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Survey on the Patent Law Awareness and the Entrepreneurial Trend of Greece's Graduates of Technology Institutes

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ABSTRACT In information technology industry, the development of new technology achievements influences and inspires the business world, serves and contributes to the progress of society. This rapidly evolving technological advancement needs a legal framework in order to obtain social and commercial status. Patent Law is the legal science and patent is the legal tool that adds value to intangible assets and therefore technology scientists are motivated to ensure their invention with a patent and also dominant technology enterprises are competing for the development of a strong patent portfolio. For the first time in Greece, combining the fields of intellectual property law and technological innovation, we created a survey using a questionnaire that was distributed in 2019, to graduated students of technology institutes in Greece. The purpose of the present survey is to clarify the knowhow of students as for the legal point of view of technology. We intend to find out, whether Greece's potential inventors have beyond their technological background, the skills and knowledge to support a potential innovative idea. The results of the survey were that students have confidence in the institution of patents; however they lack the knowledge of patenting technological inventions. At the same time they have a positive attitude and motivation for entrepreneurship in the technological industry. Consequently, it is vital to apply measures in education, for the next generation technical inventors to have the knowhow of utilizing their intellectual asset in their own free will. Then, we can refer to integrated scientist technocrats who can protect their intellectual property and manage a competitive business.

INDEX TERMS Artificial intelligent inventions, computer related inventions, entrepreneurial trend, management of technology, patent law awareness, smart technology, survey on technology institutes.

I. INTRODUCTION

In information technology industry, the development of new technology achievements influences and inspires the business world, serves and contributes to the progress of society. This rapidly evolving technological advancement needs a legal framework in order to obtain social and commercial status. Although for legislation it is difficult to keep up with technology, many efforts are observed in the direction of reforming Intellectual Property Law (IPL) to the nowadays requirements of technology world. Patent Law which is a part of IPL adds value to intangible assets and therefore technology scientists are motivated to ensure their invention

with a patent, perhaps to establish a start-up company and also dominant technology enterprises are competing for keeping their technological superiority through the development of a strong patent portfolio.

At this point, we need to specify the nowadays technological world, which is represented by Industry 4.0 and includes smart technology achievements such as Cloud Computing, Big data, the Internet of Things (IoT), Artificial Intelligence (AI) and computer related inventions in general. Initially, we provide brief definitions of the above terms mentioned; Industry 4.0 stems from the internet, enables communication between humans and machines in cyber physical systems and aims to acquire and process data and to self-control certain tasks [1], AI is the ability of machines to execute functions that are associated with human intelligence [2],

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IoT is a technology in the sector of telecommunications [3]. It describes the networking and communication between physical and virtual objects [4]. Big data developed on the ground of the continuous and increasing use of smart devices which connect, collect, exchange and transfer large amounts of data [5], Cloud Computing technology provides storage spaces and mechanisms for data analysis [5], Patent Law is the Regulatory basis and patent is the legal tool that provides protection from infringement to an inventor's intellectual property. Patents motivate scientists to invent by offering them a limited-time monopoly on the technological achievement they invented [6]. Discussions on technical issues like Big data and intellectual property indicate that ethics and computing is a challenge of this era [7].

Further, we refer to the European Patent Convention [8]. As far as what concerns computer-implemented inventions, the patentability requirements that they should fulfill according to Art.52(1) are:

- there must be an "invention", belonging to any field of technology
- the invention must be "susceptible of industrial application"
- the invention must be "new" and
- the invention must involve an "inventive step"

It is also important to notice that "claims" for computer-implemented inventions should define all the features which are essential for the technical effect of the process which the computer program is intended to carry out when it runs. According to Art. 84, the claims cannot include program listings. Program listings are accepted only in the description. Moreover, the effective date of the European application is the date of its filing, Art. 54(2),(3) and a European patent lasts for 20 years from the date of filing the application, Art.63. In addition, in order for a patent to stay in force renewal fees must be paid, otherwise the patent will lapse. Eventually, in case of an infringement, according to Art. 64(3), any infringement of a European patent shall be dealt with by national law in each Contracting State in respect of which the patent is granted.

Afterwards, in terms of Patent Law and technology, patents are the primary way to protect and promote innovation in technology applications. The main challenge is to be able to distinguish among technological achievements those that meet the requirements of granting a patent and to have the knowhow to manage an invention for the benefit of the inventor, the economy and society.

This is where the issue arises. Often engineers and scientists of technology have the knowhow to develop an innovative idea, but lack the knowledge to support their invention and protect it from being stolen and used immorally. However, the problem lies deeper, in their academic education at the university; Most of the curriculum in Technical Institutes do not include courses in IPL, nor do they deal with the management and commercialization of a potential invention, even if industry is increasingly pointing out the education of IPL at technical universities.

Regarding all mentioned above, in this paper we try to draw conclusion as for the effect of Patent Law into nowadays technology graduated students of Greece through a survey which is implemented with a questionnaire.

The purpose of the present survey is to clarify the knowledge that the students have acquired the moment of completing the university curriculum of a technology department, as for the management and the legal status of technology. We intend to find out, through this survey, whether Greece's potential inventors have beyond their technological background, the skills and knowledge;

- to protect their potential invention,
- to ensure the paternity of their intellectual property,
- to benefit from their invention's exclusive commercial exploitation,
- to survive in the global technology innovation industry, in which possibly they may excel,
- to promote the country's economy by establishing a technology company, and
- to contribute to the wider society with their technological achievements.

Further the objective of this survey is to indicate that a curriculum of a Technical Institute should include IPL and all legal and managerial issues that concern a technology inventor. It is important to develop responsible inventors and scientists in industry of technology, technical universities and society generally. The technology industry has already indicated the need for technology professionals who work and take decisions led by their legal engineering skills.

This course should be included in the education of technology students in order to prepare the potential technology professionals from every perspective and for every application or transaction of technology.

To the best of our knowledge, this is the first time that a survey which refers to graduate students of Technical Institutes in Greece and examines their knowhow on Entrepreneurship and on Patent Law in the direction of supporting a potential technological invention, is conducted.

The rest of the paper is organized as follows; In Section 2 there is a review of the related research on legal and entrepreneurial aspects that concern technology world. In Section 3 we explain the methodology that we follow for this survey and we analyze all queries that are involved. In Section 4 we analyze and discuss the results of the survey through tables and figures, in Section 5 we provide the conclusion of the current paper and we make proposals regarding the results of the survey lastly Section 6 is our future objective.

II. RELATED WORK

For the purpose of this survey we study and analyze previous literature which has been published in the field of IPR, Patent Law, smart technology and industrial world. The following paragraphs present the papers which contributed in our study, some of them are surveys on the field of technical patents and entrepreneurship and some of them are utilizing elements

from technical patents to conclude their value in business world.

In [9], a survey on engineering students' as for IP education is conducted in 5 China's universities, concluding the need for strengthening IP awareness in the Electronics Engineering Curriculum. A design of a course is also proposed by using a case study in integrated circuits.

In [10], two undergraduate technology management programs carried out a survey that concerns international technology management professionals. The majority of the professionals were employed in education, computers, information technology, manufacturing, and research and development. The result of the survey focuses on what elements, the technology professionals, regard as essential for managing future's technological entrepreneurship.

A survey on the harmonization of intellectual property systems in software industry from the point of view of Japanese inventors is presented in [11]. It is a questionnaire survey to inventors referring to the promotion of an invention in subjects of "Grace Period", "Inventive Step", "Strength of Patent Protection", "Unitary Patent System", "Globally Harmonized Patent System". The results show that the inventors are positive to this harmonization.

In [12], a survey is presented in order to indicate support systems for IP activities of university students in Korea and Japan. This study intends to help the development of IP academic activities in Korea and Japan through presenting, by week, e-learning IP support program, as education for inventions. Lastly a comparison of IP support programs is applied between Korea and Japan.

In [13], a patent survey to 60 Japanese R&D directed firms is conducted through a questionnaire. The selected firms were investing in R&D and they possessed a capable number of patent applications. The results show the way that Japanese firms face the patent systems between the last decade and the next decade.

A survey of IP rights literature from 1971 to 2012 is presented in [14]. This study utilizes a network of citations in order to find out the knowledge diffusion structure of the IP rights literature.

In [15], the paper suggests a course of law for computer professionals that includes: "legal aspects, ethical aspects and professional responsibility". The paper indicates the importance of students' legal awareness of IP by saying that jobs for computing graduates need not only technical knowledge, but commercial, ethical and legal awareness, too.

In [16], the study states that the challenges for IP protection in China's cultural and creative industries are the low awareness of the importance of IP protection and the choice of the IP protection that in every case best suits (among patent rights, trademark rights, commercial secret rights, and anti-unfair competition legislation).

In [17], a technology assessment to three technologies with the largest number of patents is analyzed by using patent evaluation. A common software tool is used as the analytical

tool for evaluation of IP and a patent portfolio technology analysis is developed by using machine learning techniques.

In [2], it is stated that AI technology challenges Patent Laws on the basis of the patent eligibility of an AI invention. The study also states that computer technology is the most important technology in the field of AI and advises patent applicants to focus on the claims of the described invention as for clearly indicating the technical problems that the invention solves with a view to survive in patent examination.

In [18] the paper notices the difference between open source licenses and the current Standard Settings Organizations legal framework regarding IP rights. It also refers to the FRAND license commitment for patented technologies and the copyrighted software.

A study is presented in [19], which measures the role of innovation through patent applications in business success. The sample for the study is Swiss companies and the results show that patent applications have a great impact on the business performance of small and medium sized enterprises.

The study in [20] focuses on the patent eligibility of AI inventions. Furthermore it states that due to the contribution of AI achievements to the society, many countries started to revise the patent examination guidelines related to the patent-eligibility criteria of AI inventions.

In [21], in order to list the emerging technologies and especially those with complexity like robotics this paper proposes as a methodology patents data containing robotics in their titles and abstract and patent citations. This study contributes to open innovation measures for organizations.

In [6], the paper refers to China's revision of the Examination Guidelines as for Patents that concern AI related inventions. This revision is valid since 2017. The paper comments the updated guidelines which state that an invention related to computer program or business model which includes a technical feature, consists a patentable subject.

In [22], the article applies a learning method for patent value estimation. Principal component analysis is used to indicate the patent value and then deep neural networks are also applied. A detailed case study of IoT patents is developed and Taiwan IoT high value patents are used to confirm the competition in technology innovation.

In [23], the writers utilize Machine Learning and patent information to provide an analysis of the nowadays companies' technology development. The patent information is analyzed from three companies and the proposed method, manages to disclose the companies' technology fields, their technological transition, and their similarities and differences.

In [24], this article compares patent measurement methods and finds that the patented coupling analysis method can depict the technical characteristics of technical fields. This method in combination with other statistical methods helps to conclude technical similarities among enterprises as for technology intelligence.

In [25], is presented the development of web-based e-learning systems in order for students to learn IPL. The

system uses logic circuits in exercises to teach legal texts and also video systems.

On the grounds that Japanese Patent Office act is of great importance because Japan's and USA's AI technology leads the technological world, this paper [26] with a view to increase the patentability of AI related inventions at the JPO, analyzes the procedure and the patent examination guidelines.

In [27], it is stated that Chinese internet companies began to be an essential part of the world's digital economy. Then by using text mining and patent data and by comparing the three enormous companies in China, this paper examines the development of technological capabilities through the innovative strategies of those companies. The elements that are used from these companies are; patent portfolios, patenting patterns and trends and the paper also intends to point out differences between the three of China's companies and their respective companies in US as for technology.

In [4], a study is presented which tries to predict the industry correlation among logistics and information and communications technology industries with the influence of IoT. There is an empirical patent analysis that concludes the ability of IoT to support companies as for covering the need of new technological and market competences.

In [28], the writer wonders whether IPL is ready for AI. He states that when software implemented AI system makes choices, the legal frame adjusts. He searches between copyright and patents which better serves AI and concludes that patentability of AI inventions will probably not be decided by patent offices, but by courts and also wonders whether a machine could also be an inventor.

In [29], there is an analysis of the innovative ideas of the IoT technology and there are also future policy suggestions for the countries. The paper for the IoT technology uses bibliometric, "Patentometrics" to make the analysis. The results show that the innovation characteristics in the IoT technology differ for each country.

In [30], the writers develop a research of an intelligent patent summarization methodology using AI machine learning algorithms to conclude through given patent domains the patents' worth and technical advantage.

In [31], regarding current IPL system in China as for big data, the paper lists the issues of IP protection in software and IoTs driven by industrial innovation. Proposals are stated so as to improve the software patent system and patent examination and aims to provide digital software IP protection.

This article, [32], analyzes for technology companies the IP decisions should take by using a dataset including machine learning patents. It also analyzes patent claims and provides patent critique on the grounds of informatics, IP and technology scholarship.

In [33], the paper refers to India's IP rights across the world and also analyzes the regulations of IP rights in India, indicates the needs and roles of patents, trademarks, industrial designs, copyright, etc.

In [34], the article examines how patents impacts on university researchers. "They created a dataset of royalty-sharing policies from 152 universities, which shows substantial variation across universities and time." They conclude that for larger share of royalties, it is better to be retained by universities, because money is used to reinvest in research and education. The writers wonder for the future research whether increasing the inventor's involvement in university patent policies leads researchers to make and use better patents.

In [35], the literature is connected to academic entrepreneurship "By relying on a sample of Italian academic spinoffs established over the period 2006–2012", the results show that necessity-oriented academic spinoffs have greater survival trend, while opportunity-oriented spinoffs have the trend to develop further.

The paper, in [36], analyzes how quality of research results manages the relation between university research collaboration and technology transfer. For this purpose the writers use Chinese universities with patents granted in USPTO. The results show that the size of university research collaboration impacts on the results of a research as for quality and that university collaboration with companies reflects also a better quality. Also, the quality of research results has a positive impact on the technology transfer.

In [37], the writers by "using a knowledge production framework, they identify empirically U.S. Small Business Innovation Research projects of 1992 to 2001". The results in an empirical way show that if the firm collaborates with a university in this funded project, then more scientific papers follow.

In [38], the writers basing on the fact that women in entrepreneurship are few, they conducted a gender-sensitive entrepreneurship education program for women students of engineering and computer science. The student mentors were interviewed about their experiences and reported positive views on entrepreneurial "self-efficacy" and significant "awareness of diversity and gender issues". Lastly they noticed the students' interest in "becoming an entrepreneur" the years that follow

In [39], the paper refers to a new research university that provides entrepreneurial postdocs with a program that educates the scientists and turns them into entrepreneurs. The program offers education in startup intellectual property and financial aspects. "The program was launched in 2014 and has incorporated 25 postdocs and their startups." This program resulted in contribution to technology transfer.

In [40], the article examines technology transfer and entrepreneurial innovation in Egypt where there is not exist a unified system of policy to ensure the IP of university research. The study involves "interviews with experts, a questionnaire survey of Egyptian Science, Engineering and Technology academics, three case studies of Technology Transfer Offices and a 237 respondent industry survey". The results indicate that there is lack of collaboration between university and industry and there is the need for the development of a policy that promotes universities and industry to collaborate.

In the direction of developing an IP rights system in China, a survey in [41] was conducted to underline the factors that form the behavior as for IP rights in China of professional designers. "A qualitative contextual interview study, conducted with 49 Chinese designers and design managers." The results of the survey show that Chinese design professionals have different motivations for their design work and different levels of IP rights awareness. Based on the findings, a theoretical model is proposed.

In [42], the paper arise the question "who should own an academic patent obtained as a result of funded research", in order innovation to be served? This paper analyzes the point of views of engineering graduate students, who are also experienced in R&D, as for patent ownership in universities. The findings can result in the development of an ownership policy that can serve future innovation.

In [43], the article focuses on academic entrepreneurship and academic patenting. University administrations have installed technology transfer offices to promote patenting. The writers introduce "an agent-based simulation for evaluating measures" that can be used by a technology transfer office in order to promote academic patenting and the establishment of start-up companies basing on patents.

Lastly, in [44], the article analyzes the results of a qualitative study that intends to compare the structure and operation of the programs for "intellectual property management and technology transfer", and the encouragement of entrepreneurship, in five research "institutions in America". The study presents similarities and differences among these institutions.

III. METHODOLOGY

For the purpose of this survey we compiled a questionnaire, which is used in empirical study. This questionnaire was distributed in 2019, to 5 Institutes of Technology in Greece, (3 University Departments of Informatics, 2 University Departments of Electrical and Computer Engineering in different regions of Greece), of which only the first Institute of Technology includes in its curriculum a course related to Law and Information Technology, to fourth-year or fifth-year graduated university students.

The total sample is 198 technological educated students out of which 161 have valid questionnaire participation. In Table 1, the number of participants is listed by each one of the five Institutes of Technology, as well as the share of each Institute to the total. The 1st and the 2nd Institute of Technology have the most participants (30, % and 31,1% respectively).

There are 16 questions in the questionnaire, close-ended with binary possible answers and one question which is an open-ended question, where participants could give a short answer. The analysis that follows includes tables for all the questions (Q1 to Q16), with frequencies of the YES/NO, a/b, replies and percentages for the number of students that have replied positively. The analysis for each question is made for all five Institutes of Technology.

TABLE 1. Number of participants per institute of technology.

Universities	Number of students	Number of participants	% of participation	participants % of the total
1st Institute of Technology	50	49	98%	30,4%
2nd Institute of Technology	58	50	86%	31,1%
3rd Institute of Technology	20	17	85%	10,6%
4th Institute of Technology	50	30	60%	18,6%
5th Institute of Technology	20	15	75%	9,3%
Total	198	161	81%	100,0%

Below, follows a detailed explanation of the result that we intend to derive from each question and at the end of this explanation exists Table 2 with this questionnaire.

Q1. Did you know that Intellectual Property Law concerns technology scientists and engineers who develop technological innovations? – We want to find out whether the students know that technology has not only scientific profile but also industrial profile and legal status among society.

Q2. Did you know that computer related achievements (e.g. smart applications, smart phones,...), IoT technological achievements (e.g. in smart homes, in smart industry, in energy,...), AI achievements (e.g. machine learning applications, robotics, haptics,...) are patentable subjects? -We want to specify what technology means and connect their technological knowhow from university to legal aspects. Whatismore, we want to introduce the institution of patents and link it to the possible inventive idea they may have conceived.

Q3. Did you know that the inventor of a technological invention can ensure the paternity of his idea and its

Distribution of participants per Greece's Institute of Technology

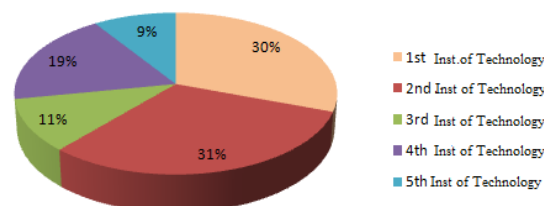


FIGURE 1. Percentage of participants per Institute of Technology.

exclusive commercial exploitation? - We intend to clarify that for all these technologies, that they have been taught

so as to expertise in their professional lives, by implementing achievements and serving the technological innovation industry, they can be protected from their intellectual effort's infringement and they can be rewarded with exclusive commercial exploitation.

Q4. Is an algorithm a patentable subject?-We intend to find out whether they have the knowhow of distinguishing what technological subject is patented or not. An algorithm may be innovative as they regard, but it is not patentable individually as an entity.

Q5. Is the code of a computer program a patentable subject?- We intend to understand whether they regard that for the computer inventions they are familiar with, the code that was written by an expertise, is the subject of patentability. We want also to find out whether they distinguish the difference between copyrights and patents. Lastly we want to see whether they cope with a computer invention as a whole, accompanied by the effects that the software when runs, brings to a computer's hardware.

Q6. Are you a supporter of open source software?-We know that students use open source programs during their studying at university. At this point, after all mentioned, we want to find out, whether they are able to weigh the pros and cons of a patentable invention though an invention protected by Patent Law and an open source software program freely available or under conditions available to public.

Q7. A technological innovation of yours would be a) Open source software or b) Protected by Patent Law?- After thinking of what they merely support, we want to see on which side they are going to classify their potential invention. They want an invention to be protected through the grant of a patent or they want to contribute to the technological community.

Q8. A patent lasts for 20 years giving its holder exclusive rights as for commercial exploitation. Do you believe that 20 years is a reasonable time period for technology inventions, regarding that technology evolves rapidly? - We want to ascertain whether future technocrats believe that technological achievements should be profitable to their patent owners for less than 20 years, regarding that technology evolves rapidly. Afterwards inventions should be available for the common good of society. Otherwise, if they believe that the holder of a patent should benefit from his invention at least for 20 years, regardless whether the invention is technologically obsolete.

Q9. Do you think that prior to 20 years the patented invention should be available to the public?- After many years of dominance of the technological industry in the world economy and after many patents that have been issued, this question is still of great concern to the scientific community both of technological and legal direction, whether updating the law as to the duration of a patent.

Q10. Have you ever visited the patent office in Greece or have you ever visited the sites of United

States/European/Japan patent office or World Intellectual property organization, in order to be informed about technological achievements and their legal protection in society?- Through this question we intend to understand whether tech-savvy graduates have ever wondered about information as for patents; where a patent can be issued, how many organizations there exist, what geographical power a patent may have, how much this process may cost, and where they can apply for a patent. This information may be provided to all these sites.

Q11. Have you ever considered or implemented an innovation? Or have you found an optimized solution to a problem?- We intend to find out, regarding the technological stimuli that these students receive from not only their everyday life but also from their technological academic community, whether they have ever conceived an innovative idea or even implement it, or even conceived an optimized solution because this is also a subject of patentability, a fact that they may ignore.

Q12. If yes, (a) did you reveal it or b) you first consulted a lawyer?- At this question it is very important to know how they faced their potential invention. Did they have the background to support their innovation, claim it or they revealed it and possibly lost the paternity of their intellectual asset.

Q13. Have you ever considered establishing a start-up company based on a technological achievement?- We intend to realize the perception of commercializing an innovative idea and whether it is an incentive for entrepreneurship. We also want to see whether young scientists have the vision to become an active member of the technology industry and business innovation by owning a tech-company.

Q14. What is the most up-to-date, technological breakthrough you've heard, seen or used?- By this question, we intend to find out what kind of technology they admire and in what field of technology their interests are focusing.

Q15. Do you believe that in the technological industry a start-up can survive?- We intend to find out what technology graduates have in mind about the venture of starting a new business basing on their innovative idea, what they think about competition within the technological industry, whether they would be afraid of competition or if they would make the effort to get involved in technological business world.

Q16. Do you believe that a technological enterprise or an inventor should spend money on patenting a technological innovation before it is disclosed?- We intend to find out whether the students believe that it is worth the effort and money to apply for a patent in order to support and commercially exploit from an innovative idea or in case of an enterprise to expand a patent portfolio. We want to know if they have the will to utilize their technical skills to implement a technical achievement and undertake the procedure for granting a patent.

TABLE 2. The questionnaire.

	Queries	YES	NO
1	Did you know that Intellectual Property Law concerns technology scientists and engineers who develop technological innovations?		
2	Did you know that Computer related achievements (e.g. smart phones, smart applications..), IoT technological achievements (e.g.in smart homes, in smart industry, in energy..), AI achievements (e.g. machine learning applications, robotics, haptic technology..) are patentable subjects?		
3	Did you know that the inventor of a technological invention can ensure the paternity of his idea and its exclusive commercial exploitation?		
4	Is an algorithm a patentable subject?		
5	Is the code of a computer program a patentable subject?		
6	Are you a supporter of open source software?		
7	A technological innovation of yours would be a)open source software or b) Protected by Patent Law?	Choose a or b	
8	A patent lasts for 20 years giving its holder exclusive rights as for		

IV. RESULTS AND DISCUSSION

In this section we are going to present through graphics the results of the survey. We are also going to analyze those results from the answers to each of Q1-Q16 questions of the questionnaire. Lastly, we are going to draw conclusions for the 5 Institutes of Technology as for Patent Law awareness and the entrepreneurial trend of the potential inventors from Greece's Institutes of Technology.

In Q1: "Did you know that Intellectual Property Law concerns technology scientists and engineers who develop technological innovations?", the majority of the students of the first Institute of Technology (IT1), in which also a course related to Law and Information Technology is taught, declared Yes, which means that they can realize the legal protection that Law can provide to inventors of technology. The

TABLE 2. (Continued.) The questionnaire.

	commercial exploitation. Do you believe that 20 years is a reasonable time period for technology inventions, regarding that technology evolves rapidly?		
9	Do you think that prior to 20 years the patented invention should be revealed to the public?		
10	Have you ever visited the patent office in Greece or have you ever visited the sites of United States/European/Japan patent office or World Intellectual property organization, in order to be informed about technological achievements and their legal protection in society?		
11	Have you ever considered or implemented an innovation? Or have you found an optimized solution to a problem?		
12	If yes, (a) did you reveal it or b) you first consulted a lawyer?	Choose a or b	
13	Have you ever considered establishing a start-up company based on a technological achievement?		
14	What is the most up-to-date, technological breakthrough you've heard, seen or used? (write it down there.....)	Write it down	
15	Do you believe that in the technological industry a start-up can survive?		
16	Do you believe that a technological enterprise or an inventor should spend money on patenting a technological innovation before it is disclosed?		

rest of Institutes of Technology declared No, indicating that they cannot realize the relation between Law and Technology.

In Q2: “Did you know that computer related achievements (e.g. smart applications, smart phones,...), IoT technological achievements (e.g. in smart homes, in smart industry, in energy,...), AI achievements (e.g. machine learning applications, robotics, haptics,...) are patentable subjects?”, the majority of students declared Yes in IT1 and in the rest of Institutes of Technology the majority of students chose the No option. We observe that what technology means to the majority of all students has not a legal point of view, even for technology achievements they do not connect them consciously with patents or they are not aware of what “patentable subject” means.

In Q3: “Did you know that the inventor of a technological invention can ensure the paternity of his idea and its exclusive commercial exploitation?”, the majority of the students in IT1 answered Yes, in the rest of the Institutes of Technology the answer was No and we observe that the majority of the participants are not aware of that an inventor can protect his innovative idea, his intellectual effort and can also individually benefit from it, if it is a profitable invention.

In Q4: “Is an algorithm a patentable subject?”, in IT1 the majority answered No, yet a sufficient percentage answered Yes. In the rest Institutes of Technology, the answer was Yes, by the majority of participants. This means that most of the students regarding an algorithm and its steps as innovative they think, incorrectly, it can be patentable as it is.

In Q5: “Is the code of a computer program a patentable subject?”, the majority of all participants answered Yes, which means that they regard the code that was written by an expertise, as patentable subject. They are not aware of the difference between copyrights and patents and they do not face a computer invention as a whole, accompanied by the hardware.

In Q6: “Are you a supporter of open source software?”, the majority of students in IT1 and IT2 answered Yes, students in IT3, IT4 marginally answered No and students in IT5 marginally answered Yes, which means that the majority of the participants support open source programs. Although, in Q7: “A technological innovation of yours would be a) Open source software or b) Protected by Patent Law?”, the majority of the participants of all Institutes of Technology answered b, which means that as far as what concerns using technology they prefer this to be free and open but when we come to their potential invention, their intellectual property they would rather prefer a patented invention. So, we observe that the majority of the students are not clearly understand what it is to support an open source program and which is the contribution of open source technology achievements. Furthermore, they do not seem to know what it really means to protect an inventor's intellectual property, beyond any economic benefit and any possible imitation of the invention, a patent ensures him morally among societies, justifies him commercially, and encourages him to create.

In Q8: “A patent lasts for 20 years giving its holder exclusive rights as for commercial exploitation. Do you believe that 20 years is a reasonable time period for

technology inventions, regarding that technology evolves rapidly?”, the majority of the students in IT1, IT3, IT4, IT5 answered No. In IT2 the students marginally answered Yes. We conclude that future technocrats believe that technological achievements should be available for the common good of society earlier than the 20 years, regarding that technology evolves rapidly. In Q9: “Do you think that prior to 20 years the patented invention should be available to the public?”, the majority of the participants answered Yes, by supporting their previous answer.

In Q10: “Have you ever visited the patent office in Greece or have you ever visited the sites of United States/European/Japan patent office or World Intellectual Property Organization, in order to be informed about technological achievements and their legal protection in society?”, the majority of the students in all Institutes of Technology answered No. Despite, IT3 where all students answered No, there existed in the other Institutes of Technology positive answers. We realize that very few graduates have ever wondered about information as for patents even if this information is available online, too.

In Q11: “Have you ever considered or implemented an innovation? Or have you found an optimized solution to a problem?”, the majority of the participants answered No, but for this question it is crucial to refer to the number of students that answered Yes; 5/49 in IT1, 9/50 in IT2, 2/17 in IT3, 8/30 in IT4, 7/15 in IT5, which is a sufficient proportion of inventiveness. In Q12: “If yes, (a) did you reveal it or b) you first consulted a lawyer?”, the vast majority chose the answer a, only in IT1, where the students are taught a course regarding Law and Information Technology, 3 out of 5 students chose that they have first consulted a lawyer.

In: “Q13: Have you ever considered establishing a start-up company based on a technological achievement?”, in IT1, IT2, IT3 the minority of the students answered Yes but the positive ratio was sufficient and in IT4, IT5 the majority of the students answered Yes. Therefore, we realize that the perception of commercializing an innovative idea and the trend of entrepreneurship is positive enough.

In Q14: “What is the most up-to-date, technological breakthrough you've heard, seen or used?”, the majority of students answered; “smart phones”, “smart applications”, “smart transportation”, “IoT” and, “google”. Regarding all of the participants' answers they admire technologies that can be applied in smart devices, smart cities, AI achievements, computer related inventions and telecommunications.

In Q15: “Do you believe that in the technological industry a start-up can survive?”, the vast majority of the participants answered Yes, which means that technology graduates regard as feasible the venture of starting a new business basing on an innovative idea, despite the competition.

In Q16: “Do you believe that a technological enterprise or an inventor should spend money on patenting a technological innovation before it is disclosed?”, similarly the vast majority of the participants answered Yes, which

means that most students believe that it is worth the effort and money to apply for a patent.

Below follows the graphic analysis with tables and figures for each question. At the end, there is also one table/graph for each Institute of Technology, incorporating all the questions.

TABLE 3. Question 1.

Q1	YES	NO	Yes%
1st Institute of technology	38	11	77,6%
2nd Institute of technology	20	30	40,0%
3rd Institute of technology	3	14	17,6%
4th Institute of technology	8	22	26,7%
5th Institute of technology	5	10	33,3%
Total	74	87	46,0%

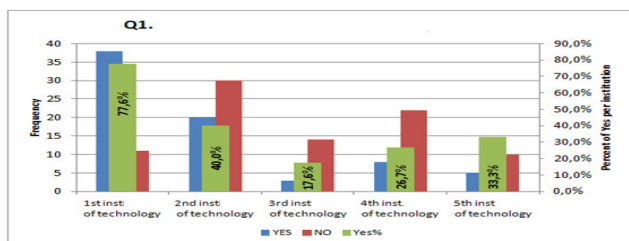


FIGURE 2. Q1: "Did you know that Intellectual Property Law concerns technology scientists and engineers who develop technological innovations?"

TABLE 4. Question 2.

Q2	YES	NO	Yes%
1st Institute of technology	35	14	71,4%
2nd Institute of technology	15	35	30,0%
3rd Institute of technology	2	15	11,8%
4th Institute of technology	6	24	20,0%
5th Institute of technology	4	11	26,7%
Total	62	99	38,5%

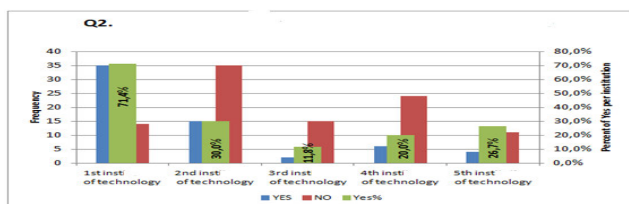


FIGURE 3. Q2: "Did you know that computer related achievements (e.g. smart applications, smart phones,...), IoT technological achievements (e.g. in smart homes, in smart industry, in energy,...), AI achievements (e.g. machine learning applications, robotics, haptics,...) are patentable subjects?"

TABLE 5. Question 3.

Q3	YES	NO	Yes%
1st Institute of technology	47	2	95,9%
2nd Institute of technology	24	26	48,0%
3rd Institute of technology	5	12	29,4%
4th Institute of technology	14	16	46,7%
5th Institute of technology	7	8	46,7%
Total	97	64	60,2%

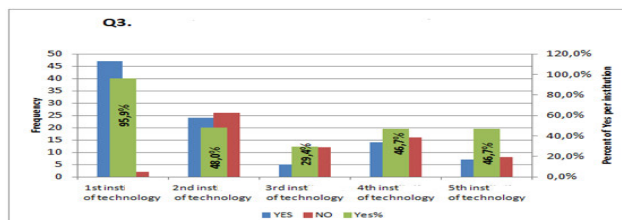


FIGURE 4. Q3: "Did you know that the inventor of a technological invention can ensure the paternity of his idea and its exclusive commercial exploitation?"

TABLE 6. Question 4.

Q4	YES	NO	Yes%
1st Institute of technology	22	27	44,9%
2nd Institute of technology	35	15	70,0%
3rd Institute of technology	13	4	76,5%
4th Institute of technology	25	5	83,3%
5th Institute of technology	10	5	66,7%
Total	105	56	65,2%

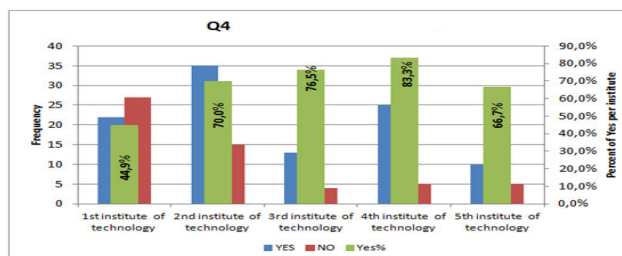


FIGURE 5. Q4: "Is an algorithm a patentable subject?"

Judging from the results, it is obvious that in the most critical questions that prove students' knowledge of the relationship among technology and the law and the rights of the inventor, IT1, which is the only Institute that includes in its curriculum a course related to Law and Information Technology, gave the following answers:

- In Q1 the majority knew that IPL concerns technology scientists

TABLE 7. Question 5.

Q5	YES	NO	Yes%
1st Institute of technology	30	19	61,2%
2nd Institute of technology	40	10	80,0%
3rd Institute of technology	15	2	88,2%
4th Institute of technology	26	4	86,7%
5th Institute of technology	12	3	80,0%
Total	123	38	76,4%

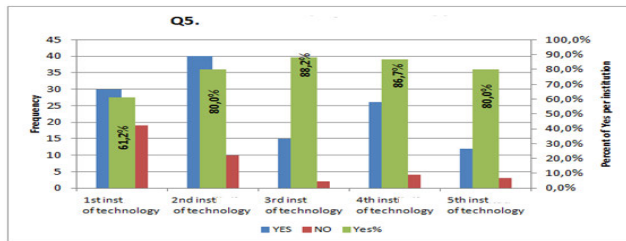


FIGURE 6. Q5: "Is the code of a computer program a patentable subject?"

TABLE 8. Question 6.

Q6	YES	NO	Yes%
1st Institute of technology	46	3	93,9%
2nd Institute of technology	38	12	76,0%
3rd Institute of technology	7	10	41,2%
4th Institute of technology	14	16	46,7%
5th Institute of technology	8	7	53,3%
Total	113	48	70,2%

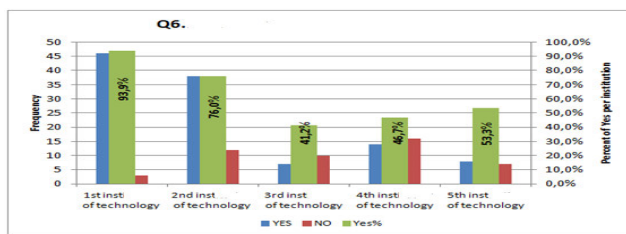


FIGURE 7. Q6: "Are you a supporter of open source software?"

- In Q2 the majority knew that computer and AI achievements may be patentable subjects
- In Q3 the majority knew that an inventor can protect the paternity of his idea and its exclusive commercial exploitation
- In Q4 the majority knew that an algorithm is not patentable, however the majority of students did not know that the code of a computer is not patentable(Q5)
- In Q12 the majority answered that in case of their invention they would consult a lawyer rather than reveal their invention

TABLE 9. Question 7.

Q7	a	b
1st institute of technology	20	29
2nd institute of technology	9	41
3rd institute of technology	4	13
4th institute of technology	9	21
5th institute of technology	5	10
Total	47	114

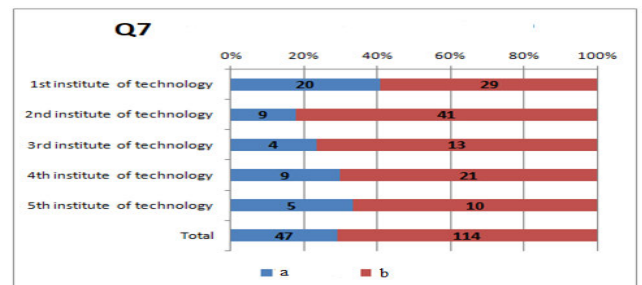


FIGURE 8. Q7: "A technological innovation of yours would be a) Open source software or b) Protected by Patent Law?"

TABLE 10. Question 8.

Q8	YES	NO	Yes%
1st Institute of technology	18	31	36,7%
2nd Institute of technology	27	23	54,0%
3rd Institute of technology	4	13	23,5%
4th Institute of technology	10	20	33,3%
5th Institute of technology	3	12	20,0%
Total	62	99	38,5%

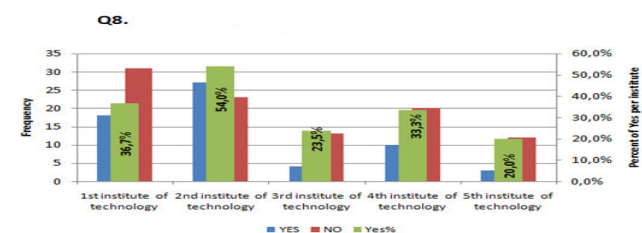


FIGURE 9. Q8: "A patent lasts for 20 years giving its holder exclusive rights as for commercial exploitation. Do you believe that 20 years is a reasonable time period for technology inventions, regarding that technology evolves rapidly?"

In contrast, the other 4 Institutes of Technology, in these questions had opposite percentages indicating the absence of teaching.

Afterwards, we conclude that graduate students of Greece's Institutes of Technology need to be aware of the legal and entrepreneurial framework of a technical invention. It is of vital importance to distinguish what is patentable and what is not, what novel means regarding an invention, what is the inventive step, what means prior art and which invention is regarded as industrial applicable. All these are the

TABLE 11. Question 9.

Q9	YES	NO	Yes%
1st Institute of technology	27	22	55,1%
2nd Institute of technology	39	11	78,0%
3rd Institute of technology	15	2	88,2%
4th Institute of technology	26	4	86,7%
5th Institute of technology	14	1	93,3%
Total	121	40	75,2%

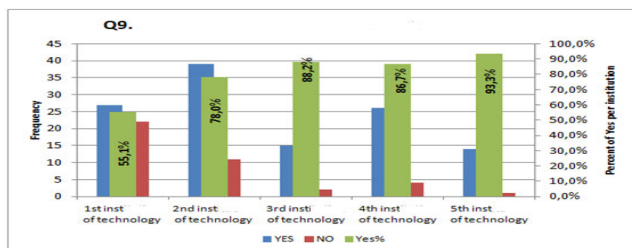


FIGURE 10. Q9: "Do you think that prior to 20 years the patented invention should be available to the public?"

TABLE 12. Question 10.

Q10	YES	NO	Yes%
1st Institute of technology	15	34	30,6%
2nd Institute of technology	8	42	16,0%
3rd Institute of technology	0	17	0,0%
4th Institute of technology	9	21	30,0%
5th Institute of technology	6	9	40,0%
Total	38	123	23,6%

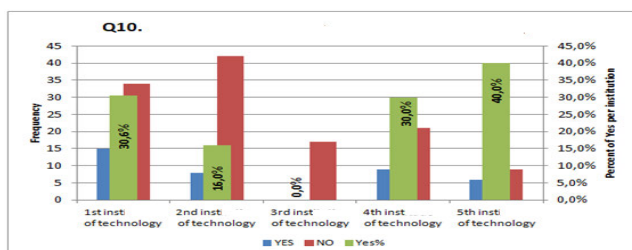


FIGURE 11. Q10: "Have you ever visited the patent office in Greece or have you ever visited the sites of United States/European/Japan patent office or World Intellectual property organization, in order to be informed about technological achievements and their legal protection in society?"

requirements in order to grant a patent. They should also have the knowhow to define the technical field of their invention, to claim their invention and to define the required protection, through the disclosed claims in the patent application. They should be capable of guiding a person state in the art, like an examiner of a Patent Office, to reach the desirable result by undertaking every step mentioned in the description of the claimed invention. Then, an inventor of technology fields

TABLE 13. Question 11.

Q11	YES	NO	Yes%
1st Institute of technology	5	44	10,0%
2nd Institute of technology	9	41	18,0%
3rd Institute of technology	2	15	11,8%
4th Institute of technology	8	22	26,7%
5th Institute of technology	7	8	31,8%
Total	31	130	18,3%

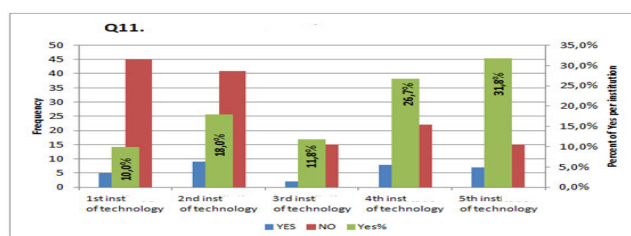


FIGURE 12. Q11: "Have you ever considered or implemented an innovation? Or have you found an optimized solution to a problem?"

TABLE 14. Question 12.

Q12	a	b
1st institute of technology	2	3
2nd institute of technology	9	0
3rd institute of technology	2	0
4th institute of technology	7	1
5th institute of technology	5	2
Total	25	6

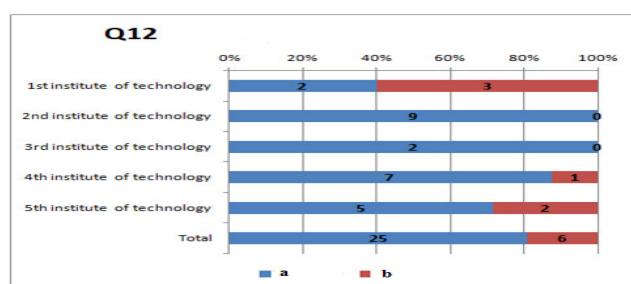


FIGURE 13. Q12: "If yes, (a) did you reveal it or b) you first consulted a lawyer?"

can apply for a patent and ensure priority for the potential invention the day of his application.

In addition, students should have entrepreneurial knowledge. They should be able to evaluate the feasibility of their invention. They should have the knowhow to understand whether they can support and afford an invention relying on their own strengths by establishing a start-up company, or whether they could otherwise negotiate with

TABLE 15. Question 13.

Q13	YES	NO	Yes%
1st Institute of technology	18	31	36,7%
2nd Institute of technology	19	31	38,0%
3rd Institute of technology	7	10	41,2%
4th Institute of technology	20	10	66,7%
5th Institute of technology	11	4	73,3%
Total	75	86	46,6%

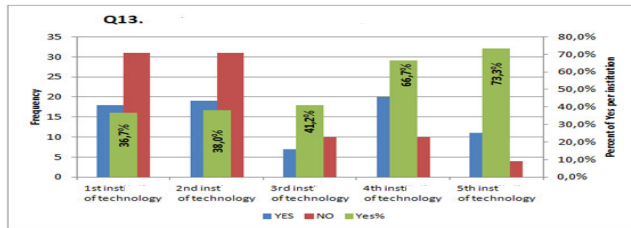


FIGURE 14. Q13: Have you ever considered establishing a start-up company based on a technological achievement?"

TABLE 16. Question 14.

Q14	Institute of technology					Total
	1	2	3	4	5	
AI	6	5	3	5	4	23
google		9				9
haptics	2					2
internet	2	5				7
IoT	10				6	16
robots	3	3		2	2	10
smart apps	10	8	6	5		29
smart devices				3	3	6
smart hotels	4					4
smart phones	10	15	8	10		43
smart transportation	2	5		5		12
Total	49	50	17	30	15	161

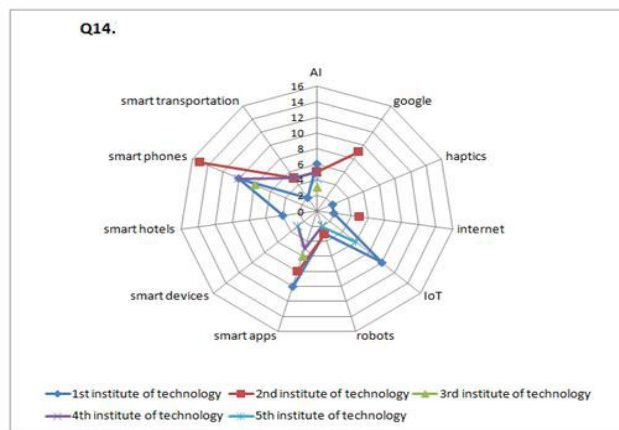


FIGURE 15. Q14. What is the most up-to-date, technological breakthrough you've heard, seen or used?"

TABLE 17. Question 15.

Q15	YES	NO	Yes%
1st Institute of technology	40	9	81,6%
2nd Institute of technology	28	22	56,0%
3rd Institute of technology	11	6	64,7%
4th Institute of technology	18	12	60,0%
5th Institute of technology	9	6	60,0%
Total	106	55	65,8%

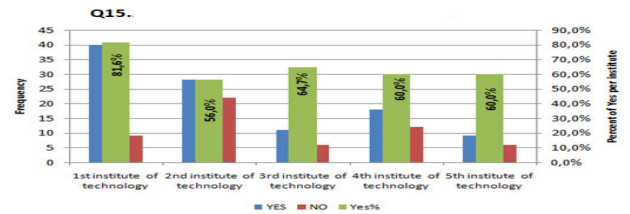


FIGURE 16. Q15: "Do you believe that in the technological industry a start-up can survive?"

TABLE 18. Question 16.

Q16	YES	NO	Yes%
1st Institute of technology	42	7	85,7%
2nd Institute of technology	37	13	74,0%
3rd Institute of technology	11	6	64,7%
4th Institute of technology	22	8	73,3%
5th Institute of technology	14	1	93,3%
Total	126	35	78,3%

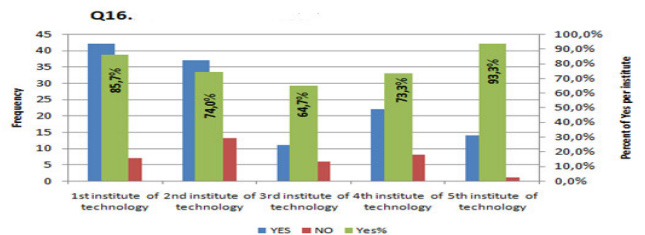


FIGURE 17. Q16. "Do you believe that a technological enterprise or an inventor should spend money on patenting a technological innovation before it is disclosed?"

an existing company about the possibility of selling their intellectual property rights. They should know the value of possessing a patent portfolio and they should develop managerial skills in order to cope with the competition of the technology industry.

Further, regarding the curriculum of Greece's Institutes of Technology we assume that the level of students' learning is offered for further development of skills in the fields of Law and Entrepreneurship. Furthermore, as far as what concerns the results of the survey, we conclude that the students trust

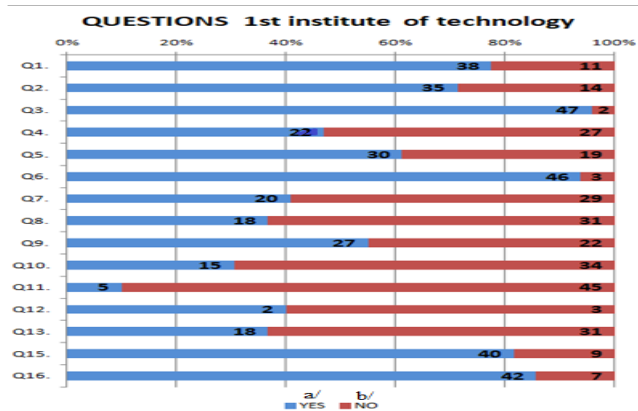


FIGURE 18. All answers for the 1st Institute of Technology.

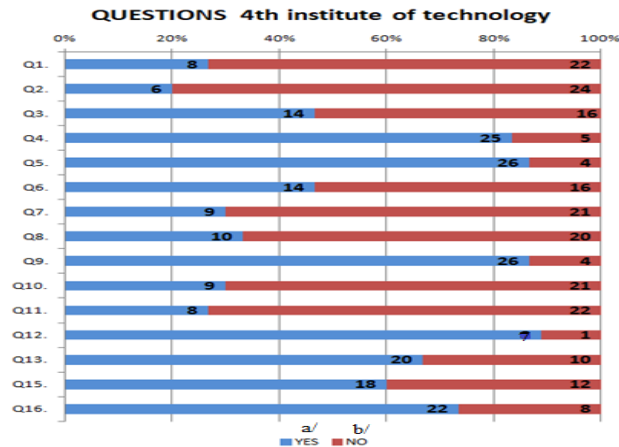


FIGURE 21. All answers for the 4th Institute of Technology.

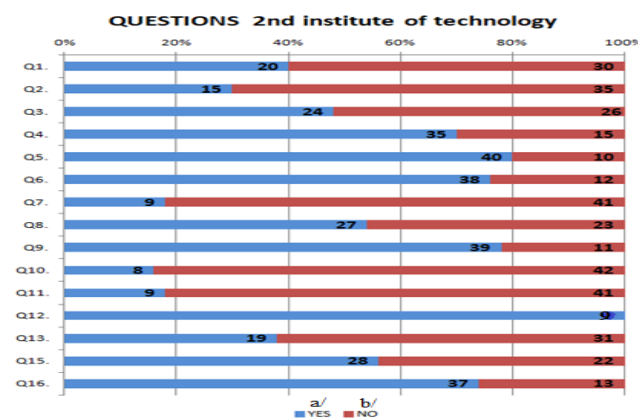


FIGURE 19. All answers for the 2nd Institute of Technology.

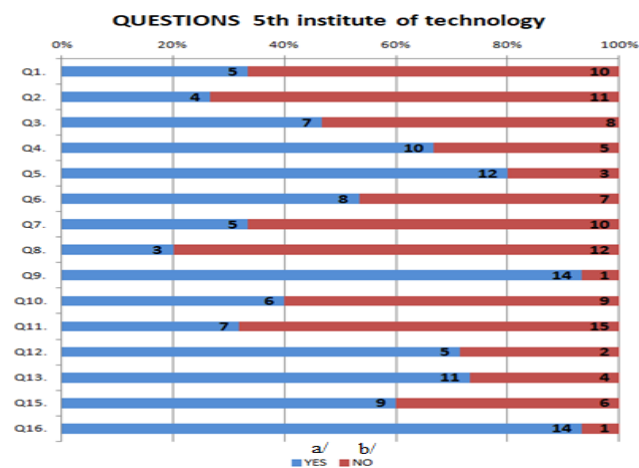


FIGURE 22. All answers for the 5th Institute of Technology.

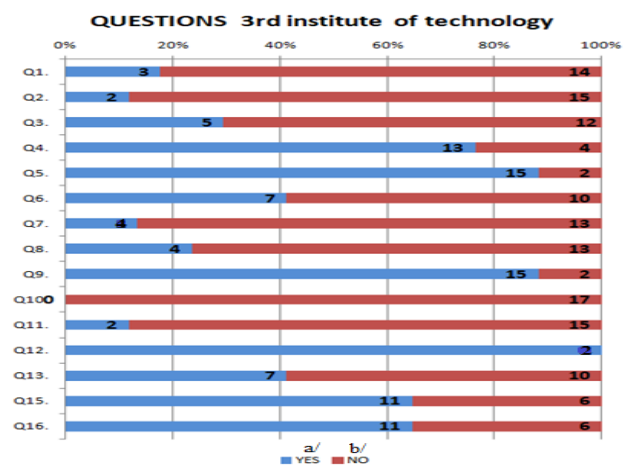


FIGURE 20. All answers for the 3rd Institute of Technology.

Patent Law, are positive to enter the business world and are also motivated from technology to establish a start-up company. They are willing to fight competition and survive in the industry of technology and they are willing to undertake and finance a patent procedure for their potential invention.

Eventually, from the literature we presented above with the papers that contributed in our study in the field of IPR, Patent Law, smart technology and industrial world, we realized the great impact of IP on industry of technology, education in the field of computer science and society. We also realized the efforts from all professionals in adjusting law to the rapidly evolvement of technology, the issue for patent eligibility of computer implemented inventions and AI implemented inventions and last but not least the utility of AI machine learning algorithms and Big data to conclude through given patent domains the value of patents and their technical advantage. Therefore, the results from relevant surveys and studies in the literature indicate the importance of focusing the education of graduates from technological Institutes in IP courses. The majority of studies and surveys in literature refer to the point of view of technology management professionals, inventors, R&D firms and technological companies and universities as far as how to develop an e-learning IP support program, a course of law for computer professionals and e-learning course of IP for students. Although, there exist a

study in the literature, see [9] including a survey conducted in 5 China's universities for engineering students' as for the need of IP education, to the best of the authors' knowledge, this is the first time that a survey, which refers to graduate students of Technical Institutes in Greece and the rest world, is conducted and examines their knowhow on Entrepreneurship and on Patent Law, in the direction of supporting a potential technological invention. In our survey, similarly with earlier results excluding from the literature, we realize the primordial importance of developing and inserting in the technical universities' curriculum a course for IP activities to support invention.

V. CONCLUSION

Combining the fields of IPL and technological innovation, we created a survey using a questionnaire that was distributed in 2019 to graduated students of 5 Institutes of Technology in Greece. The purpose of the research is to determine whether Greece's potential inventors have the technical skills to support a potential innovative idea.

Based on the research the conclusions follow:

Technology students are not consciously aware of the Patent Law. However they have confidence in the patent institution. There is a lack of knowledge in the field of patenting technological inventions. Technology students should not only be able to conceive and implement an innovative idea, but should be able to support and protect their intellectual property. They need to know what subject is patented, regarding technology fields, what a patent may offer to them and they should be given the opportunity to use their intellectual asset in their own free will. They should have entrepreneurial knowledge so as to understand the value of possessing a patent portfolio and they should develop managerial skills in order to cope with the competition of the technology industry.

Furthermore, based on the results, we conclude that questioned students of Greece are willing to patronize their potential invention by granting a patent, as well as they intend to commercially exploit their potential invention.

At the same time they have a positive attitude and motivation for entrepreneurship and they want to get involved in the technological industry. They are willing to establish their own business which ensures a contribution to the country's future economy and believe that a nascent technology company can cope with the competition in the industry of technological innovation. They believe that it is worth to undertake and financially support a patent granting process in order to protect an innovation from infringement.

Moreover, they regard that an invention should be available to the public earlier than the 20 years that provides the Patent Law, and therefore contribution in society's technological advancement is achieved. So, maybe it is time for the law to be revised.

Furthermore, judging from the results of the survey, it is obvious that in the most critical questions, that prove students' knowledge of the relationship among technology, the law and the rights of the inventor, the students' answers,

of the only Institute that includes in its curriculum a course related to Law and Information Technology, indicated knowhow that obviously comes from the teaching of the respective course. In contrast, the other 4 Institutes of Technology, in these questions had opposite percentages indicating the absence of teaching a Patent Law course.

Therefore, it is imperative that the curriculum of Greek university Technology Institutes be enriched with courses of Intellectual Property and entrepreneurship, too.

Further, it is recommended for the students of Technical Institutes to participate, by preparing a patent or a business plan for a technical invention, in patent contests or contests for innovation and startup companies. Many patent contests are organized nowadays from private and public institutions of every country with a view to promote innovation and technology.

In addition, technical universities should install technology transfer offices to promote patenting. A technology transfer office can promote academic patenting and the establishment of start-up companies basing on patents. The collaboration between industry and university through this action may also be encouraged.

Last but not least, it is recommended that Patent Offices, included the national Patent Office in Greece, should collaborate with the Institutes of Technology and take action for the preparation of distance learning programs regarding the information of new inventors about the procedures for applying for a patent and the legal protection, national or wider, they may require for their potential invention.

Consequently, only then we can refer to integrated scientist technocrats who can protect their Intellectual Property, are able to manage a competitive business and therefore contribute to smart technology industry and society's well being.

VI. FUTURE WORK

As it has been already mentioned, the technology industry is increasingly pointing out the need for IPL education at technical universities. Therefore, in the near future, we intend to conduct this survey in other European countries and the rest of the world, in order to draw conclusions about the knowhow of graduate students, of Technological Institutes, on Patent Law, Entrepreneurship, and their skills in managing a potential technological invention.

In this direction we will have a more comprehensive view of the overall education of young scientists in the global industry of technological innovation and then measures may be applied, where it is deemed useful, in terms of integrating IP courses in the curriculum of technical universities.

Further, we also intend to develop an IPL course for undergraduate students of technical universities to serve the purpose of educating students in terms of Intellectual Property and both legal and managerial issues that concern an inventor. This course will require 2 hours of lectures per week for 15 weeks, which will not be time consuming and will not burden an existing compulsory education program.

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