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Training Information Technology Human Resources in the Era of Industry 4.0 in Vietnam

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Abstract

With the explosion of the Internet, digital transformation is an inevitable trend that no country can stand outside of. In Vietnam, digital transformation is considered an essential trend for the development of all sectors of life. To strongly promote the digital transformation process, Vietnam has set the goal by 2030 to become a digital nation, pioneering the experimentation of new technologies and models. To achieve this goal, Vietnam will enhance digital transformation efforts in three main areas: Digital government, digital economy, and digital society. To fulfill these objectives, it is necessary to synchronously implement various factors such as tasks related to perfecting and innovating technologies including digital infrastructure, digital platforms, specialized digital technologies, and especially training a workforce of information technology engineers to implement digital transformation in agencies

and enterprises to meet the requirements of digital conversion. This presents both an opportunity and a significant challenge for universities offering information technology programs in deploying training activities and enhancing the quality of information technology human resources amidst the ongoing digital transformation. In this article, the authors focus on the following main contents:

1. Clarifying the workforce of the information technology sector and the demand for information technology workforce;
2. Analyzing and forecasting employment and salaries in the information technology sector;
3. Proposing solutions to enhance the quality of information technology human resources to meet the requirements of digital transformation.

Keywords: Training, Quality of Human Resources, Information Technology, Digital Transformation, Digitalization, Digital Transformation Process, Digital Transformation Content

1. Introduction

The Fourth Industrial Revolution (also known as Industry 4.0) has changed the way people live and work. In the report *"Preparing the Future Workforce for the Fourth Industrial Revolution. An Action Framework for Organizations"* by Deloitte Global and the Global Business Coalition for Education, the key features of the Fourth Industrial Revolution include: Increasing automation and the use of robots, big data to create intelligent supply chains, and artificial intelligence in decision-making. In the context of the Fourth Industrial Revolution, the trend of digital transformation aimed at enhancing labor productivity and operational efficiency is an inevitable trend for businesses. The replacement of humans with machines, modern technology has become the goal and means to develop the economy in countries. Digital transformation is an inevitable trend for every country facing the impact of the Fourth Industrial Revolution, and Vietnam is no exception. In that context, the demand for information technology engineers is very high to build and operate digital data systems, digital technologies that are being strongly implemented in Vietnam and around the world. Therefore, to meet the new requirements of the market, of businesses in the context of digital transformation, Vietnam needs to train a sufficient quantity of quality information technology human resources amidst the ongoing digital transformation. This is a major challenge for universities offering information technology programs in designing training curricula, implementing training activities to enhance the quality of human resources in the context of digital transformation.

2. Theoretical Basic

The demand for information technology human resources and the challenges posed to training information technology human resources

Improving the quality of human resources is an important factor in economic development, especially in the current context of digital transformation. In recent years, the Party and the State have been particularly concerned with building and developing high-quality human resources to meet the requirements of industrialization, modernization, and international integration. Through the Congresses of the Communist Party of Vietnam, the Party's viewpoint on the development of human resources, especially high-quality human resources, demonstrates continuity, comprehensiveness, and adaptability to meet the requirements of human resources in the new context of globalization and deeper international integration. As a result, the quantity and quality of high-quality human resources have achieved some encouraging results in recent years. However, the development of high-quality human resources still reveals many limitations that have not met the requirements and tasks, especially the new demands for technological change in the context of digital transformation. Currently, one of the biggest obstacles assessed in the context of digital transformation is the lack of high-quality human resources to meet the requirements of digital transformation.

To propose training solutions to enhance the quality of high-quality human resources to meet the requirements of digital transformation, the authors conducted a survey of 86 enterprises using 2 questionnaires: A questionnaire for 86 managerial staff (representatives of enterprises) and a questionnaire for 270 workers to assess the current situation of workers' skills and the level of their skills in response to the requirements of digital transformation, the challenges posed to high-quality human resources to adapt to technological changes in the context of digital transformation. Based on this, proposing training solutions to enhance the quality of human resources to adapt to technological changes in the context of digital transformation.

Firstly, it is necessary to understand the information technology human resources, the information technology human resources in Vietnam are the workforce working in telecommunications enterprises, information technology industrial enterprises; human resources for information technology applications; human resources for training in information technology, electronics, telecommunications, and people using information technology applications. This human resource is a key factor in determining the application and development of information technology in Vietnam. To perform well in the information technology industry, this workforce must have in-depth knowledge and skills in Computer science, Software technology, Computer engineering, Information systems, Computer networks and communications, Network security, research and development, processing, or application of software systems; knowledge of design, construction, installation, operation, and maintenance of computer system components, hardware, software of computer systems and computer-based equipment systems; knowledge of computer networks and communications. These are essential knowledge and skills for building and operating infrastructure systems to serve digital transformation in

Vietnam today.

In the context of deeper international integration, the demand for developing e-government in Vietnam along with increasing applications of information technology in enterprises, organizations are growing larger, evidenced by the number of information technology startup companies being very large and rapidly increasing in recent years. The strong development of Vietnam's e-government along with the strong development of software development companies and information technology consulting and development companies is leading to a large and increasing demand for highly skilled information technology human resources. Specifically, there are currently many domestic startups operating in the information technology sector, along with Vietnam's achievement of agreements, signing and effective enforcement of the EU-Vietnam Free Trade Agreement (EVFTA) leading to a large demand for information technology human resources due to investment waves from foreign technology companies, software development companies into Vietnam. As technology advances, the demand for human resources in this field increases. Career directions in the information technology industry are diverse, and career opportunities are closely related to designing information technology software applications in various fields and information technology solutions in organizations, enterprises. Depending on the nature of the business domain of agencies or enterprises, positions for graduates in information technology can be classified as follows:

1. Become a software developer: Directly creating software products.
2. Software quality assurance: Directly inspecting the quality of products created by software developers.
3. System analysis and design specialist, data management, network administration, computer hardware technical, etc.
4. Information technology project management expert, coordinating various IT projects.

According to forecasts from the Ho Chi Minh City Labor Market Information Forecasting Center for the period 2020 - 2025, the demand for information technology and information management system human resources ranks second among the 4 key industries in Ho Chi Minh City.

TopDev conducted a survey consisting of 46,000 IT candidates, 1,151 businesses, and over 150,000 job data sent to Forbes Vietnam, showing that the demand for recruiting IT personnel continued to increase sharply after 2020, and it is forecasted that there will be a shortage of IT personnel after 2020. According to statistics from the TopCV recruitment platform, software IT employees are one of the top three most sought-after positions in 2022, and this trend continues to be maintained this year, along with two other industries, business, and marketing. It is forecasted that from 2022 to 2024, Vietnam will still lack 150,000 - 195,000 programmers/IT engineers annually. (Source: TopDev: Forecasting IT Labor Shortages - ITICTQL)

Also, according to TopDev's report, Vietnam has attracted attention, leading technology companies in the region to come here to hire or build product development teams, with a growing wave of innovative startups in the technology sector, especially after major investments in technology startups. The wave of transformation of traditional

companies (Digital Transformation - DX) such as tourism, agriculture, real estate, etc., all want to do DX and e-commerce. This leads to a significant increase in the demand for IT personnel on a broad scale in the coming years. At the recent Vietnam ICT Summit 2019, Minister of Information and Communications Nguyen Manh Hung stated that Vietnam needs to develop an additional 50,000 information technology (ICT) businesses to accelerate Vietnam's digital transformation. With this observation, it can be seen that the trend of IT human resource demand is very large, contributing to the development of the digital economy in Vietnam, where the IT sector is a branch of IT.

In the US, graduates in information technology have the highest starting salaries among the 144 professions surveyed. In Vietnam, in recent years, graduates in information technology have attracted great attention from businesses with quite high starting salaries compared to the

general level of the economic - management - social sector. According to Mr. Tran Anh Tuan, Deputy General Director of the Labor Market Information and Forecasting Center, Ho Chi Minh City: The practical demand for training engineers, bachelor's degrees with the ability to analyze, design, build, and operate information technology systems is becoming increasingly urgent. Especially in today's information explosion era, the demand for building, developing, and managing activities of e-government, e-commerce, e-learning, etc., is increasingly requiring skilled IT experts in Vietnam.

Regarding salaries, the income for positions in the information technology sector, the salary survey results from First Alliance show that the salaries of positions in the information technology sector are very high, much higher than those of labor in the economic - management sector. Specifically:

Table 2: Salaries of some positions in the information technology industry

Unit: USD/Month

Position	Hanoi			Ho Chi Minh City		
	Experience	Min	Max	Experience	Min	Max
Data Scientist	1-5	1,500	5,000	1-5	1,500	5,000
Senior Bridge System Engineer (BSE)				6-10	2,000	3,000
Data Engineer	1-3	1,500	5,000	1-3	800	1,500
Project Manager	5-12	1,500	3,500	5-10	2,000	3,500
Business Analyst	2-5	1,000	2,200	3-8	1,500	2,500
QA/QC Manager	6+	1,500	2,500	6+	2,000	3,000
QA/QC Engineer	1-6	500	1,500	1-6	600	2,000
Senior Tester/ Test Lead	3-5	700	1,500	3-5	700	1,800
ERP/SAP Consultant Lead	5-10	1,500	4,000	5-10	2,500	5,000
ERP/SAP Consultant	2-5	800	2,000	2-5	1,000	2,500

Source: Vietnam 2021 salary guide - First Alliance salary survey

According to statistics from the TopCV recruitment platform, among the 10 surveyed industries, Software IT and Information Technology (IT) are among the highest-paying groups when comparing personnel with the same seniority.

Chart 1 shows the salaries of IT industry positions based on seniority. Specifically:

The internship position in the field of software IT offers a salary of 3-5 million dong. Meanwhile, salaries for positions in the communication and advertising sector range from 2.5 to 4 million dong, auditing sector from 3 to 4 million dong, and education sector from 2.5 to 4.3 million dong.

With 1-3 years of experience, personnel in the software IT industry are paid 15-30 million dong, while those with over 5 years of experience earn 30-50 million dong. In the field of information technology (IT), the corresponding salary ranges from 13.8 to 25 million and 30-50 million dong.

Statistics also show that work experience significantly influences the salaries in the IT and IT fields. While IT personnel with less than one year of experience only receive salaries ranging from 7 to 16.5 million dong, this figure doubles after 1-3 years.

In managerial positions, the salary of Chief Technology Officers (CTOs) is the highest, ranging from 60 to 142 million dong. This is much higher compared to Human Resources Directors (49.5-90 million dong), Business Directors (60.5-120 million dong), and Finance Directors (50.5-105 million dong).

With forecasts indicating an increasing demand for personnel and salaries, the rising income in the information technology industry is providing opportunities for trained

personnel in the field. However, it also poses challenges for startup businesses and Vietnamese enterprises operating in software development due to the scarcity of IT personnel and significant investment waves from technology companies entering Vietnam. This presents an opportunity for universities to train IT personnel better, but it also poses a challenge in enhancing the quality of education to meet the increasing demand for IT personnel in both quantity and quality.

3. Recommendations

Some recommendations to enhance the quality of information technology education to meet digital transformation requirements.

Recommendations for universities offering information technology programs in Vietnam

In recent years, facing the increasing societal demand, particularly from businesses, the number of universities offering information technology programs in Vietnam has been on the rise, both in the North and South. However, the domestic supply of information technology professionals from universities still does not meet the demand for this workforce. In terms of policy, the Ministry of Education and Training has established specific training mechanisms and prioritized admission and training for groups of majors in the computer science and information technology fields to meet the demand for this workforce for the entire national economy, including computer science, computer networks and data communication, software engineering, information systems, information security... providing motivation for universities to enhance their training capacity to meet the

demands for human resources. Therefore, in the coming time, universities need to be proactive in anticipating the investment trends of European companies in Vietnam, as the demand for information technology workforce continues to increase to establish information technology education programs and develop advanced training programs to meet the demand for both quantity and quality of information technology workforce for domestic and foreign-invested enterprises. Additionally, universities, students, and academies specializing in information technology need to establish close links with businesses to train information technology professionals:

Firstly, universities need to proactively develop training program content, admission consulting, admission organization, and implementation to meet the labor market demand, annual enrollment targets. Specifically, to achieve high-quality training and meet the demands for information technology professionals in the labor market, universities need to focus on:

Developing advanced, specialized training program content inheriting from advanced computer science universities worldwide.

Innovating training methods, focusing on applying information technology in teaching. The changing methods lead to changes in teaching methods, traditional pedagogical techniques are no longer suitable or effective. The implementation methods must change, requiring creativity, flexibility in the application and use of technology features and devices to achieve the expected teaching results. Digital transformation is not just about digitizing lectures or using software for lesson preparation but also about transforming the entire teaching method, teaching techniques, classroom management techniques, interaction with learners into the digital space, leveraging information technology to successfully organize teaching. Student learning processes are also tracked and stored using technology rather than traditional record-keeping systems.

Providing in-depth training in information technology, updating training programs according to technology change trends in the context of digital transformation. In addition to focusing on professional training, universities and training institutions need to strengthen skills training for IT students, especially self-learning skills, research skills, teamwork, communication, and foreign languages, as foreign languages are key and the biggest bottleneck for IT personnel, hindering IT personnel from accessing new knowledge from the world and the region.

Enhancing the quality of lecturers: Improving the professional competence and skills of lecturers, who need more practical experience in production units. Furthermore, training institutions need to expand international cooperation in training, fostering, and improving professional competence, selecting capable and quality personnel and students for studying and in-depth research in new fields worldwide.

Building and improving training facilities and equipment. To be able to train high-quality information technology workforce in the context of digital transformation, universities need to develop and perfect many synchronous factors such as tasks related to perfecting, innovating technology including digital infrastructure, digital platforms, specialized digital technologies for educational training, innovating appropriate institutions and supporting digital transformation.

** Collaboration with technology companies in training information technology workforce*

Universities and technology companies can collaborate in training in the following ways:

(1) Developing advanced training programs, updating according to changing information technology trends.

To develop advanced training programs, and to keep up with the rapidly changing trends in information technology, universities need to invite experts from companies to participate in building training programs, contributing opinions to improve information technology training programs.

(2) Collaborating in training activities, organizing internships, and practical visits to companies.

To enhance practical knowledge and skills for students to meet job requirements at companies, universities need to collaborate with companies, inviting IT experts from companies to participate in training specific modules, especially in-depth topics on information technology, new trends in technology innovation and information technology. Furthermore, universities also need to organize practical visits, sending students to intern at IT companies such as FPT, VIETTEL, MISA, CMC,... so that students can practice skills in real-life situations and update new knowledge, skills, and technologies at companies.

Additionally, agencies and businesses commission key training institutions in some areas such as cybersecurity, information security to invest resources in human resources and infrastructure to serve training, build traditional training systems combined with online training, develop training topics suitable for each target group, management agencies, businesses, public service units,...

Recommendations for businesses in need of information technology workforce:

In the context of intense competition among businesses (both domestic and foreign-invested businesses), to attract and select enough and qualified information technology workforce, businesses need to implement the following measures:

- *Firstly, it is necessary to establish good remuneration policies and create favorable working environments to attract and retain information technology workforce.*
- *Secondly, it is necessary to collaborate with universities, academies in training high-quality information technology workforce, including offering scholarships to outstanding students, participating in developing training programs, participating in the training process at universities specializing in information technology, accepting students for internships to develop capacity to meet job requirements for the company.*
- *Thirdly, directly training workforce to meet job requirements by accepting fresh graduates majoring in information technology and continue to train them to meet various job positions.*

4. Conclusion

With the trend of digital transformation, the demand for information technology workforce is significant, providing ample opportunities for IT professionals to work for domestic and foreign-invested enterprises with high salaries and incomes. However, to meet the complex requirements of the IT industry and to adapt to working in large companies, especially those with foreign investment and

multicultural environments, Vietnamese workforce in general, and IT workforce in particular, need to study and train to enhance their capabilities:

- Enhancing professional capabilities: IT workforce needs to study and train extensively in both deep knowledge of information technology and foreign languages, as well as soft skills such as adaptability, trend awareness, communication skills, teamwork,...

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