA, 2018).

These practices of information and knowledge sharing have led to the new trend of “open innovation,” in which farmers and enterprises collaborate to develop new products, services, or markets. In 2018, the European Commission launched the SmartAgriHubs project, a public-private partnership in which ICT suppliers, farm enterprises, research institutes, technology experts, and other relevant actors are brought together across Europe to create networks for this “innovation ecosystem” in the agri-food sector<sup>3</sup>.

## **2.3 Big data analysis and smart agriculture**

The development of new technologies that enable the collection and sharing of digital information related to agriculture—especially in developed countries where the amount of accumulated data is enormous—has ushered in a new era of “smart farming.” “Big data” accumulated via new technologies such as the Internet of Things (or IoT, that is, data from agricultural machinery and robotics connected to the internet) and cloud computing systems can now be analyzed and used to support decision-making in farm

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<sup>3</sup> Information on SmartAgriHubs can be retrieved from the University of Ferrara website: <http://www.unife.it/ricerca/finanziamenti-gestione/ricerca-internazionale/progetti/smartagrihubs> (Accessed in January 2019)

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operations and management.

Information-related activities are being practiced in arable agriculture, livestock, horticulture, and fisheries (the literature on a wide variety of practices, mainly in Europe and North America, has been reviewed by Wolfert et al., 2017)<sup>4</sup>. These activities include sensing and monitoring, analysis and planning, control of climate conditions, storage of information in the cloud system, and sharing supply chain information. Accordingly, businesses have emerged that develop and provide network “platforms,” ranging from companies that provide one “layer” (a software, for example) to providers that package services with all the necessary layers (sensing, controlling, communication, cloud computing, analysis, etc.) (Ferrandez-Pastor et al., 2016).

### **3. Enterprises relating to ICT application in agriculture in Vietnam**

#### **3.1 Government policies to support “high-tech” agriculture**

The legal basis for the various policies that promote “high-tech” agriculture in Vietnam is the Law on High Technology, enacted in 2008<sup>5</sup>. The applied aspect of this law, called the National Program of Hi-tech Development Through 2020<sup>6</sup>, includes an agricultural sector component<sup>7</sup>. The master plan on high-tech agricultural zones<sup>8</sup> and the regulations for recognition of high-tech agriculture enterprises<sup>9</sup> were designed based on this program. According to the Law on High Technology and these subsidiary legislations, the government expects the application of high-technology to “turn out agricultural products of high quality, yield and added value” (Article 3, Section 5).

Although the government has keenly promoted this legislation, there are no reliable statistical data on entities related to “high-tech agriculture” in Vietnam. According to a news article, the Ministry of Agriculture and Rural Development has

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<sup>4</sup> According to the evaluation of Wolfert et al., the literature in this research area has lacked scientific rigor so far because big data applications are still in the early stages of development. However, it concludes that farm operations and management will continue to change drastically given farmers’ access to real-time data and real-time forecasting (Wolfert, et al., 2017: 77-78).

<sup>5</sup> 21/2008/QH12 issued on November 13, 2008.

<sup>6</sup> 2457/QD-TTg issued on December 31, 2010.

<sup>7</sup> The Agriculture Development Program of High-tech Application under the National Program of Hi-tech Development Through 2020 (1895/QD-TTg issued on December 17, 2012).

<sup>8</sup> Master Plan on Agricultural Areas and Zones Applying High Technology Through Year 2020 and Orientation to Year 2030 (575/QD-TTg issued on May 4, 2015).

<sup>9</sup> Regulation on Criteria, Jurisdiction, Order and Procedures for Recognizing Agricultural Enterprises Applying High Technology (19/QD-TTg issued on 19 April 2018).

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provided high-tech agriculture certificates to 40 agricultural enterprises, including 12 cultivation, 19 seafood and nine livestock enterprises<sup>10</sup>. Moreover, 35 “high-tech agricultural zones” have been developed, with the national and provincial governments planning three more by 2020. Although the names of these enterprises are not listed in the article, they seem to be those that operate agricultural production themselves using high-tech devices and systems.

Annex 1 is the list of the enterprises that post the information on their “high-tech” agriculture-related businesses on their websites. As can be seen in this list, in addition to the enterprises that operate their “high-tech” production, there are some newly established enterprises that develop and provide ICT-related equipment and services to individual farmers and agricultural enterprises. The following are two such examples. We collected this information through interview surveys, websites, and other documents provided by the enterprises.

### **3.2 Agri Media**

Established as a small venture in Hanoi in 2014, Agri Media has grown into an enterprise with 85 staff members and experts as of the end of 2018<sup>11</sup>. Agri Media is the first (and, at this point, only) private company with official authorization to provide weather information in Vietnam, collected at 90 smart weather stations installed across the country. The company specializes in providing real-time data and forecast data to registered farmers and enterprises. Agri Media also collaborates with many hydropower plants, providing accurate weather information and forecasts, helping plant managers decide when to discharge water from dams and in what quantity.

Agri Media has signed a partnership with telecommunication networks including Vinaphone and Mobifone, the two largest mobile network operators in Vietnam. Agri Media has 9 million registered users who use its weather information services. The company has also established a “call center” and mobile phone application, allowing registered farmers to make inquiries about farming-related decisions. This part of the company’s business is implemented without farmers’ financial burden (i.e., free of charge), and in some provinces, the Department of Agriculture and Rural Development has contracted with Agri Media to provide such services to local farmers.

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<sup>10</sup> *Vietnam Economic News* on October 30, 2018 (<http://ven.vn/high-tech-boost-vital-for-vietnams-farming-in-21st-century-35760.html>, accessed in January 2019)

<sup>11</sup> <http://agrimedia.vn/en/home/> (Accessed in January 2019)

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In addition to providing weather information, Agri Media provides various services related to weather and agricultural production, including:

- (1) Weather monitoring and forecast modeling
- (2) Planning a spraying and fertilizing schedule
- (3) Plant disease risk modeling
- (4) Crop monitoring
- (5) Insect monitoring
- (6) Soil analyses/irrigation management

Agri Media focuses primarily on open culture farming rather than greenhouse farming, recognizing that open culture is still the standard agricultural style for the majority of Vietnamese farmers. Agri Media started its pilot project on IoT application and big data in Thai Nguyen province, with plans to continue until December, 2019. The company collects local climate and related information, such as temperature, humidity, wind, etc., using sensors (made by Pessl Instruments, Austria) installed in open cultivating farms. It also collects soil data, mainly its temperature, pH, and electric conductivity levels.

In Thai Nguyen province, five districts are participating in the pilot trial, which covers a wide range of agriculture products, including tea, one of the province's major products. According to one project manager, the new ways of farming supported by Agri Media could improve their farm's efficiency in terms of water and fertilizer use by 30-40%, since decision-making will be based on data rather than experience or inspiration.

### **3.3 Hachi Smart Agriculture**

Established in 2016, Hachi Smart Agriculture is another Hanoi-based company<sup>12</sup>. Hachi provides consultation on the design and installation of hydroponic greenhouse cultivation systems with IoT-connected equipment. Hachi developed its business in collaboration with experts at the Vietnam National University of Agriculture (VNUA). After installing a greenhouse, Hachi provides solution services to farmers until the end of their first harvest. If farmers agree, Hachi also accepts productivity records from these farms. In addition to providing consultation and solutions, the company has

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<sup>12</sup> <http://hachi.com.vn/> (Accessed in January 2019)

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established some experimental farms, including one on VNUA property, in order to better understand which hydroponic production systems might be most appropriate for the Vietnamese climate and markets. The enterprise is also experimenting in software development, with the goal of being able to provide a means for farmers to control all inputs remotely from a Hachi smartphone application.

Hachi was awarded the “Vietnam Talent Award” by the Vietnamese Ministry of Information and Telecommunication in 2016 and, that same year, received support from Vietnam Silicon Valley, an “angel fund” that fosters technological innovation in Vietnam<sup>13</sup>. The World Bank has also provided assistance, through the Vietnam Climate Innovation Center, for Hachi’s IoT application for hydroponic cultivation of safe agricultural products according to VietGAP (Vietnamese Good Agricultural Practices).

Throughout its operations, Hachi has recognized that using ICT can create the conditions for more efficient greenhouse cultivation by reducing and economizing inputs such as fertilizer, water, and human resources. Hachi’s system is particularly valuable given its labor-saving potential and the higher guarantee of quality control for its agricultural products. On the other hand, the company is not yet fully confident in its energy-saving effect, and it recognizes that the fact that their system requires large amounts of electricity may be a challenge in the future.

#### **4. Concluding remarks: potential and challenges**

The first half of this paper demonstrates that the use of ICT in agricultural practice is a global trend, taking place in both developed and developing countries. The demand for precision agriculture requires the collection and analysis of digital information. However, information and knowledge related to production are no longer provided exclusively from knowledge-rich experts to farmers. Now, experts, farmers, and supply chain businesses are connected and able to exchange this information. The proliferation of mobile phones has also enabled increasing connectivity, with “platform” businesses accelerating these trends.

The application of ICT in Vietnamese agriculture is still in its early stages. Some enterprises have started to provide services that support decision-making by providing information on weather, production methodologies, or markets. Some have

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<sup>13</sup> <http://www.siliconvalley.com.vn/> (Accessed in January 2019)

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also established experimental farms, allowing them to measure the effectiveness of their production system using ICT equipment. Although there has not yet been sufficient analysis of these experiments, there is a growing expectation that ICT application will make agriculture more efficient and create more added value.

Given urban consumers' increasing interest in "safe" or "green" products and the growing presence of foreign retailers, demand for precision agriculture will surely increase in the near future. Increased opportunities to export agricultural products thanks to Vietnam's participation in free trade agreements will also increase demand for ICT applications, since those products must be produced in accordance with importers' certification requirements. The increased connectivity brought by ICT may also benefit the many who have recently shifted to these new commodities, including corporate farms and the farmers who switched from grain to non-grain crops, who will need information on production methodology and markets. Moreover, ICT application is also expected to enable more efficient production, reduce water use and other inputs, and reduce the labor requirements.

The Vietnamese government has issued many policies promoting high-tech agriculture. Many support measures in this field have been implemented, from low-interest loan to preferential land use, taxes (e.g., a reduction in equipment import tariffs), and training. Most of the beneficiaries of the government's support of "high-tech" agriculture are corporate farms sponsored by big enterprises like Vin Group—groups that can invest huge amounts of money in facilities and equipment. On the other hand, these policies and the various programs that support them are not specifically aimed at promoting ICT application or "smart" agriculture, and most startups and ICT solutions companies do not seem to benefit from these government policies.

These same policies and programs do not benefit ordinary farmers, either: the high-tech agricultural production methodologies promoted by the government, as well as the big corporate farms' practices, are less relevant to the traditional open cultivation of arable or horticultural land. In Vietnam, the challenge will be developing IoT equipment, software, services, and ICT production systems that are affordable and adaptable for ordinary farmers. The use of ICT by ordinary farmers will also be a solution to the current labor shortage in the agricultural sector, one that will no doubt worsen in the near future.

Encouraging the diffusion of ICT throughout ordinary farms may also increase the amount of data that IoT devices are able to collect. By using the

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accumulated data for big data analysis, this will in turn will help increase production efficiency and reduce production risks on a larger scale. The challenge in doing so lies in both collecting information efficiently and more cheaply and in storing, analyzing, and sharing this information securely using cloud computing systems. One new potential area in Vietnam is the establishment of network platform businesses to deal with these data. However, this may also lead unavoidably to arguments surrounding ownership of this information (to whom does this information belong? Who can decide the spheres of information sharing?). Policies related to the protection and use of this information should therefore be incorporated into the policies promoting high-tech agriculture.

Lastly, ICT can be used to support agriculture on a larger geographic scale. Concepts and practices of “climate-smart agriculture” have been proposed, describing ways in which agriculture can be adapted based on climate change to reduce environmental pressure during the production process, for example, in the cases of rice production and aquaculture in the Mekong Delta and coffee production in the Central Highlands (Nguyen Song Tung and Bui Quang Tuan, 2016). Using remote sensing and satellite images to capture data on a larger geographic scale would be of help in implementing climate change-adaptive agriculture or evaluating the impact of such climate-smart agriculture practices.

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Annex 1 List of enterprises with “high-tech” agriculture-related businesses

	Enterprise	Location	Profile	Link
1	Agri Media	Hanoi	Company specializing in weather forecast and Agriculture. Based on state-of-the-art technology, supplying technological solution, smart service of weather and agriculture, support preventing and dealing with the risk of disaster and limited adverse impact of climate change on agriculture, economic fields and human life.	<a href="http://agrimedia.vn/en/home/">http://agrimedia.vn/en/home/</a>
2	Hosco JSC Next Farm Project	Hanoi	Founded in 2010, Hosco provides IT services and solutions at national scale. Also the developer of Project Next Farm - IOT Solutions for Agriculture (Farm and Fishery), winning several national prizes for IT solutions	<a href="http://www.hosco.com.vn/Gioi-thieu-cong-ty.html">http://www.hosco.com.vn/Gioi-thieu-cong-ty.html</a> <a href="https://www.nextfarm.vn/">https://www.nextfarm.vn/</a>
3	Gratiot	Hanoi	Providing IoT/IT solutions for smartpone, smart-home, and smart agriculture	<a href="http://gratiot.top/hongphuc.net">gratiot.top/hongphuc.net</a>
4	HACHI Smart Agriculture	Hanoi	Hachi is to build smart hydroponic farm by apply nutrient know how, automation system and expert of agriculture engineer	<a href="http://hachi.com.vn/">http://hachi.com.vn/</a>
5	FPT Corporation Fujitsu Corporation	Project completed.	Cooperation Centre for Smart Agriculture - founded in early 2016, is the center that applies cloud computing in agricultural technology from Japan in Vietnam. Fujitsu trial at Ha Nam was partially funded by JICA Vietnam office.	<a href="https://fpt.com.vn/vi/tin-tuc/chi-tiet/fpt-va-fujitsu-khai-truong-trung-tam-hop-tac-nong-nghiep-thong-minh-fpt-fujitsu">https://fpt.com.vn/vi/tin-tuc/chi-tiet/fpt-va-fujitsu-khai-truong-trung-tam-hop-tac-nong-nghiep-thong-minh-fpt-fujitsu</a>
6	Delco Farm	Hanoi	Joint project between Wala JSC of VNPT Technology and Delco Investment & Construction JSC in 2016, 6-ha farm in Bac Ninh province, applied technology from Israel, Thailand, etc. on agricultural products (eggs, melon, vegetables)	<a href="https://delcoagri.com/">https://delcoagri.com/</a> <a href="https://thingxyz.net/about">https://thingxyz.net/about</a>
7	Demeter Vietnam		Start-up that provides IOT solutions applicable to most models in Agriculture in Vietnam. Its partners include Cau Dat Farm (Da Lat), joint venture of Intel and a Malaysian company about shrimp (Ca Mau), etc.	<a href="http://demeter.vn">http://demeter.vn</a>
8	Global	HCM City	Global CyberSoft (GCS) is a leading global IT solutions provider	<a href="http://www.globalcybersoft.co">http://www.globalcybersoft.co</a>

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	Cybersoft Vietnam Smart Agri		founded in California in July 2000, and has been a company of Hitachi Consulting Corporation since October 2014. With extensive experiences and rich expertise, Global CyberSoft poses to be a major IT pioneer and trusted partner in Vietnam since 2007. After 13 years of operation, GCS has reached the top of leading IT companies in Vietnam with many awards and certificates, especially CMMi level 4.	<a href="http://smartagri.com.vn/#/home">m/en/about-us http://smartagri.com.vn/#/home</a>
9	Mimosa TEK	HCM City	Founded in 2014, Mimosa TEK provides farm management solutions for both smallholder farmers and large agricultural companies in different parts of Vietnam and for different crops. Mimosa TEK collaborates with reputational partners in irrigation infrastructure supplies and greenhouse construction to provide complete solutions for customers.	<a href="https://mimosatek.com/en/site/home/our_story">https://mimosatek.com/en/site/home/our_story</a>
10	Eplusi Technology LTD	Can Tho	Eplusi Technology originates from a group of electronic engineering students, the year of 2009-2013 Can Tho University, majoring in Electronics and Telecommunication Engineering, Computer Engineering, Automation – Control Engineering. Eplusi Technology Co.,Ltd was officially founded on 25th August 2016, and recently located in Ninh Kieu District, Can Tho City, Vietnam. Eplusi Technology is technically supported by staff members of the Department of Electronics and Telecommunication Engineering, College of Engineering Technology, Can Tho University (Dr. Luong Vinh Quoc Danh).	<a href="https://eplusi.net/eplusi-overview">https://eplusi.net/eplusi-overview</a>
11	IoT Open Community for Viet Nam	Hanoi	IOCV is founded by five member enterprises, namely VCCI-ITB, VNPT Technology, FOSS Development & Services Jsc, VIELINA and NetNam. They are all five enterprises specializing in technology in Vietnam since 2017. The goal of IOCV is to build an open IoT community that shares the achievements of application development for businesses and end users in Vietnam. At the time of launch, in addition to its founding members, the IOCV had 21 members enrolled. IOCV is developed in nine groups, including market group, media group, business group, software group, hardware group, connection group, simulation team, IoT	<a href="http://iocv.fds.vn/">http://iocv.fds.vn/</a>

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			center and investors.	
12	CENINTEC	HCM City	Centre of Industrial Equipment and Technology Development (CENTINTEC) was founded in 1995, with most of the members from HCMC University of Technology (HUTECH).	<a href="http://cenintec.com/san-pham-2">http://cenintec.com/san-pham-2</a>
13	LINA Network	HCM City	In 2018, three big Thailand-based agriculture groups (Chok Chai, SAP Siam Food International and AIM Thai) signed a memorandum of understanding (MoU) with Vietnamese LINA Network to apply blockchain to make the source and quality of products transparent.	<a href="https://lina.network/">https://lina.network/</a>
14	RYNAN Technologies Vietnam JSC	Tra Vinh	Devoted to creating the most effective and environmentally friendly solutions for research, integration, production and commercialization of the cloud-connected smart meters, smart sensing devices, Software as a Services (SaaS) and mobile applications (Apps) for smart energy and water management networks to serve the residential, industrial and agricultural sectors.	<a href="http://rynan.vn/en/">http://rynan.vn/en/</a>
15	Vinamilk	HCM City	Founded in 1976, currently the largest corporation in Vietnam, specialized in Milk and dairy products, Vietnamese large brand name	<a href="https://www.vinamilk.com.vn/en/cai-tien-doi-moi/page/248/new-production-technologies">https://www.vinamilk.com.vn/en/cai-tien-doi-moi/page/248/new-production-technologies</a> <a href="https://www.vinamilk.com.vn/en/cai-tien-doi-moi/page/249/research-and-product-improvement">https://www.vinamilk.com.vn/en/cai-tien-doi-moi/page/249/research-and-product-improvement</a>
16	VinEco	Hanoi	Member of VinGroup, established in 2015, 200mil USD investment, 500 staffs, thousands of local employees. Specialized in producing and selling agricultural products.	<a href="https://vineco.net.vn/gioi-thieu">https://vineco.net.vn/gioi-thieu</a>
17	TH Group	Nghe An	Founded in 2008, currently one of the biggest corporations in Vietnam, specialized in Milk and dairy products.	<a href="http://www.thmilk.vn/index.php?route=information/process">http://www.thmilk.vn/index.php?route=information/process</a> <a href="http://www.thmilk.vn/information/farm_th">http://www.thmilk.vn/information/farm_th</a>
18	DTK Phu Tho	Hanoi	Founded in 2000 as a Commercial Company in animal feeding, in 2015,	<a href="http://www.dtk.com.vn/goc-ba">http://www.dtk.com.vn/goc-ba</a>

Sakata, Shozo ed. New Trends and Challenges for Agriculture in the Mekong Region: From Food Security to Development of Agri-Businesses, BRC Research Report, Bangkok Research Center, JETRO Bangkok/IDE-JETRO, 2019.

			DTK Jsc. expanded to all stages of production, from producing animal feeding to farming and food processing. Position 58th in Top100 largest private companies in Vietnam in 2016.	<a href="http://o-chi/dtk-khanh-thanh-nha-ma-y-san-xuat-trung-ga-sach-800-ty.html">o-chi/dtk-khanh-thanh-nha-ma-y-san-xuat-trung-ga-sach-800-ty.html</a> <a href="http://dtk.com.vn/gioi-thieu/lich-su-phat-trien-va-thanh-tuu.html">http://dtk.com.vn/gioi-thieu/lich-su-phat-trien-va-thanh-tuu.html</a>
19	Cargill Vietnam	HCM City	Cargill provides food, agriculture, financial and industrial products and services to the world. 155.000 employees worldwide, 70 countries/regions, 150 years of experience	<a href="https://www.cargill.com.vn/vi/n%C3%B4ng-nghi%E1%BB%87p">https://www.cargill.com.vn/vi/n%C3%B4ng-nghi%E1%BB%87p</a>
20	Huy Long An	Long An	Founder of HLA group (Mr.Vo Quan Huy) started his career since 1990s, but started banana industry since 2014, then until 2016, the first export from HLA began.	<a href="http://hla.vn/">http://hla.vn/</a>
21	Dalat Hasfarm	Dalat, Lam Dong	Scope of business: production, distribution of young plants, cut flowers and pot plants in both domestic and export markets.	<a href="https://www.dalathasfarm.com/thong-tin-doanh-nghiep">https://www.dalathasfarm.com/thong-tin-doanh-nghiep</a>
22	Minh Phu Seafood	HCM City	Minh Phu is leading seafood company in Vietnam. Their products are currently available in more than 50 countries and territories, with turnover of over VND 12,000 billion per year.	<a href="http://minhphu.com/en/about-us/">http://minhphu.com/en/about-us/</a>