Postmodern Openings

ISSN: 2068-0236 | e-ISSN: 2069-9387

Covered in: Web of Sciences (WOS); EBSCO; ERIH+; Google Scholar; Index Copernicus; Ideas RePeC; Econpapers; Socionet: CEEOL; Ulrich ProQuest; Cabell, Journalseek; Scipio; Philipapers; SHERPA/RoMEO repositories; KVK;

WorldCat; CrossRef; CrossCheck

2020, Volume 11, Issue 4, pages: 248-261 | doi:10.18662/po/11.4/233

Software Engineering Ethics

Daniela MARCU¹, Dan Laurențiu MILICI², Mirela DANUBIANU³

- ¹ "Stefan cel Mare" University of Suceava, Faculty of Electrical Engineering and Computer Science, E-mail: mdaniela.marcu@yahoo.ro
- ² "Stefan cel Mare" University of Suceava, Faculty of Electrical Engineering and Computer Science, E-mail: dam@usm.ro
- ³ "Stefan cel Mare" University of Suceava, Faculty of Electrical Engineering and Computer Science, E-mail: mdanub@eed.usv.ro

Abstract: Over the past 30 years, computer engineering has developed a lot. Currently, computer and software applications have a central role in business, medicine, security, communications, industry, education, and everyday life. Software developers, peoples who manage computer networks, data security analysts can do well, but they also have the potential to cause suffering and harm to the clients or ordinary peoples, willingly or not. For this reason, IT activities must be regulated by specific laws. From the beginning, we argue that the law is not the same thing as ethics, even if both promote the good. Certain ethical principles can be strengthened by law. In the field of computer science and technology, can exists theft, privacy violations, violence and harassment. To combat and punish such actions and behaviors, law is needed. But is software engineering a profession? If so, are there codes of professional ethics whereby specialists in the field can regulate their professional activity, as is the case, for example, in areas such as justice or medicine? In relation with that, Gibbs and Ford have identified 8 components of a professional infrastructure. Some of that is: initial vocational training, professional accreditation, licensing, continuous vocational training, the existence of code of ethics. (Ford & Gibbs, 1996). With the fact that software engineering is a profession, in this article we present the main principles of behavior. The principles are not legally binding. This are grouped by interest categories depending on who or what is involved in the interaction with software engineering.

Keywords: ethics; principles of software engineering ethics.

How to cite: Marcu, D., Milici, D. L., & Danubianu, M. (2020). Software Engineering Ethics. *Postmodern Openings*, 11(4), 248-261. doi:10.18662/po/11.4/233

1. Introduction

One of the first questions that we propose to answer in this article is: can software engineering be considered a profession? Consequently, it is necessary to define this term. The profession is requiring a call to do it, specialized knowledge and, most of the time, an intense academic training (Merriam-Webster, 2020).

Medicine and law are two of professions very well known to all. In the last 30 years, a new field has developed, a computer industry that has numerous and diverse areas of interest: computer programming, system administration, data analysis called software engineering. Is software engineering a profession like the others? What is a profession?

According to the International Encyclopedia of Social Sciences (IESS), the basic criteria of a profession include:

- a requirement for initial vocational training accompanied by a system for validating the skills and level of training of the person;
- a requirement for certain stages of training to be developed also after starting the profession;
- a requirement relating to the existence of certain ways to ensure that the skills acquired are used responsibly on a social level (Sills, 1968).
- Gibbs and Ford have identified eight components of a fully-fledged professional infrastructure:
- initial vocational training refers to the courses that potential professionals must follow before practicing the chosen profession;
- professional accreditation is the one that certifies that the training was conducted according to the profession's standards;
- training of practical skills gives candidates the opportunity to acquire the practical skills needed to practice the profession;
- candidate certification as a result, candidates are assessed to determine their level of training
 - licensing grants candidates the right to practice
- continuous vocational training enables professionals to have access to the necessary training to maintain the skills and knowledge necessary to carry out their professional activities
- the existence of a professional organization made up of the majority of the profession

• the code of ethics - is a mechanism by which a professional organization ensures that members of a profession will use their knowledge for the benefit of society (Ford & Gibbs, 1996).

Schematically these components can be represented as follows: (Figure 1)

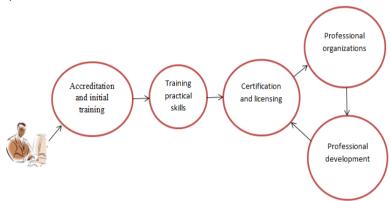


Figure 1. Components of an organized professional infrastructure **Source:** Ford & Gibbs (1996)

A profession must have a code of ethics so that practitioners adhere to certain rules that are necessary in order not to damage the other people in society. This code also includes disciplinary sanctions for those who violate the rules.

In the field of computers, things are quite different from other domains. In order to practice medicine, law, or to be an authorized accountant, training, practice, licensing in the field, and the right to practice is required. All these professionals are subject to the codes of ethics specific to their professions. It's not the same in the field of computer science. To write a computer program, install different applications, maintain a computer network, do not need to be licensed in the industry, and no professional organization can forbid that. Another different aspect is the possibility of assuming individual responsibility. A doctor treating a patient bears full responsibility for the decisions he takes in relation to him. Programmers work in teams on a project. Each performs certain tasks within it. If the finished product does not work properly, it will inconvenience users, responsibility is assumed by the team manager.

Computer and computer technologies are increasingly used in many areas. For example, in the field of marketing, the analysis of large volumes of data contributes significantly to making the best decisions that take into account consumer preferences. This is also the first area in which Big Data

technologies have been successfully implemented. Another area in which they are currently under development is genomics. It is estimated that by 2020, sequencing of the entire human genome will be achieved. It provides a systemic understanding of the disease and makes it possible to identify orthographic differences by comparison with the genome of other individuals. Interpretation of data analyzes makes it possible to treat patients differently and to find the best individual treatment solutions, depending on the patient's genetic structure (Marcu et al., 2019). The interdependence of molecular biology with information technologies makes the work of geneticists quite similar to that of software developers.

The source of correct moral decisions is a good character and, of course, education. But this can not be enough. In the situations described above, we are dealing with taking data from patients or clients. This also required the permanent establishment and updating of a system of rules that do not harm or harm anyone interacting with different software applications in any way. It concerns the protection of personal data.

Software Engineering fulfills all the prerequisites of a profession. Establishing a code of ethics for professionals in this field has proved to be quite difficult. Adding new rules of conduct takes place as reality changes.

2. Certification and licensing in the field of software engineering

The two major organizations supporting the computer industry are: Institute for Electrical and Electronics Engineers (IEEE) and Association for Computing Machinery (ACM). They have over 150,000 members together. They have as main purpose the support of the discipline and the professionals in the field through publications, conferences, technical committees and others. In 1993, these two organizations formed a committee to explore the possibility of software engineering becoming a profession. They have established that a software engineer is a person who develops or maintains software. Several issues have been solved (Quinn, 2009):

- conducting a survey among practitioners to help know the skills needed by software engineers
 - establish criteria for the accreditation of study programs developing a code of ethics for software engineers

3. The difference between ethics and law

In general, we can identify three types of ethics: professional, personal and one that contains principles on the distinction between correct and wrong behavior, between good and evil, which is also called morality (Harris et al., 2009). There are professions where personal or moral ethical principles are in contradiction with professional ethics. A soldier has to execute an order or have a specific behavior that may conflict with personal or religious beliefs. Fortunately, the software engineer is not generally confronted with such internal conflicts.

We are taught from the early years of life that it is wrong to get things belonging to someone else. But, however, theft is a reality. It is necessary to prevent and punish it through legislative regulations. Theft is also the appropriation of intellectual property rights such as books, articles, or software. They are protected by copyright law.

The development of the Internet and online communication through social networks have led to the occurrence of phenomena of harassment, harm to a person's dignity, ethical actions.

Bullying is a form of cyber-violence that consists of deliberate actions of intimidating some people to achieve their dignity. It addresses aspects of discrimination, belonging to a particular race, ethnic group, religion, social category or social orientation. They appear in all social environments, even in the educational system. In order to combat and punish these actions, at the end of 2018, the Senate of Romania adopted a draft law prohibiting bullying in all areas dedicated to education.

Manipulating people with the clear purpose of getting benefits from it is just an act devoid of ethics or a crime? Deliberate actions of political propaganda, recruitment, psychological warfare, remote control are a form of cyber terrorism.

It is clear that a professional in software engineering must first know the laws that relate to the sphere of interest of his activities, but also the ethical principles of this profession.

Some of the principles of software engineer ethics are strengthened by specific laws.

4. Code of ethics for software engineers

The development of the current society takes place in parallel with that of software technologies. Taxpayers can pay their taxes online, banking applications allow money to be transferred between different accounts, the public transport system offers a wealth of facilities, from online ticket

purchase, to real-time tracking of somebody with GPS technology, anyone can buy anything online, anyone can communicate with anyone through social networks. All these facilities are in the background of software engineers. Their importance can no longer be disputed among other professions such as medicine. Creating applications for destructive purposes, deliberately inserting bugs in programs, accessing and unauthorized modification of applications or personal accounts may cause inconvenience, financial loss, public image damage, personality denial, and other damages. As a result, the existence and observance of rules of conduct and clear sanctions in the event of non-compliance are imperative.

The Code of Ethics provides software engineers and managers a way of identifying ethically inappropriate actions. It also has an educational component. He expresses the consensus of ethics. He aims to inspire not only professionals, but also those who carry out such tasks.

Some of the provisions of the Code of Ethics and Professional Conduct was adopted for the first time by the ACM (Association for Computing Machinery) in 1992 (ACM, 1992). The complete and revision edition is from 2018. Some of provisions can be found in the table below, grouped into two broad categories of interest: general and specific to the profession. (ACM, 2018)

Table 1. Provisions of the Code of Ethics

Criterion	Provisions of the Code of Ethics	
General	The professional must contribute through his actions to the general good of society.	
	Professional activity should not harm other people.	
	The professional must respect the privacy of others and his actions be confidential.	
	The professional must respect the property of others.	
	The professional must be honest.	
Specific to the profession	The software engineer must acquire the professional skills he needs and develop them all the time.	
	The software engineer must strive to produce quality software in the shortest possible time.	
	The software engineer must know and abide by the domain and scope laws in which a software package will be used and created.	
	The software engineer must always honor his contracts and dealings	

	with other people.
	The software engineer must not access computer resources to which access is not allowed.
	The software engineer must support customers to have access to and understand modern technology.

Source: ACM (1992, 2018)

In 1999, Luciano Floridi formulates a new theory of ethics called Ethics of Information. Within this theory he defines the concept of infosfera as a universe made up of 27 fundamental information. The alteration of the information structures in this universe has been called entropy. In connection with this, Floridi proposed four moral laws of the Ethics of Information, described in the accompanying diagram (Floridi, 2008).

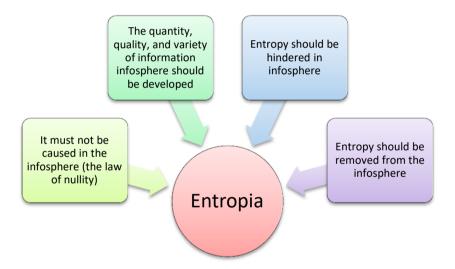


Figure 2. Principles of Information Ethics – Floridi [Floridi, L. 2008]

Floridi advances the development of informational ethics in the sense of philosophical understanding.

The fundamental moral issue of Information Ethics is to answer the question whether what is good for one of the informational entities that make up the infosfera is good for the universe of the infosphere in general.

It also sets out a series of fundamental principles and concepts of information ethics in the table below (Vacura, 2015).

Table 2. 7 Fundamental Principles of Floridi

N	Principle	Description of the principle
	Uniformity of becoming	All actions and events are treated as informational processes
	The reflexivity of the information process	Any information process generates other information processes
	Inevitability of the information process	An informational process is also the absence of information
	Uniformity of existence	An entity is an information package
	Uniformity of the agency	An agent is an entity capable of producing phenomena that affect the infosphere
	Uniformity of non-existence	Non-existence is the denial of any information
	Uniformity of the environment	Infosfera is an environment comprised of all information entities

Source: Vacura (2015)

5. Principles

Each of us, in our professional activities or in everyday life, is confronted with various issues about which we need to make certain decisions. But it's not always white or black. In its actions, the software engineer may be confronted with ethical principles that contradict each other. He must sometimes turn to his own conscience and judgment, as a man when faced with a moral problem. The principles to be enumerated and described are not lawful. They are indicative and may undergo modifications or additions.

Principles are grouped by interest categories depending on who or what is involved in the interaction with software engineering: public, customer, employee, manager, on the one hand, and on the other hand the product and its own judgment (Quinn, 2015).

5.1. Principle 1. The public

The software engineer must act in accordance with the interests of the public and not his. Depending on the situation, it must:

- Be objective and treat respectfully any software product that they need to evaluate or develop
 - Take the full responsibility of their work

- He does not accept bribes
- Not accept any reward from a third person other than the one with which he has entered into a contract
- Refuse to participate in any decision by a government or professional organization to advise or develop a product or other related documents if the persons concerned have an interest therein
- To approve a software product only if it is safe, meets all specifications, passes all tests and does not diminish the quality of life
- Communicate to authorities any malfunctioning of the software that could pose a threat to the public or the environment
 - Cooperate in solving issues of public interest caused by its software
- Take into account the different physical disabilities that the public may have when making a software product
- To volunteer his / her professional skills to educate the public about the use of technology

5.2. Principle 2. Customer and employee

The software engineer must create or administer software that does not pose any danger to the safety and health of the hazards. He must always be right in relation to the client. The software engineer must:

- Not to provide services for which there is insufficient professional training
- Use the client's property only for authorized purposes or under the permissions granted by the client
 - Not to use illegally or unlicensed software
- Keep the confidentiality of information from the client and are not of a public nature
- Communicate promptly to the client or employer if the project can not be achieved, is too expensive or infringes intellectual property rights or other specific laws
- Do not accept other responsibilities if they are to the detriment of the customers they already have

5.3. Principle 3. The product

The software engineer must ensure that the product he delivers to the client or employer meets the highest quality standards he can offer. He must:

- Strive to achieve high quality, reasonable cost and to ensure that any compromises are clear and accepted by the customer or employer
 - Ensure that the goals are realistic for each work they have to do
- Identify, define and take into account all aspects: economic, legal, environmental, cultural, ethical in making or modifying software products
- Try to always work on existing professional standards and move away from them only when justified by ethical or legal considerations
- Ensure that project cost estimates are realistic and prevent unwanted additional costs
- Ensure the testing, maintenance and review of the products and documents attached to them
- Provide adequate documentation including any problems discovered with the solving solutions for each of the projects where they work
- Take care to use data for which it is licensed or obtained by legal or ethical means
- Treat any form of product maintenance as well as creating a new product.

5.4. Principle 4. The judgement

Codes of ethics are not laws and are not intended to encourage litigation. They have been formulated to support professionals so that they can guide and have a good relationship with customers or employers. The software engineer must take care to maintain his / her professional independence and reputation. He must:

- To maintain professional objectivity and to treat with respect any product and documents attached to it
- Sign only on documents that have been created or modified under their own supervision and for which they have the necessary expertise
- Not accept payments from a third party unless they have been made with the consent of all parties
- Disclose to all parties concerned possible conflicts of interest when they can not be resolved amicably
 - Always place human values ahead of technological ones
- Refuse to participate in projects for which the employer is a government or an organization that does not act for the benefit of the population, but for personal purposes.

5.5. Principle 5. The management

When a software engineer gets to a leading position, he must support all team members to meet their goals, be fair:

- Ensure that all employees are informed about the specific standards and requirements of the project
- Ensure that all team employees are aware of the company's password processing policy, files, and other confidential information
- Assign work assignments in line with professional training and the desire to improve it
- Ensure a fair hearing during an employee's interview that violates company policies or ethical codes
- Provide potential employees with real-world information on future work tasks and other issues related to them
- Ensure fair pay and according to the work done, according to tradable criteria
- Not to require any employee to do things that contradict ethical codes or legislation.

5.6. Principle 6. The profession

The software engineer must act with integrity and professionalism always having the safety and welfare of the customer always prioritized. For this he must:

- Promote aspects of software engineering that can be accessed by the public
- Distribute knowledge, discoveries, information about new software products by attending conferences, publishing articles in specialized journals
- Demonstrate civic accountability to society by using its professional skills to participate in humanitarian or general interest actions
 - Associate only with firms that have a good reputation
- Ensure that employers and clients are aware of the ethical code that they have to observe in relation to their contracted activity
- Contribute to creating an organizational environment based on ethics and professionalism
 - Report any offenders to ethical codes to responsible persons
- To accept remuneration only in accordance with the professional skills it has.

5.7. Principle 7. The colleagues

The software engineer must:

- Encourage colleagues to behave according to codes of professional ethics
- Evaluate the work of others in an objective, sincere and satisfactory manner
 - Be objective about your colleagues' opinions, issues, or wishes
- Ensure that other colleagues are informed and aware of all aspects of company policy regarding confidential data handling, passwords, and personal file management
- Not to interfere unfairly with a colleague's career, but to properly inform the parties when they find lack of competence or intentional non-compliance with firm policies or contractual provisions
- Call for help from a professional in all situations where he / she does not have the necessary knowledge to solve certain work tasks.

5.8. Principle 8. The own person

The software engineer will learn throughout his / her profession and will always promote an ethical attitude about it. He must:

- Always improve their skills to create quality software at reasonable cost and in a short time
- To improve their knowledge to create accurate, well-documented documentation
- To improve their knowledge of the software and documentation they work with
- Always be informed about new legal issues related to the use or creation of software products
- To improve their knowledge of the provisions of professional ethics codes and to proceed to their observance
- Quit personal prejudices about his collaborators so as not to damage their dignity

Not to influence anyone to violate ethical codes (Quinn, 2015).

6. Conclusions

Software engineering is a profession. Software developers, as well as those who manage and maintain computer equipment and networks can

harm other people's moral and material damage. For this reason, their actions must be regulated by a code of professional ethics.

The dynamics of current technological development and globalization have led to the emergence of new developments in software engineering and, consequently, to new ethical approaches to various issues related to: network communication and hacking or malware, robotics, law proprietary software products, data mining and personal information protection, banking and governmental applications, and more. With the development of the Semantic Web, the prerequisites for an interaction between software agents without the human presence have been created, which leads to a totally approach to the concepts of traditional ethics and to future research topics.

Acknowledgements

The activity was carried out with POCU/380/6/13 financing through the Financing Contract 36355 / 23.05.2019 - SMIS code: 123847

References

- Association for Computing Machinery (ACM). (1992). Ethics, The Official Site of the Association for Computing Machinery's Committee on Professional Ethics. http://ethics.acm.org/code-of-ethics/previous-versions/1992-acm-code/
- Association for Computing Machinery (ACM). (2018). ACM Code of Ethics and Professional Conduct. https://www.acm.org/binaries/content/assets/about/acm-code-of-ethics-booklet.pdf
- Floridi, L. (2008). Information ethics: Its nature and scope. In J. Van den Hoven & J. Weckert (Eds), Information technology and moral philosophy. Cambridge Studies in Philosophy and Public Policy (pp. 40-65). Cambridge University Press.
- Ford, G., & Gibbs, N. (1996). A mature profession of software engineering. Technical report. Carnegie-Mellon University. https://resources.sei.cmu.edu/asset_files/TechnicalReport/1996_005_001_16460.pdf
- Harris, C. E., Pritchard, M. S., & Rabins, M. J. (2009). Engineering ethics: Concepts and cases (4th ed). Cengage Learning.
- Marcu, D., Danubianu, M., & Pentiuc, G. (2019). Big data technology Valuable tool for healthcare research. International Journal of Computer Science and Network Security, 19(4), 116-122. http://paper.ijcsns.org/07 book/201904/20190416.pdf

- Merriam-Webster. (n.d.). Profession. https://www.merriam-webster.com/dictionary/profession
- Quinn, M. J. (2009). Ethics for the information age (3th ed.). Pearson Education.
- Quinn, M. J. (2015). Ethics for the Information age (6th ed.). Pearson Education.
- Sills, D. L. (Ed.). (1968). International encyclopedia of the social sciences. Macmillan Company and The Free Press.
- Vacura, M. (2015). The history of computer ethics and its future challenges. Information technology and society interaction and interdependence. Proceedings of 23rd Interdisciplinary Information Management Talks (IDIMT 2015) (pp. 325-333). Trauner Verlag Universitat.