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Readiness of Economics Students for Industry 4.0: A Case Study at Private Universities in Vietnam

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Abstract

The present study aimed to qualitatively investigate the readiness for The Fourth Industrial Revolution (Industry 4.0) of economics majors at Vietnam's private universities. Initially, A survey questionnaire was built to collect data from 350 students majoring in economics at private universities in Vietnam. The rate of valid answers is 100% (N=350). Descriptive statistics and regression analysis were used to analyze quantitative data. Through the regression analysis, findings confirmed a research representative model which had previously hypothesized that perceptions, tech skills, and non-tech skills of Vietnamese economics majors are correlated to their readiness for Industry 4.0. The findings of this study suggest that higher education plays a crucial role in heightening undergraduates' skills to gear up for their future careers during this disruptive development. The analysis results of the article can be used as a reference to increase college students' readiness toward IR 4.0, thereby ensuring the quality of students after graduation to meet the needs of society.

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1 Introduction

Currently, the industry worldwide is standing in the 4th stage of development, also known as the fourth industrial revolution (Omar & Hasbolah, 2018). The Fourth Industrial Revolution or Industry 4.0 originates from industrial development and high-tech strategies in 2011 in Germany. It is the premise to open up concepts such as the Internet of Things, Industrial Internet, Manufacturing based on cloud computing, and Smart Manufacturing. Specific products include robotics, artificial intelligence, autonomous vehicles, 3D printing, nanotechnology, biotechnology, materials science, energy storage, etc. (Ahmad et al., 2019; Kuruczleki et al., 2016).

The scientific and technological achievements created by Industry 4.0 are gradually replacing people in many fields of production and business, especially in simple, hard labor, or other complex activities. This directly threatens workers who do not have the right qualifications. Therefore, human resources in today's era are required to equip themselves with necessary skills and competencies such as problem-solving skills, communication skills, interpersonal skills, learning lifelong learning, and the ability to work in teams to solve challenging problems and manage complex workplace situations (Kwok et al., 2014). Responding to that need, today, most countries focus on teaching and training skills and knowledge toward Industry 4.0, especially in higher education. Currently, higher education is undergoing a generational transition, as universities must adapt to the needs of the 21st-century workforce (Rayner & Papakonstantinou, 2015).

In Vietnam, the leadership is always interested in developing the country in the rapidly developing science and technology context of Industry 4.0. Besides, the number of Internet users in 2018 in Vietnam reached 64 million, accounting for 67% of the population. Vietnam can be in the top 10 countries with the highest percentage of people accessing the Internet, with about 80% of the population using the internet by 2020. As for social networks, there are 55 million users, accounting for 57% of the population (DAMIO, 2018). Statistics show that Industry 4.0 has a strong impact on all areas of Vietnamese social life. That shows the fact that to race with an Industry 4.0, which is said to have no historical precedent and an exponential growth rate (WEF, 2016), the training of human resources with a high level of readiness for Industry 4.0 is considered to show potential for job performance and development of the country (Caballero & Walker, 2010).

Countries around the world in general and Vietnam, in particular, have identified "Education" as the key to moving forward and developing the country in the context of Industry 4.0. Therefore, to assist in enhancing the quality of education in this era, the study will examine the readiness of economics students at private universities in Vietnam for Industry 4.0. The two research questions posed by the authors to form the basis for the article are:

1. Are students' perceptions, tech skills, and non-tech skills positively related/correlated to the student's readiness for Industry 4.0?
2. Which factor has the strongest influence on the readiness of economics students for Industry 4.0?.

In addition to learning about perception and measuring students' readiness for Industry 4.0 (an important indicator affecting the quality of human resources for Industry 4.0), our research team also formed a research hypothesis that "Students' perception of Industry 4.0 will have an impact on their readiness for Industry 4.0". The acceptance or rejection of the hypothesis will be through the results of data processing obtained from the student survey. With this novelty, the study hopes to attract and expand more research related to this topic in the future.

Literature Review

Industrial Revolution (IR) 4.0 is the fourth development phase of the Industrial Revolution in the world, characterized by a combination of technologies related to the physical, digital and biological scope. According to a report at the World Economic Forum (WEF) Conference held in January 2016, Industry 4.0 is a technological advancement with automation and data exchange through cyber-physical systems, the Internet of things, cloud computing, and cognitive computing. It is also often referred to as a "smart factory" because a modern technological system monitors the physical production processes, contributing to economic value (Schwab, 2016). It can be said that Industry 4.0 brings tremendous impact to the world because it affects the way people live, work, play, socialize, and even how people should behave (Ahmad, 2016).

The existence and influence of the Industrial Revolution (IR) 4.0 on the development of a country has caused most countries to race against each other in the application of Industry 4.0 in all fields in life, and Vietnam is no exception.

For Vietnam, Industry 4.0 is a potentially great opportunity. However, most domestic organizations and businesses (including private and public) are still not prepared for how Industry 4.0 will transform their business or organization. Leaders fear Industry 4.0 will affect the entire organizational system. It involves major changes and uncertainties in processes, management, and operations and change can simplify or complicate the problem, depending on its application. Responding to the challenges of Industry 4.0, the Vietnamese government has issued promulgations towards Industry 4.0, specifically "Resolution 52-NQ/TW dated September 27, 2019, of the Politburo on several Undertakings and Policies to actively participate in the Fourth Industrial Revolution" and "Decision 749/QD-TTG 2020 on approving The National Digital Transformation Program to 2025, orientation to 2030". Accordingly, Vietnam agrees that the perception of human resources will play a decisive role in moving towards Industry 4.0. For that reason, the Government determines that education plays an extremely important role, and it is necessary to prioritize the application of Industry 4.0 in Vietnam (Kaminski et al., 2009; Saraswati et al., 2020; Dewi, 2020).

Towards Industry 4.0, the Education Program must be adjusted to strengthen and add appropriate skills and knowledge to students. Accordingly, Education 4.0 was introduced to improve and modify the structure of education, especially in universities, to produce creative and highly analytical students who can integrate, collaborate and work together not only with humans but also with robots as well because those skills are imperative in the future employment (Sani, 2018). This educational model is also commonly known as Industrial Education when it integrates Industry 4.0 into the learning system of educational institutions. Therefore, it helps students know and understand society's labor needs (Hasees, 2018). Since then, Industrial Education has helped students increase their competitive job opportunities after graduation. In Industry 4.0, Education for sustainable development based on practice and research is an important condition to meet the needs of applying Industry 4.0 achievements to the development of countries.

Currently, in the world and in Vietnam, there are very few studies related to the level of readiness for Industry 4.0, especially among university students. Most previous studies only focused on higher levels such as workers or management. The government may not have done enough to communicate the importance of Industry 4.0, thus explaining the lack of perception among the population that must include students (Abdullah et al., 2017). One of the pillars of Industry 4.0 is economical, so human resources working in this field must ensure high adaptability and stability at work. To achieve that requires them to have a solid foundation in Industry 4.0-related knowledge, perception, and skills after graduating from university. Combined with the fact that there has not been any specific research on students' readiness for Industry 4.0 at private universities, the research motivation of the topic was formed.

Various methods or techniques have been used to measure student readiness. In a study by Caballero & Walker (2010), she used qualitative methods to identify job readiness characteristics and then developed a scale known as the Work Skills Scale (WRS) to measure the job-readiness of the graduate population. Qualitative data identifies ten broad categories of job readiness: motivation, maturity, personal growth/development, organizational awareness, technical focus, interpersonal orientation employee, work attitude, problem-solving, suitability, and endurance. In her research, Dr. Holly Hungerford-Kresser, used qualitative research, a combination of action research methods and case studies. The action research method is flexible constant and allows him to critique and adjust appropriately to the task at hand. More specifically, Ahmad et al. (2019), identified Technical Skills and Non-Technical Skills as two factors affecting students' readiness for Industry 4.0. Based on the development of the results of this report, we develop the paper's conceptual framework.

In an overview of previous studies, Ahmad et al. (2019), identified that technical skills include using specialized tools, processes, and techniques (Rasaki & Abioye, 2018). Technical skills include skills necessary to achieve service delivery duties, including specialized knowledge in the use of tools and instruments. Technical skills are known as computer skills and Internet knowledge. One study found that technical skills were most sought after in new payrolls (Aasheim et al., 2009). Technical skills are unique to a particular job area (Stone, 2011). The technical skills listed in the previous study include knowledge and applicability in computers, programming languages, database management, optimization, and key areas. of management accounting, finance, and operations management (Farkas & Nagy, 2008). Ahmad et al. (2019), also asserted that non-technical skills include Industrial Revolution awareness and soft skills of graduates to use Industrial Revolution knowledge and disciplinary skills in the workplace (Jackson & Chapman, 2012). Non-technical skills, commonly referred to as core or professional skills, are common among students of all disciplines (Jackson & Hancock, 2010). Employers recognize that gaps in non-technical skills affect performance, output, and job performance (Roepen, 2017). The more fundamental problem is that despite a basic understanding of non-technical skills in higher education, most students are opposed to linking university training with industry requirements and thus challenge the curriculum reform strategy (Jackson & Hancock, 2010). The results from the average values of the variables related to Technical skills and Non-technical skills given by Ahmad, AR et al., have proven their research hypothesis completely correct.

Ahmad et al. (2019)'s model is accepted and used in a few studies related to determining readiness for Industry 4.0. Most of them only focus on two factors, Technical skills and Non-technical skills, in developing students' readiness to ensure the quality of human resources to meet career requirements in the digital age, typically those of Yazgan (2021), or Ulfatin et al. (2020). Our authors will conduct a re-test of their model to complete the research purpose. Not only that, we have found one more qualified factor affecting students' readiness for Industry 4.0, which is students' perception. This factor is based on the study of Omar & Hasbolah (2018). Therefore, we give the conceptual framework of the article, as shown in Figure 1. Based on this framework, we will re-test their model and seek answers to the research question that we have posed to satisfy the purpose of the study.

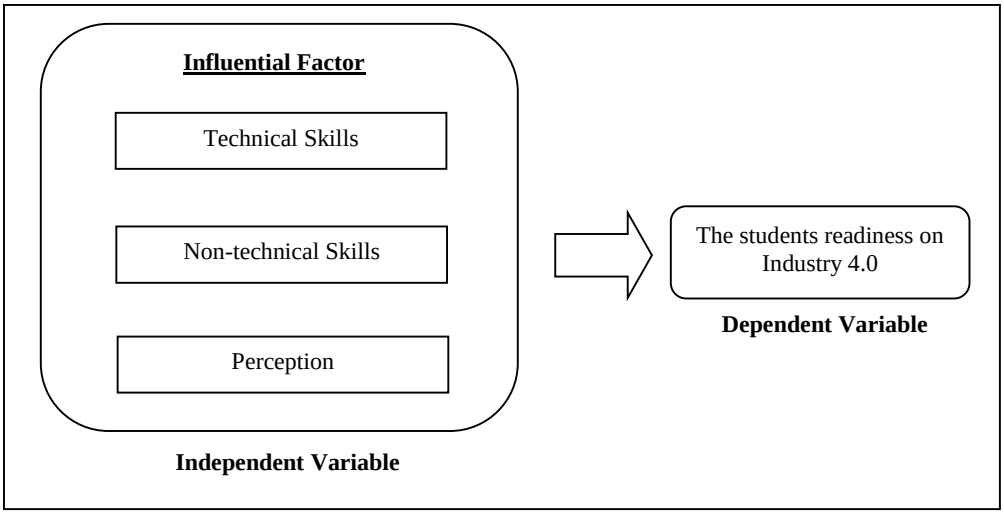

Figure 1. Theoretical Framework of the study

2 Materials and Methods

Research data

The study used a survey questionnaire to collect data, consisting of five sections. Section 1 includes detailed questions related to the respondents' demographics, namely: Age, Gender, and Year of College. Regarding gender, the sample was divided into male and female. For the university year, the request made to the respondents is to indicate what year they are currently studying at the university. Section 2 aims to find out information about students' awareness and knowledge of Industry 4.0. Respondents' awareness and knowledge are measured by letting them self-assess their level of interest and knowledge about Industry 4.0, the sources of information that respondents learn about Industry 4.0, and their further understanding of it is indicated by choosing a "yes" or "no" question. Section 3 includes 10 statements for students to self-assess to make their point of view about Industry 4.0. These statements are in the form of a Likert Scale that ranges from 1 (strongly disagree) to 5 (strongly agree). Next, section 4 assesses students' attitudes towards Industry 4.0. The aim is to know if they are engaged in activities that bring about greater knowledge and perception of Industry 4.0. The last section still uses the responses in the Likert Scale to explore the respondent's readiness for Industry 4.0 and the factors affecting this level of readiness (Neumann et al., 2021; Bauman & Rose, 2011; Honti et al., 2020).

The survey questionnaire was built using the Google Forms application and sent to students in the economic sector studying at private universities in Vietnam for online implementation. In total, 350 students participated in the survey. After the screening process, 350 responses were valid and could be analyzed. Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 23 software (IBM Corporation, New York, NY, USA). Descriptive and frequency analysis was performed, and the results were based on the total number of respondents answering each specific question.

Measuring student readiness toward Industry 4.0

To measure the readiness for Industry 4.0, the study compares the average value between the questions representing the concept of readiness for Industry 4.0 and the estimated value of the interval (Yasin et al., 2016; Landell, 1997). There are three corresponding range estimates. Namely, 1.00 to 2.33 is low, 2.34 to 3.67 is average, and 3.68 to 5.00 is high. Comparing the average value of the question item with the range of values, it is possible to know the students' readiness for Industry 4.0. The interpretation of the interval estimate is shown in Table 1 below.

Table 1
Interpretation for the estimate

Group	Mean Scores	Interpretation of Mean Scores
1	1.00 – 2.33	Low
2	2.34 – 3.67	Moderate
3	3.68 – 5.00	High

Factors affecting readiness for Industry 4.0

To determine the factors affecting readiness for Industry 4.0, based on the studies of Omar & Hasbolah (2018); Ahmad et al. (2019), combined with the results of data analysis from the survey questionnaire, we built a representative research model through the following regression equation:

$$Readiness_i = \alpha + \beta Perception_i + \lambda TechSkills_i + \gamma NonTechSkills_i + \varepsilon_i \quad (1)$$

In which: The independent variable "Perception" represents the student's perception of Industry 4.0; "TechSkill" represents the technical skill factor required for Industry 4.0, and "NonTechSkill" represents the soft skills factor required for Industry 4.0. The dependent variable "Readiness" represents the readiness factor for Industry 4.0. The results of the regression coefficient from equation (1) will be the basis to answer the research questions posed.

3 Results and Discussions

Characteristics of the study sample

The intended participants for this study were economics students at private universities in Vietnam (Table 2).

Table 2
Description of respondents

		Frequency	Percent
Gender	Male	92	26.3%
	Female	258	73.7%
	Total	350	100.0%
Student	1st year	174	49.7%
	2nd year	94	26.9%
	3rd year	77	22.0%
	4th year	5	1.4%
	Total	350	100%

Knowledge towards Industry 4.0

Students' self-reflection of their understanding of Industry 4.0 and their knowledge and information (Figure 2 and Table 3). Surprisingly, over two-thirds of the students gain information about Industry 4.0 from the mass media, and only one-fifth get their knowledge from university lectures.

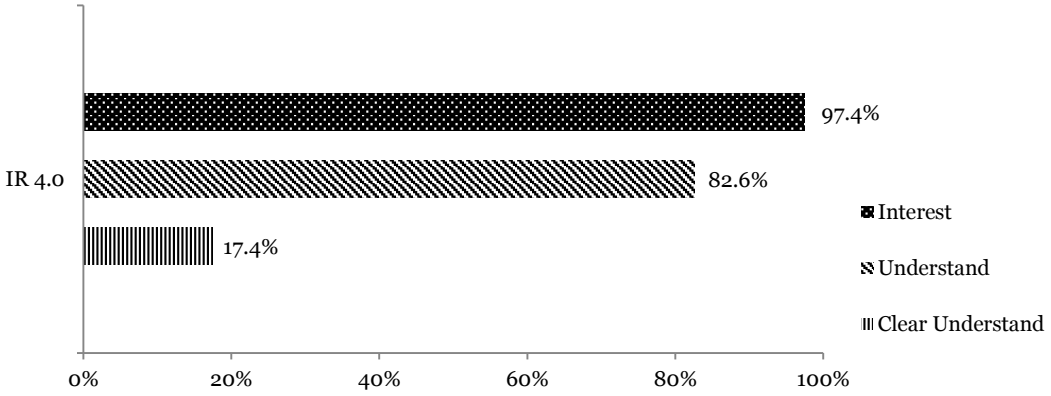

Figure 2. Students' understanding and interest in Industry 4.0

Table 3
Sources of information about Industry 4.0

Information sources	Frequency	Percent
Books, newspapers, magazines	140	20.7%
Media: TV, Radio, Social Network	331	49.0%
Talks and seminars	66	9.8%
Subjects taught at school	138	20.4%
Total	675	100.0%

Some statements related to Industry 4.0 for respondents to express their awareness and knowledge (Table 4). Only about 29.4% of students agreed that Industry 4.0 is similar to previous industrial revolutions; the rest expressed uncertainty or disagreement. This is confirmed when the first Industrial Revolution discusses the mechanization of production using water and steam power, the second focuses on creating mass production using electrical energy, and the third uses electronics and information technology to automate production; industry 4.0 mainly discusses the combination of technologies characterized by physical network systems, internet of things, cloud computing and cognitive computing. Furthermore, the students also agreed that Industry 4.0 is based on the use of physical network systems (68.3%), smart factories, big data and the internet of things (71.1%), digital transformation (74.9%), and automation (68.6%).

Table 4
Knowledge and Awareness of the Economics Students on Industry 4.0

Statements	Yes	No	Uncertain
Industry 4.0 represents the industry of the future.	85.1%	2.3%	12.6%
Industry 4.0 is similar to previous industrial revolutions.	29.4%	28.9%	41.7%
Industry 4.0 is based on the use of a Cyber-Physical System.	68.3%	2.9%	28.9%
Industry 4.0 is related to “Smart Factory”, “Big Data” and “Internet of Things”.	71.1%	2.6%	26.3%
Industry 4.0 is about digital transformation in the industry.	74.9%	5.1%	20.0%
Industry 4.0 is not just about automation and data exchange.	68.6%	6.9%	24.6%

Perception toward Industry 4.0

The results show the mean of all the variables used for the question as rated by the respondents (Table 5). All variables have mean values from 3.49 to 5.00, rated "Moderate" and "High." This shows that the students agree with most of the variables asked, but they cannot give stronger agreement (asymptote to value 5.00).

Table 5
Perception of economics students towards Industry 4.0

Statements	Mean	Level
Vietnam is ready for Industry 4.0.	3.694	High
Regulators and policymakers need to improve their understanding of Industry 4.0	3.694	High
Industry 4.0 requires skills in technology, data analysis, critical thinking, and adaptability	3.714	High
Due to Industry 4.0, the role of economic sectors has changed in response to new possibilities in data analysis.	3.631	Moderate
Data security is the biggest concern in Industry 4.0.	3.837	High
Industry 4.0 will enhance the efficiency of processes in an organization.	3.683	High
Industry 4.0 will bring greater benefits to society.	3.720	High
Industry 4.0 is the next evolution of automation that is more flexible and convenient	3.674	High
Industry 4.0 will have a huge impact on the employability of economics majors after graduation.	3.614	Moderate
Industry 4.0 will consume a significant part of the cost for an organization.	3.494	Moderate

Attitude towards Industry 4.0

The attitudes of economics majors at private universities in Vietnam and their reactions and behaviors towards Industry 4.0 (Table 6). The survey findings indicate that economics students are conscious of Industry 4.0 in their studies, despite their limited exposure. This is in line with their perceptions.

Table 6
Economics students' behaviour towards Industry 4.0

Statements	Yes	No	Uncertain
Have you ever discussed Industry 4.0 with your classmates?	45.1%	34.0%	20.9%
Have you ever learned about Industry 4.0 in class?	52.6%	28.0%	19.4%
Have you ever attended any seminars or seminars related to Industry 4.0?	25.7%	60.0%	14.3%
Do you agree that current students are lacking in exposure to Industry 4.0?	60.3%	19.4%	20.3%
Do you think that learning about Industry 4.0 is important for students?	81.7%	4.9%	13.4%
Do you think Industry 4.0 will change the learning method of the economic sector?	69.4%	11.1%	19.4%
In your opinion, should universities implement Industry 4.0 according to specific industries?	74.9%	6.9%	18.3%
Do you intend to know more about Industry 4.0?	81.7%	7.4%	10.9%

Check the reliability of the scale

The reliability test of the scale is done through Cronbach's Alpha coefficient test (Cronbach, 1951). The research model of the topic includes 3 independent concepts and a first-order unidirectional dependent concept. Each concept has at

least 3 observed variables. Cronbach's Alpha coefficient was performed separately for each concept. The scale only ensures reliability when Cronbach's Alpha coefficient is greater than 0.6 and the total correlation coefficient of the observed variables is at least 0.3. Table 7 shows the results of Cronbach's Alpha coefficient analysis.

Table 7
Cronbach's Alpha coefficient analysis results

Variables	Number of Items	Overall Cronbach's Alpha	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
Perception toward Industry 4.0	10	0.964	0.732 - 0.887	0.950 - 0.960
Tech skills required for Industry 4.0	5	0.934	0.809 - 0.836	0.917 - 0.922
Non-Tech skills required for Industry 4.0	10	0.962	0.793 - 0.865	0.956 - 0.959
Ready for Industry 4.0	6	0.969	0.882 - 0.922	0.961 - 0.965

Table 7 shows that the coefficients of Cronbach's Alpha of the research variables are all greater than 0.6 (the lowest is 0.934), and the correlation coefficients of the total variables are all greater than 0.3 (the lowest is 0.495) (Nunnally, 1978). This result shows that the scale has high reliability, and no observed variables are excluded from the scale.

Exploratory factor analysis

Exploratory factor analysis was performed for the independent and dependent variables. Table 8 summarizes the results of EFA analysis and factor rotation matrix.

Table 8
Summary of exploratory factor analysis results

Parameters	EFA (Independent Variables)	EFA (Dependent Variable)
KMO	0.949	0.928
Bartlett's test	0.000	0.000
Eigenvalue	1.701	5.200
Total variance extracted	0.762	0.867
Minimum load factor	0.743	0.919
Number of extracted factors	3	1
Number of variables eliminated	0	0

The results in Table 8 show that, performing EFA analysis for independent factors with KMO = 0.949 (greater than 0.5) and Sig. Bartlett's Test = 0.000 (less than 0.05), Eigenvalue = 1.701 (greater than 1), 3 factors have been extracted with a total variance of 74.3% (greater than 50%) and no observed variables excluded due to meeting the conditions of convergence and discriminant value of the scale (Hair, 2009). Accordingly, factor 1 (X1) corresponds to the concept of "Perception toward Industry 4.0" including 10 questions, presented results in section 3.1.3 of this article. Factor 2 (X2) corresponds to the concept of "Technical skills needed for Industry 4.0" including 5 questions; and finally, factor 3 (X3) corresponds to the concept of "Non-Technical skills needed for Industry 4.0" including 10 questions. The next section will present detailed results of questions belonging to two factors, X2 and X3.

Also, in Table 8, the study performs EFA analysis for the dependent factor corresponding to the concept of "Ready for Industry 4.0". The results of EFA analysis for the dependent factor showed that, with KMO = 0.928 (greater than 0.5) and Sig. Bartlett's Test = 0.000 (less than 0.05), Eigenvalue = 5.200 (greater than 1), data extracted 1 factor with total variance extracted is 86.7% (greater than 50%). The results from the factor matrix show that there is one factor extracted with the smallest loading factor of 0.919, and no observed variables are excluded from the EFA analysis. Thus, the dependent factor (Y) corresponding to the "Ready for Industry 4.0" concept includes 6 questions.

Level of readiness towards Industry 4.0

Readiness was determined by comparing the mean of the items with the estimated range. There are three levels of readiness based on the Likert scale with five levels, specifically low when the average value of the item is in the range 1.00 - 2.33; moderate when the average value is in the range of 2.34 - 3.67; and high when the mean is between 3.68 - 5.00 (Yasin et al., 2016; Landell, 1997). Table 9 presents the mean, standard deviation, and level of the questionnaires representing the concept of readiness of students for Industry 4.0.

Table 9
Student readiness for Industry 4.0

Ready for Industry 4.0	Mean	Std. Dev.	Level
I am willing to adapt to the changes in Industry 4.0	3.68	0.967	High
I am willing to apply technology skills to the job required in Industry 4.0	3.78	0.936	High
I am willing to learn new knowledge provided by the school about Industry 4.0	3.84	0.935	High
I am willing to renew my mission to match Industry 4.0	3.71	0.989	High
I am willing to change my working style in Industry 4.0	3.71	0.991	High
I am willing to attend Industry 4.0 training courses	3.76	0.979	High

Table 9 shows that the average values of the questions are in the range of 3.68 - 5.00. The results show that students' readiness toward Industry 4.0 is high. With the highest mean value of 3.84 and the lowest of 3.68, it means that most of the economics majors at private universities in Vietnam are ready to apply technical skills to the jobs needed during Industry 4.0, ready to learn new knowledge about Industry 4.0 provided by the school and ready to change the working style in this period. Not only that, the majority of respondents are ready to adapt to the changes in Industry 4.0, ready to perform tasks in an innovative way towards Industry 4.0, and they are also ready to participate in training courses on Industry 4.0 (Heijltjes et al., 2014; Rohayani, 2015; Hung et al., 2010).

The results in Table 10 show that the average value of the questions is in the range of 2.34 - 5.00, which means that students' level of technical skills necessary for Industry 4.0 lies in the medium and high levels. The highest average score is 3.70, showing that economics majors at private universities in Vietnam agree that using email is an important skill in the era of Industry 4.0, and learning how to use it to send or receive messages is necessary as most information or learning materials today can be shared or sent via e-mail. In contrast, the lowest average score was 3.32, which means that the majority of respondents think word processing skills are not so important for Industry 4.0 (Faller & Feldmüller, 2015; Jabbour et al., 2020).

Similar to the results in Table 10, the average value of questions about non-tech skills is also in the range of 2.34 - 5.00 (Table 11). Therefore, the level of soft skills of students necessary for Industry 4.0 remains at medium and high levels. The highest average score is 3.69, showing that students majoring in economics at private universities in Vietnam show a high sense of responsibility at work in the era of Industry 4.0. In contrast, with an average score of 3.48, the respondents' ability to devise many options to meet their work goals related to Industry 4.0 is still limited.

Table 11
Student's level of soft skills required for Industry 4.0

Non-Technical Skills for Industry 4.0	Mean	Std. Dev.	Level
I can map out many options to meet the goals in work related to Industry 4.0.	3.48	0.891	Moderate
I can track the progress of work projects towards applying advanced technology in Industry 4.0.	3.56	0.880	Moderate
I can consider the outcomes that will occur in projects on Industry 4.0.	3.51	0.885	Moderate
I can accept work-related risks during Industry 4.0.	3.49	0.936	Moderate
I can adapt to different situations that occur during Industry 4.0	3.54	0.887	Moderate

I can self-reflect to upgrade myself and my organization towards Industry 4.0.	3.67	0.879	Moderate
I have leadership ability and keep up to date with the latest technology applications.	3.49	0.942	Moderate
I have a fiduciary capacity to keep my job inside Industry 4.0.	3.55	0.890	Moderate
I can motivate others to work for a common goal in this technology age.	3.55	0.909	Moderate
I am willing to own and take responsibility for my work by adapting to Industry 4.0.	3.69	0.902	High

Regression analysis

Before performing the regression equation estimation, the study calculates the correlation coefficient between the pairs of independent variables and the VIF index to check whether the model violates the phenomenon of multicollinearity or not (Hair, 2009). The estimated results of the correlation coefficient and VIF index are shown in Table 12, the correlation matrix table.

Table 12
Correlation matrix

Variables	Y	X1	X2	X3	VIF
Y	1.000				- - - -
X1	0.687***	1.000			1.399
X2	0.673***	0.491***	1.000		1.901
X3	0.674***	0.482***	0.659***	1.000	1.878

*** 1% significance level; ** 5% significance level; * 10% significance level

The estimated results in Table 12 show that the correlation coefficient between the two independent variables, X2 and X3, has the highest value (r = 0.659), and the highest VIF index is 1.901 < 3. This result confirms the regression model does not violate the multicollinearity assumption (Dormann et al., 2013). Next, the regression results will be presented (Table 13).

Table 13
Regression results

Variables	Y: Ready for Industry 4.0			
	β	Std. Error	Beta	t. stat.
Constant	0.073	0.145	----	0.502
X1: Perception toward Industry 4.0	0.400***	0.036	0.409	11.117
X2: Tech skills required for Industry 4.0	0.283***	0.044	0.278	6.493
X3: Non-Tech skills required for Industry 4.0	0.339***	0.049	0.293	6.885
Number of observations	350			
R^2 adjustable	66.3%			

Regression results in Table 13, regression coefficients of X1 (0.400; p < 0.01), X2 (0.283; p < 0.01) and X3 (0.339; p < 0.01) all have positive signs and are statistically significant with significance level of 1%. This result shows that the factors "Perception toward Industry 4.0" (X1), "Tech skills required for Industry 4.0" (X2), and "Non-Tech skills required for Industry 4.0" (X3) act in the same direction as "Ready for Industry 4.0" (Y). In particular, the factor "Perception toward Industry 4.0" has the strongest impact on "Ready for Industry 4.0".

Discussion

The indicator of interest and knowledge of economics students shows that linking education with Industry 4.0 at private universities in Vietnam is worth paying attention to, especially when the trend of the world has identified the education sector as a source of candidates. It will have to adjust its training to prepare students to be qualified candidates for the industry in the future (Baygin et al., 2016). Further emphasizing the role of education in the era of Industry 4.0, the Ministry of Higher Education (MoHE) in Malaysia has developed the Malaysia Education Master Plan 2015-2025, known as MEB (HE). With many programs and technologies involved in redesigning the higher education system in Malaysia, the main goal is to combine education with Industry 4.0 (MoE, 2015). As a result, college students are prepared and well-versed in Industry 4.0. Furthermore, trainees and lecturers are expected to be aware of new trends in the industry field (Maria et al., 2018). Besides that, these indicators show that economics students at private universities in Vietnam can distinguish the main features of Industry 4.0 as wande general ideas and knowledge about it. From there, it shows their awareness and knowledge of this new revolution.

Industry 4.0 creates great uncertainties that change business models across industries. As a result, economists are required to have advanced skills and competencies beyond their traditional roles, such as skills in information technology and data analysis and critical thinking, and adaptability to Industry 4.0 (according to respondents' consent). Although the respondents could not give a firm opinion on the impact of Industry 4.0 on employment, most of them agree that Industry 4.0 will have a huge impact on the employability of economics students after graduation. The future challenge is not a shortage of jobs but a lack of workers with the right skills. To successfully implement Industry 4.0, employers must ensure that their organization accompanies the technology transition with training and development programs for their workforce, using new tools and technologies that skilled workers use (Romero et al., 2016). This suggests that the current education system may need to be improved to meet demand from industry.

According to survey results from students, information and data security is the biggest concern in Industry 4.0 (according to survey results from students). To apply Industry 4.0 effectively, providing relevant and reliable information or data is of the utmost importance as they will be analyzed to help people in the decision-making process. Therefore, relevant legal regulations need to be promulgated and implemented to avoid data theft and unauthorized use. Respondents also agreed that regulators and policymakers also need to improve their understanding of Industry 4.0 to create new sanctions appropriate against unauthorized use by third parties for data protection purposes. The legal part will need to be effectively revised to accommodate the evolution of Industry 4.0 so that it can address any issues that arise during the adoption process.

Most of the review participants agree that Industry 4.0 will bring greater benefits to the organization, business, and society. Industry 4.0 will be a catalyst to help amplify the benefits that technology brings to people. The application of Industry 4.0 will lead to high productivity and efficiency in organizations and businesses because it helps reduce redundant factors and simplify processes. In addition, the next evolution of automation in Industry 4.0 makes the technology smarter and better, with less human intervention and therefore less error rate. However, Industry 4.0 will not benefit society if the world continues on its current trajectory. Meanwhile, students also agree that Industry 4.0 will involve high costs for an organization or business. Industry 4.0 will require a huge amount of capital to ensure smooth adoption and implementation in an organization or business due to its highly complex nature, especially in the early stages. However, organizations will absorb costs in the long run by having efficient processes that will reduce the associated costs.

Students also agree that universities should prepare students to face the challenges brought by Industry 4.0. This view is consistent with the findings of some researchers, who believe that Industry 4.0 requires changes in key aspects of education in terms of curriculum, delivery, and educational structure (Hasees, 2018). To prepare for the Industrial Revolution 4.0, students themselves need to be more proactive in finding and accessing information about it. This is confirmed through research results when 81.7% of students intend to know more about Industry 4.0. This shows that the students are motivated and encouraged to be a part of Industry 4.0. The results indicate that the students believe that Industry 4.0 will bring more opportunities to learn many new things and help them in their studies. This is inadvertently in line with the discussion of three common factors in students' attitudes towards technology: affections, behaviors, and beliefs by the authors Abdullah et al. (2015). Accordingly, students' attitudes towards technology correlate with positive feelings about it, high behavior when using it, and firm positive beliefs. A 2003 statement by Rogers (2010), said that people might react differently to a new idea, practice, or object based on differences in their attitudes toward innovation. They may react positively or negatively to new ones.

Universities must be prepared to adapt and change their curricula so that graduates can find employment in this age of innovation. The results from Table 5 can be reference data for private universities in Vietnam in particular and

universities in Vietnam, in general, to improve teaching quality and students' capacity, emphasizing pursuing innovative technologies to meet student needs. This will allow them to have a better learning experience during their university training. As a result, graduates will be equipped with new skills, including critical thinking, problem-solving, communication, collaboration, and creativity. In addition, educational authorities and administrators also need to add to their understanding of the application of Industry 4.0 in the education industry.

The average readiness value of economics students is high, indicating that the education system of private universities in Vietnam is still well developed to meet the worldwide economy's development needs and new demand for highly skilled human resources, changing industrial structure, social/cultural change, and constant advancement of modern technology (Dwiyanti et al., 2018). Private universities in Vietnam show their important role in equipping students with the necessary skills to move towards Industry 4.0. The average values of student skills members are above moderate. Developing individuals with the right working attitudes and competencies needed to compete favorably in a global society (Tai et al., 2003), Industry 4.0 era requires students to be equipped with various skills (including technical and social/soft skills). Research by authors Dwiyanti et al. (2018), on the impact of Industrial Education on students' social skills/soft skills has highlighted the importance of social skills/soft skills besides the necessity of technical skills for this era. Research indicates that adaptive and communication skills are two essential skills that prepare students to face challenges and competition between humans and robots in Industry 4.0 (Lawal, 2013). Therefore, it is necessary to maintain and improve the average value of Industry 4.0 related skills for students at private universities in Vietnam.

Last, with the result of regression analysis, the factor "Perception toward Industry 4.0" has the strongest impact on "Ready for Industry 4.0". This means, to promote education well its mission in the direction of Industry 4.0, private universities in Vietnam need to recommend policies to increase students' readiness for Industry 4.0, focusing on the dimension "Perception toward Industry 4.0" as this is the strongest influence on readiness for Industry 4.0. However, to ensure a uniform increase in readiness, the other two factors are "Technical Skills" and "Non-Technical Skills" of the students, which must also be given appropriate development attention because these are also two factors that impact the readiness of students towards Industry 4.0.

4 Conclusion

This study has examined a testing model which is thought to contribute to the readiness of Vietnamese economics majors for Industry 4.0. Multiple regression analysis revealed that students' perception of Industry 4.0, tech skills, and non-tech skills have an impact on their readiness for Industry 4.0. That shows private universities in Vietnam are doing a good job in defining education as a bridge to move towards Industry 4.0. One of the more significant findings to emerge from this study is that the factor of perception has the strongest impact on this level of readiness in addition to the necessary technical and soft skills. Due to factors acting in the same direction, private universities in Vietnam in particular, as well as educational institutions in Vietnam in general focus on raising students' perception about Industry 4.0 in combination with equipping them with new skills, which is necessary for Industry 4.0, will help increase students' readiness for Industry 4.0 in the future.

Based on the research results obtained, the report will be for reference and contribute to the treasure of research documents related to Industry 4.0. In practical terms, the report can contribute to the implementation of Industry 4.0 in Vietnam through the education sector, pioneered in higher education institutions in Vietnam in general and private universities in Vietnam in particular. In the future, the research can be further extended to the entire educational institution in Vietnam to be able to generalize more about this disruptive development.

Conflict of interest statement
The authors declared that's they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

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