



## **THINKING ETHICS DIFFERENTLY (CHALLENGES AND OPPORTUNITIES FOR ENGINEERS EDUCATION)**

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### **ABSTRACT**

Ethics has many definitions, each depending on its domain. In the ancient times, ethics was based on the principles of good action and the search for the common good. Generally, Ethics is understood as a system of moral principles which affect our ways of living. Ethics are related with what is good for society and individuals and is described as moral philosophy. Ethics only makes sense if we put them in the context of human action understood as responsible, creative and communicative. Applied Ethics and Codes of conducts have appeared in the contemporary period. One of the key issues in the engineering education ethics program is the problem of margins/limits of autonomy that will enable future engineers to act ethically in accordance with universal ethical principles and the existing codes of ethics. Computer ethics adds the intellectual property rights, and also the use of personal data. The paper shows a general review of ethics, its history, its evolution, with an emphasis on engineering education. It also mentions the big data issue in ethics.

**Keywords:** ethics; engineering education; engineering ethics; computer ethics



## 1. INTRODUCTION

The whole history of Human Societies has been marked by the tensions and conflicts generated by the development of Science and Technology. Thomas Kuhn, in his book *Scientific Revolutions* (1962), illustrated this idea and wrote that scientific progress is the mirror of changes in the social world "when paradigms change, the world itself changes with them" and "after a revolution scientists are responding to a different world" (Kuhn, 1962).

In his approach to the scientific paradigm, Kuhn highlights the importance of the "social use of sciences" and considers that values, beliefs, and traditions are the main components of scientific theories and they are transmitted and propagated by the scientific community in society. The paradigm is a model of thoughts, and a set of substantial propositions taken for granted. It is constituted by the general laws and technical applications where members of a particular scientific community agree to adopt a standard on which their research must be conducted.

Margret Masterman identified "21 possible meanings for a paradigm" and argued, they can be compressed into three encompassing categories, which she termed the metaphysical (meta-paradigm), the sociological, and the art factual (Orman, 2016). "The paradigm term is analyzed stressing on two different senses of paradigm –disciplinary matrix and exemplar. It is also showed why the process of a paradigm shift, for Kuhn, leads to a scientific revolution and the revolutionary stages of such shift are explained. Finally, Kuhn's argument on incommensurability of competing paradigms and the problem of objectivity are also discussed in order to show the problematic aspects of the concept" (Orman, 2016).

In the first one, paradigm designates what the members of a certain scientific community have in common, that is to say, the whole of techniques, patents, and values shared by the members of the community. In the second sense, the paradigm is a single element of a whole, stands for the explicit rules, and thus defines a coherent tradition of investigation (Orman, 2016)

For the sociologist Alain Touraine the complexity of the contemporary world requires a "paradigm shift" which encompasses all these historical, societal and cultural changes (Touraine, 2005). In his conception, the dynamics of this new paradigm shift illustrate the significant link between Historicity and these Societal Changes. (Touraine, 1992)

Alain Touraine argues that the concept of Historicity is the analytical tool to apprehend the changing world (Touraine, 1965, 1973). Historicity refers to the capacity of society to act



upon itself, to intervene in its own functioning, to produce its normative orientations and to construct its practices at a given moment in its History. He argues that classical social and economic categories, through which sociology had analyzed the previous society, have lost their dominant epistemological position and no longer read the type of society which is presently emerging.

Therefore, it is necessary to build a new paradigm allowing us to comprehend this world based on virtual and real aspects (Touraine, 2005) characterized by the merging of the virtual world, delocalized Internet, virtual networks, and the real world of industrial facilities and production.

The new world, perceived as both virtual and real, has emerged because of the technological rupture leading to a transparent, expanded, and sharing universe of the future industry 4.0 all the industrial revolutions intervened with the appearance of the energetic changes and the means of communication (Gimelec Report -Industrie 4.0, 2013).

In the XIX century, a revolution took place due to the convergence between coal and printing industries which affected the whole knowledge system and produced important social and political changes and transformation. In Europe today, we are witnessing the emergence of a new model of convergence, the convergence of communication and energy. The communication merges with a new energy mode, i.e., the distributed energy. We are moving from the era of centralization to an era of horizontalism, and decentralization, leading to sharing and collaborative functioning (Gimelec Report -Industry 4.0, 2013).

All these transformations represent the beginning of the forth-industrial revolution, which involve the adaption of social model to new forms of work, such as cooperative and network work, decentralized micro-industrial production, all based in less hierarchical and centralized forms of organization, rendered possible through "connected intelligences".

The fourth industrial revolution has already laid down its "technological bricks" and contributed to the emergence of "integrated industry", "innovative factory" or "industry 4.0" ("smart industry) based on the flexibility of communication systems (totally interconnected) and the decentralized artificial intelligence. The industry 4.0 is based in the convergence between products, tools and professions. This new type of industry will affect the industrial paradigm in its organizational, technological, and cultural aspects (Gimelec Report, 2013).



These changes will emphasize how crucial are the social implications of technology and its reflection on the respective societies.

Going back to History, during the three previous revolutions (mechanical production, steam power, large scale production and electricity, automated production, and robots), humanity has experienced evolutions and revolutions that have profoundly changed the human life in terms of work and its organization. The traditional manufacturing processes have been characterized by a very clear division of labor. Nowadays, the new model of work organization and management has changed the role because of the increase of open platforms, virtual work, and the development of interactions between man-machine and man-system with repercussions on the regulation of work and the private lives of people.

The purpose of industrial society coupled with the scientific and technical developments is to simplify the human life, by improving the quality style, and increasing the life expectancy. However, the hard power of Science and technologies transformed individuals into victims of the same technological progress. Individuals became prisoners of industrial society, building a system of ethics to justify the instrumental reason, namely profit, consumerism, domination and control.

The society upholds the power of Science over the power of Man. The individual loses the capacity to make ethical choices. Ethical actions become limited and cause individual alienation. Technological society contributes to individual alienation because of increasing addiction or reliance on technology.

Nowadays we move from social order to the cultural order, which is built on ethical and cultural rights, which are understood as universal, and necessitating new ethical paradigm based on human dignity and responsibility.

Through the technological development, Science creates a violent society causing destructions and wars. Therefore, Engineering Education must bring about critical analysis of utilization of technologies. The human evolution showed that, in the blind pursuit of technological development, there are many examples of questionable ethics and morality.

During the first Industrial Revolution, the factory system was one of the sources of risks and inequalities (gender and income) such as the lack of safety and security standards, the use of children labor, the employment of women in dangerous places. Nowadays, all this phenomena creates an increasing separation or divide through the digital technology exclusion,



such as unequal regional development, new poverty and poor, destruction of social bonds and communication.

In France today, the digital divide is worsened for elderly who do not have access to internet networks, equipment and the dematerialization of the administrative procedures such as payment of taxes, online declaration of resources, online access to social security, health insurance and pension funds (CSA Research, Etude, 2017). This makes these people more vulnerable by excluding them from access to social life. The society must advocate new steps in this direction by restoring the digital link between poor citizens, and elderly persons through friendly applications.

Another symbol of power control by new technologies on individuals and society is the monopoly of Big Data. The technical definition of Big Data refers to its ability to capture, to search, to share, to store, and to provide massive data. Nowadays, the need for analytics and the use of massive digital data have brought new ways of seeing and analyzing the world by the search of sense through its capacity to give meaning to a large number of unstructured data, thanks to their high speed processing. Big Data deeply modified the classical decisional and traditional making process Big Data has profoundly shaken our societies, opening a new stage, described by some authors as an industrial revolution similar to the discovery of steam (early 19th century) electricity (late 19th century) and computing (end of the 20th century) or being the last stage of the third industrial revolution, that of "information".

According to Dana Diminescu et Michel Wieviorka, Big and digital Data are considered as "an integral part of a new scientific culture" (Bert-Erboul, 2015), is at the center of cultural and anthropological changes. Henceforth the social sciences should seize to face the new dominant players, whether they are political, economic or technological.

This phenomenon generates ethical consequences due of the unethical use of these massive Data such as unfairness, and negative economic outcomes, for example benefiting from the fiscal dumping and affecting the society and individuals.

Governments are also concerned about open data and have tried to regulate the access and the use of these data though normative tools.

From an ethical perspective, the need of direction in responsible Big Data research became a priority: "is real urgency to define what a 'human subject' is in Big Data research and critically interrogate what is owed to 'data subjects.'" (Metcalf & Crawford, 2016) and



reinforces the idea that the "cultural resistance of individuals" represents today's one of the ways of the defenses of "human dignity" (Touraine, 2015).

The consequences of global interconnected systems, which affected our lives, open the debate in social sciences and humanities about the role of human factor in the decision-making process in all fields of human activities. According to the social scientists and philosophers, nowadays all these mutations are the mirror of new dominant forms of power systems (technological and informational).

Recently, ethics recently emerged as an important topic for engineering students. Future engineers have to be aware of their ethical duties. In the next sections, origin and evolution of ethics education is discussed, followed by ethics from sociological perspective, then ethical education for engineering students, the pedagogical issues, a discussion, big data ethics, and finally a conclusion.

## **2. PHILOSOPHICAL APPROACH TO ETHICS EDUCATION /ORIGIN AND EVOLUTION**

Ethics is understood as a system of moral principles which affect our ways of living, how people make decisions and how later these decisions affect our lives. Ethics are related with what is good for society and individuals and is described as moral philosophy.

The word "ethics" can be used in at least "three common senses". In one sense, it is a mere synonym for ordinary morality. In another, it names a field of philosophy (moral theory, the attempt to understand morality as a rational undertaking). In a third, it refers to those special standards of conduct that apply to members of a group just because of that membership". In engineering field, ethics is understood as a " interpretation, application, and revision of engineering's special standards of conduct" (Davis, 1998).

From his perspective, the difference between the moral values or engineers commitments and ethics, special standards of conduct, still very important and helps to understand how ethics evolves over the time and different they are from country to country or field to field . The author mentioned honesty, efficiency and safety as engineering values and "reasons for adopting "standards of conducts" or standards of practice including a code of ethics "witch "tell us how we should act" (Davis, 1998).

The author emphasized that the engineer should be understood differently: I began by thinking that engineering was primarily about things, a complex but fundamentally unimaginative application of science, mere "problem solving" (as even engineers will describe



it, if you let them). I have come to understand engineering quite differently: as the practical study of how to make people and things work together better—an undertaking as creative as art, as political as law, and no more a mere application of science than art or law" (Davis, 1998). He made a clear distinction between occupation and profession and emphasized that their code of ethics is based on their profession.

Engineering ethics is kind of applied, or practical, philosophy. It is concerned with understanding and helping to resolved-certain moral problem arising in the practice of engineering.

The term is derived from the Greek word "ethos". This concept refers to custom, habit, character or disposition and covers dilemmas around the conflict of interests and values such as how to live a good life, human rights and responsibilities, the right and wrong and the moral decisions.

The concepts of ethics and morality have undergone a long historical evolution, thus marking the philosophical tradition from antiquity to the present days. Aristotle and Plato based their ethics on the principles of good action and the search for the common good, by articulating the human action with the order of the world. Aristotle identify the "virtuous action" and "virtuous activity" with the "virtuous life": "the unique function of the man is to act according with a rational principle , with virtue in a complete life" (Lewis, Kellogg&2011).

In the ancient world, Aristotle and Plato based their ethics on the principles of good action and the search for the common good. Some authors considered that "the classical vision of the common good (common bonum) with its ancient roots (Plato, Aristotle) understood as the expression of a higher interest is no longer adapted to the modern and post-modern paradigm of the actual ethical reflection which takes place in a profoundly different social, cultural and historical context" (Muller , 2004).

Nowadays we can add that ethics only makes sense if we put them in the context of human action understood as responsible, creative and communicative. These dimensions are illustrated in the philosophical thoughts of Jürgen Habermas (1992) and Hans Joas (1999).

During the Modern period, Emanuel Kant was the defender of the idea of universalism, whose values such as the reason, the law, the morality and ethics would be supposed to be able to apply to the whole of humanity (Wieviorka, 2015).





In the Groundwork for the Metaphysics of Morals (1785) Kant distinguishes between two types of actions (acts according to duty and acts by duty). The first is based on the idea of legality and interest and the second on morality or an action made by wanting to accomplish the one's duty and linked the idea of action with the idea of will, considered as autonomous, because it gives itself its own law.

He begins his Groundwork for the Metaphysics of Morals (1785) with the claim that the only thing of unconditional value is a good will, argues that such a will manifests itself only in doing one's duty for its own sake, and then concludes that since doing duty for its own sake deprives the will of any object of desire as a reason for action, nothing is left as a possible principle of morality "but the conformity of actions as such with universal law (G, 4:402)in (Guyer, 2006).

In his ethical thoughts, Kant associated the idea of human dignity with autonomy and freedom. The human dignity derives from the moral law, and is an intrinsic value. By considering "autonomy as a principle of the dignity of human nature and of all reasonable nature", Kant remains a source of inspiration for the development of ethics by associating freedom and universality.

Later on, Max Weber made the distinction between two types of rationalities. The ethics of Francois Vatan in his article, "The engineer spirit: computational thinking and economic ethics" argued that the first type of rationality deals only with the coherence of action and regarding the axiological choices. The second, embodied mainly in the practice of the engineer and the economist, this would bring back the means to the finalities in an economic perspective. He mentioned the permanent connection in the engineering work between calculation and moral values. The ordinary engineer may not always be aware of the values he implements, he is often duped by the objectivity of his calculation, forgetting the construction that makes it possible and the value of standards that govern it" (Vatan, 2008).

Debates in ethics always emphasize on the importance of action. JurgenHabermas in the Ethics of the discussion (1991) highlights the idea that the human being, finds his freedom in the communicative action and the ethics is built by the discussion and the consensus, called by Habermas the moral of communication, real and not idealistic.

The central question of his ethics is about how an action can be judged morally and how through the rational discussion we can found moral norms. According to Habermas, this moral norm comes from many people and not from a particular individual; it is the contrary to moral





obligation as in Kant moral philosophy, and the whole purpose of Habermas theory is to build the moral norms, and standards shared by all individuals.

The contemporary philosopher, Paul Ricoeur, in his book *Ethics and Morality* (1990) answered the question of whether to distinguish morality from ethics. He writes that nothing in the etymology or in the history of the use of words is impossible. One comes from Greek, the other from Latin, and both refer to the idea of morality (ethos, mores); however, a nuance can be discerned, depending on whether the emphasis is on what is considered good or what is mandatory. Human action is a central category of ethics and is intentional. The subject gives to his action a double purpose: the practical subject will do two things at once: as a person, certain gestures, and as consciousness, certain aims (Descombes, 1991).

In addition, ethics refers to standards of conduct established by society, after reflecting on what is good or bad. Morality is established by the standards of conduct of a person or group of persons; it is the framework of our personal behavior. Morality is governed by relative values such as good and evil, where ethics is the definition of acceptable or unacceptable behavior through reasoning.

Applied Ethics and Codes of conducts have appeared in the contemporary period, starting from 21 century. Etymologically, the word deontology comes from the Greek deontos which means duty. Deontology is Ethics applied to professions and establishes rules and duties for members of the same professional activity or profession. It should be emphasized that ethics and deontology are influenced by the diversity of cultures and values according to the traditions and history of each society. This is what professional practices are governed by.

In engineering, this aspect is obvious when it comes to comparing the professional practices of engineers trained in France or the United States. As for the professional practices they are governed by different standards and ethical requirements.

Early experiments in engineering education culminated in Ecole Polytechnique in France was built in Enlightenment philosophy, "scientific and democratic idealism" and human progress. The author mentioned also the British Institution of Civil Engineer (1882) which followed the same philosophy, specially, in the civil engineering considered as a "art of directing the great sources of power in Nature for the use and convenience of Man" (Davis Michael, p.15).

Until today the engineer's commitments for the human progress are considered as fundamentals of engineering ethics. Davis cited two examples related with the Enlightenment



values, the Military Academy at West Point in USA (1817), the first school of engineering which started the engineering education, curriculum and methods and the "most widely adopted code of Engineering Ethics" in the United States "engineers uphold and advance the integrity, honor, and dignity for the engineering profession by using their knowledge and skills for the enhancement of human welfare" (Davis, 1998, p. 15).

Ecole Polytechnique de Paris contributed to the emergence of engineering in the world. Today its mission is to educate future engineers "For the Homeland, Science and Glory\Napoleon Bonaparte" and link their education with the historical tradition of France with a strong emphasis on science, anchored in humanist traditions and ethical values. The school educates socially responsible future professionals who will excel in complex and innovative projects that meet the current and future challenges of our society.

The core of philosophy is structured around the idea that the confrontation and cooperation of disciplines, including philosophy, contribute to the development of innovation based on the ethical principle and responsibility. Its role is to convey to its students that ethical values complement knowledge. The role of dissemination of knowledge of the Universities is not limited to research publications but extends to online education through "Open Online Training". Its influence across the community is beyond a mere educational and scientific level and extends beyond the concept of creating knowledge. In the same tradition, Ecole des Mines was continuing to promote the humanistic model by creating the "social engineer (Audren&Savoie, 2008).

### **3. ETHICS FROM SOCIOLOGICAL PERSPECTIVE**

Today we live in a world dominated by uncertainty and the risks that are changing us. Therefore, transforming our capacity to act and cope with the complex logics of globalization shaping the relationships between individuals, and the individuals with the world (Wieviorka)

According to Touraine (2013), society as we have known until today disappears due to the loss of old references that have structured social relations. Pre-industrial societies defined by politics, law, nation or states, were dominated by the idea of progress conveyed by the Industrial Revolution. Techniques, machines, and wealth have produced unprecedented economic and social transformations, allowing societies to create and destroy themselves in the name of the same progress.

Work, social classes, competition, and investment were the founding elements of social relationships, but now we are leaving social societies and entering into the post social era



named by the French sociologist the end of societies. In the current world where the new Technological developments, systems of information and communication technologies (ICT), and digital transformation are shaking up our experiences and practices, despite its strong impact on our practices, the consequences are out of control and hard to predict .

In Post-Social stage (Touraine, 2013), these transformations reveal much more complex realities, such as the control exercised by the power systems as defined by the French sociologist as systems of domination (science, politics, economic, and finance), not only over the objective world, economic or technological, but also over our subjective world (representations, and values) influence our ways of acting.

The fundamental question facing our societies is how to find new means that allow us to resist these changes. For Touraine (2013), a new ethical paradigm based on a conception of the world that opposes all current systems of power will be the fundamental condition for the formation of collective consciousness and action. In his latest book, *We the Human Subjects* (2015) he reiterated the idea developed in his previous work (Touraine, 1993) that the cultural or ethical model directs and interprets social practices. Ethics for him has become the central issue of our times.

Through its mobilizing momentum, ethics contributes to strengthening the will of human subjects to become autonomous and responsible actors. Ethics and education increase the cultural resistance of social actors against technocratic or political domination systems. The new challenge of collective action is cultural or ethical (Touraine, 2013). In the current context, all spheres of social life and all professions are concerned by the quest for ethics. Ethics guide those actors to redefine their actions and find answers to ethical questions related to their new social and societal responsibilities.

At this point it is very important to mention that social approach from engineering ethics perspective focus in the idea that the ethics are "at least in part the product of social decision and the standards of engineering ethics "derive from the morally binding contract with society" (Davis, 1998).

The world of engineering is caught up in the whirlwind of accelerated globalization and the effect of these transformations will influence the profession and professional practices, thus needing ethics as a part of the curriculum design and making it as a must. The introduction of moral philosophy and codes of deontology in the education of engineering students is a priority



because they must be prepared to face the new challenges and risks pertaining to their professional practice in the globalized world.

The uncertainty concerning the safety and security of the human beings remains a priority for their future. Ethics education is also a challenge by itself, because it allows future engineers to understand the dilemma of a contemporary man, shared between his subjectivity, his personal values and convictions and the values of the objective, economic world related to profit and consumerism. This warrants serious consideration of the following questions;

What sense of professional responsibility will the engineering students give to their actions, choices and decisions, How will the engineers be able and be prepared to resolve the conflicts or dilemma generated by different social roles(as individual, engineer, manager or businessman) ? The logic imposed by the employer/organization on the graduate students as they emerge into the workforce and the constraints resulting from the obligation to respect the technical rules make their ability to act ethically, in certain cases limited, and as a result they disregard the moral aspects.

#### **4. ETHICAL EDUCATION FOR ENGINEERING STUDENTS**

One of the key issues in the engineering education ethics program is the problem of margins/limits of autonomy that will enable future engineers to act ethically in accordance with universal ethical principles and the existing codes of ethics.

Ethical education can provide engineering students with the proper tools to making decisions taking into consideration the individual, professional and societal impacts.

In *Making of a Humane Engineer*, Weingardt (2013) referred to Florman's main idea: engineers are both technical experts and citizens of the world. They have very high introspective, existential level, and they are competent and qualified professionally and those qualities contribute to the successful development of society.

In *Introspective engineer* (1996), Florman argued that it is "the profession most essential, to the well-being of society" (Pfatteicher, 2017) and in *Existential Pleasures* (1996) characterizes the engineer as "logical, sober, and well meaning, a very good citizen" (Pfatteicher, 2017) and describes the nature of the engineering experience in our time , engineering is "existential" .

Ethical competence and skills are considered professional and Florman (1993) wrote "we create engineering works not only to survive and prosper but also to express transcendent



aspirations". Also this point of view is shared by French sociologists, Touraine and Wieviorka, and it is considered as a capacity of social actors to build their subjectivity through the process of subjectivation. Florman insists on the fact that engineers are not totally depending on logic in all situations, remembering that emotion and belief also play a big part in many decisions.

He emphasized that the role of liberal arts disciplines is to shape the engineer's identity by virtue of education, experience, and bring benefits to their work and to the society. He confers that ethical dimensions is the belief in scientific truth considered as an important dimension of engineering profession and practice. He shared that there is a link in the ability of engineers to be hard workers and ethical persons.

The new engineer identity provides them with openness in promoting various changes requirements. In both books, *Existential Pleasures* and *Introspective Engineer*, Florman highlights a belief that engineering view has much to contribute to the society and engineers they have a "powerful potential "but they also have" many unfortunate characteristics" and calls for sensible reform educational reform of undergraduate engineering education in order to help engineers overcome these obstacles and prepare them for political and social leadership. He considered that such efforts at self-improvement will be worthwhile for engineers and society (Pfatteicher, 2017).

Engineering has long been a source of ethical concerns, which evolved through decades. Currently, engineering is a complex and multidimensional practice of technology development and requires multidisciplinary approach. This means the ability to think differently in the overall education for future engineers, in terms of challenges and opportunities.

Ethics is part of the corpus of humanities and social sciences known as SHS and it is integrated in the curriculum design for engineering education.

In France, the SHS were institutionalized in 1950 and the contributions of Georges Friedmann, author of the *Traité de sociologie du travail* (1962) and Alain Touraine (*Sociology of action*, 1965, 2000) or actionalism understood as a sociology of work were very important in emphasizing the link between the technical and the social, dimensions of human life which seem apparently dissociated (Roby, 2015). Technical evolution is at the same time human evolution and understanding its meanings is a requirement on the horizon of the new industrial revolution.

The social sciences and ethics contribute together to the development of reflexive thinking by enlightening the importance of freedom of choices and sense of the decisions to be taken in the context of these transformations.

The technical transformation is not the simple modification of a knowledge; it is the transformation of the way of life and a series of social relations arising from it; the technical problem is not the only problem, it is a human and social problem, and this is only by neglecting its essential aspects that we have tried to give a technician title or more exactly technician interpretation (Catherine Roby, 2015), Nowadays, using social and ethical approach in technical education for engineers confirm Friedman's and Touraine's intuition according to which the apprehension of the world of changing values requires a call for personal freedom as understood as the capacity of human subjects through their action to reconcile the technical and economic world with the world of subjectivity, the means with the finalities (Touraine, 2005).

Ethical education for engineering students and future engineers is becoming a priority because in today's world, science and technology are considered part of these new social and human realities characterized by the convergence of the virtual world with the real world. The smart technologies accompany people and it is necessary to conceive the new educational and training programs to reinforce their ability to cope with all these changes by integrating these new dimensions in their social and professional practices.

In this new context, the ethical conduct of future engineers is a major issue. They must learn how to protect their know-how and against new cyber-risks, and ethics will be the appropriate tool for them to face the new war called cyber-criminality. In addition, the future engineers will be aware and ready to act and react ethically to the uncertainty produced by these evolutions. Creation of sustainable industries by the future engineers mean useful solutions for society and individuals and remodeling as well the relationships between human being and the machine.

Humanities and social sciences are crucial in future professional training. New specializations and professions will emerge which will require new competences adapted to network operation already called competence industry 4.0. Expanded knowledge diffused by the new information and communication technologies and the experiences produced by the smart industry will require transversal skills, human and ethical competences.





The challenge is to determinate educators to bring ethics into every aspect of curriculum design. This will enable educators to focus on human factor as an important part of the technological society. This will enable to strengthen interpersonal communication and understanding, to learn how to show respect for cultural, social traditions, and to create a human engineer with a soul, no universality of technical inventions should be considered without understanding the human been and his deep subjectivity, by articulating the universal with the particular, and the universal ethical and moral principles with individual ethics.

Engineering education must bring about critical analysis of utilization of technologies. The power of sciences should be converted from hard into the soft power through the new engineering practices, which enables individuals to solve their ethical dilemma and issues by reconciling personal and professional ethics with organizational practices and policies, taking into consideration human subjectivity, emotions and feelings.

There is a need to humanize engineering curriculum, the new balanced approach which articulates educational contents with the needs of individuals and society. One of the most important factors for future engineers is to develop their ethical actions and decision-making capacities.

Practicing soft skills enables the new engineers to acquire greater ethical competence, reflection, as well as developing a new conscience and identity to realize that their choices are based on ethical preferences (individual and social) and these decisions and actions have a direct and phenomenal impact on his fellow human being. The engineer with a conscience is structured through this ethical education. Engineering students need to realize their fundamental responsibilities to make the right decisions, adapt best safety and security standards to reduce the risks of accidents and industrial and ecological disasters.

## **5. THE PEDAGOGICAL ISSUES**

Engineering students have to be aware of their ethical duties towards society, and clients, also towards their profession, organizations and employers. Stephen H. Unger highlight the importance of learning professional responsibilities associated with their chosen profession and he focuses on the main objectives of education in professional ethics.

The main contribution of professional ethics is to teach the future engineers how "to recognize and deal with interface problems, the need to emphasize the moral conduct such as the fair play, the honesty by including them in their good practices which involves both technical and ethical aspects (Unger, 2005).





He brings together the objectives of education in professional ethics with the idea of personal responsibility of engineers and write, "engineers are personally responsible for the consequences of their work and "they cannot properly suspend their moral judgments when they enter in the work place". In his opinion these objectives represents "a basic precept incorporated in all modern engineering codes, the duty to safeguard the public health, safety and welfare".

Through these objectives he points out the cooperative nature of engineering which according to our interpretation , the propensity of engineering students to deal with and solve the ethical issues is not acquired, but it can be developed gradually through their professional ethical education. In their training, engineering students must learn what value they have to attribute to their perceived moral beliefs through their natural connection with individual and societal responsibilities. Also to develop their critical thinking not only to solve ethical issues but also to increase their human capacities such as reflection, interrogations and interpretation of the expanded social reality.

This core of ethics needs constant adaptation and flexibility. The students have to be able to identify, define and understand the gap between the universality of the application of ethical principles and the particularity of social, cultural and religious contexts.

The educational contents vary from one culture or society to another and these variations are visible through different approaches, methods and the instruments applied into the educational and learning process.

The strategic importance of the educational project is to give value to ethics courses for engineers in order to reconcile instrumental reason with ethical reason. This reinforces the contribution of the ethics program both to the personal development of the future responsible engineers and to the construction of a more democratic society, which is based on justice, responsibility and accountability.

## **6. DISCUSSION**

Some common issues of computer ethics include intellectual property rights (such as copyrighted electronic content), privacy concerns, and how computers affect society.

For example, while it is easy to duplicate copyrighted electronic (or digital) content, computer ethics would suggest that it is wrong to do so without the author's approval. And while it may be possible to access someone's personal information on a computer system, computer ethics would advise that such an action is unethical.



As technology advances, computers continue to have a greater impact on society. Therefore, computer ethics promotes the discussion of how much influence computers should have in areas such as artificial intelligence and human communication. As the world of computers evolves, computer ethics continues to create ethical standards that address new issues raised by new technologies.

## **7. BIG DATA ETHICS**

Another form of computer ethics is big data ethics. This is a relatively new issue that determines the ethical usage of big data. Big data ethics, also known as Data Ethics refers to systemizing, defending, and recommending concepts of right and wrong conduct in relation to data, in particular personal data.

The form of data ranges between medical to web surfing data, to preferences in shopping, and others. Unfortunately there is still no unified code of ethics for Big Data and people feel sometimes unsafe in this regard. Many people were contacted through email by companies they never knew. Apparently these companies bought their information from other data collection firms. It is still not known how big data ethical usage has to be done in the future.

As an example, a problem happened when Huawei had a data-sharing agreement with Facebook to get information about millions of its users. This deal appeared to be similar to the ones with Apple, Samsung, and Amazon. But Huawei, in particular, drew attention as the US government has claimed that its devices could be used for spying on American citizens. The reason behind it was that the American government suspected that Huawei had ties with the Chinese government.

## **8. CONCLUSION**

In this paper, ethics was introduced with its changes through history. Then philosophical approach to ethics education was explained. Also the sociological perspective of ethics was explained. The importance of ethics for engineers was emphasized and discussed in teaching. Also the big data ethics issue was introduced.

There are many definitions of ethics. Each definition depends on its domain. In the ancient period, ethics was based on the principles of good action and the search for the common good. Generally, Ethics is understood as a system of moral principles which affect our ways of living. Ethics are related with what is good for society and individuals and is described as



moral philosophy. Ethics only makes sense if we put them in the context of human action understood as responsible, creative and communicative.

Applied Ethics and Codes of conducts have appeared in the contemporary period, starting from 21st century. One of the key issues in the engineering education ethics program is the problem of margins/limits of autonomy that will enable future engineers to act ethically in accordance with universal ethical principles and the existing codes of ethics. Computer ethics adds to the above the intellectual property rights, and also the use of personal data.

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