


SPECIAL ISSUE PAPER

GreCo: Green code of ethics

Ma Ángeles Moraga¹  | Ignacio García-Rodríguez de Guzmán¹ | Coral Calero¹ | Timo Johann² | Gianantonio Me¹ | Harald Münzel³ | Julia Kindelsberger⁴

¹Instituto de Tecnologías y Sistemas de Información, University of Castilla-La Mancha, Ciudad Real, Spain

²University of Hamburg, Hamburg, Germany

³APHIN e.V, Germany

⁴Technische Universität München, Garching bei München, Germany

Correspondence

Ma Ángeles Moraga, Instituto de Tecnologías y Sistemas de la Información, University of Castilla-La Mancha, Ciudad Real, Spain.
Email: mariaangeles.moraga@uclm.es

Abstract

Background Codes of ethics (CoE) are widely adopted in several professional areas, including that of Software Engineering. However, contemporary CoE do not pay sufficient attention to one of the most important trends to have appeared in the last years environmental issues.

Aim The aim of this study is to establish a Green CoE for software engineering and Professional Practices (GreCo). Our intention is to cover a wide range of aspects related to sustainability, such as economic, environmental, social, and technical features. We are additionally interested in encouraging software engineers to adopt these aspects.

Methods The Green CoE presented is the result of the interaction of several experts in the area. A first version of GreCo, whose starting point was a discussion at the GlnSEng workshop, was created by identifying key principles and adapting them to the Green area. Next, various important CoE were reviewed so as to gather the existing references to sustainability or to detect new ones. These elements would then possibly be incorporated into the new code or stimulate the creation of new sustainable principles.

Results The final result is the GreCo code, which has been produced by modifying existing principles or by the introduction of new ones.

KEYWORDS

code of ethics, green software engineering, sustainability

1 | INTRODUCTION

A common practice in all professional fields is the creation of a code of ethics with which to guide the development of the profession. Practitioners commit themselves to the specific code of ethics of their area by following its different principles, developed by experienced practitioners, industry, and academia, and it is for this reason that multiple codes of ethics can be found in literature. For example, there are codes of ethics for teachers,^{1,2} nurses,^{3,4} engineers,^{5,6} and so on.

In the computer science field, practitioners were formerly able to commit to the code of ethics for engineers in general. Then, in 1999, the IEEE Computer Society and ACM developed a specific code of ethics for software engineers, namely, the “Software Engineering Code of Ethics and Professional Practice”.⁷ This code of ethics is fundamental for computer science practitioners and is one of the most frequently referenced codes of ethics committed to in the realm of engineering. Environmental aspects are, however, currently becoming more and more important and are being introduced into society and

industry as part of their business processes.⁸ Although this code specifies certain points related to environmental aspects, there is an increasing need to assess environmental issues, as software covers more and more areas of life. Green in the field of software engineering¹⁻⁸ is, therefore, gaining more and more importance, because these areas must be dealt with. It is consequently necessary to complement the principles proposed in the code with new ones related to environmental issues.

Bearing all this in mind, the objective of this paper is to propose a code of ethics for software engineers that explicitly take Green aspects into account. From our perspective, the concept of the “Green aspect” is related to those relevant elements of concern that should be taken into account in order to evaluate Greenability. The idea of developing the Green Code of Ethics for Software Engineering and Professional

¹Green in Software Engineering: “practices which apply engineering principles to software by taking into consideration environmental aspects. The development, the operation and maintenance of software are therefore carry out in a green manner and produce a green software product, process or service”

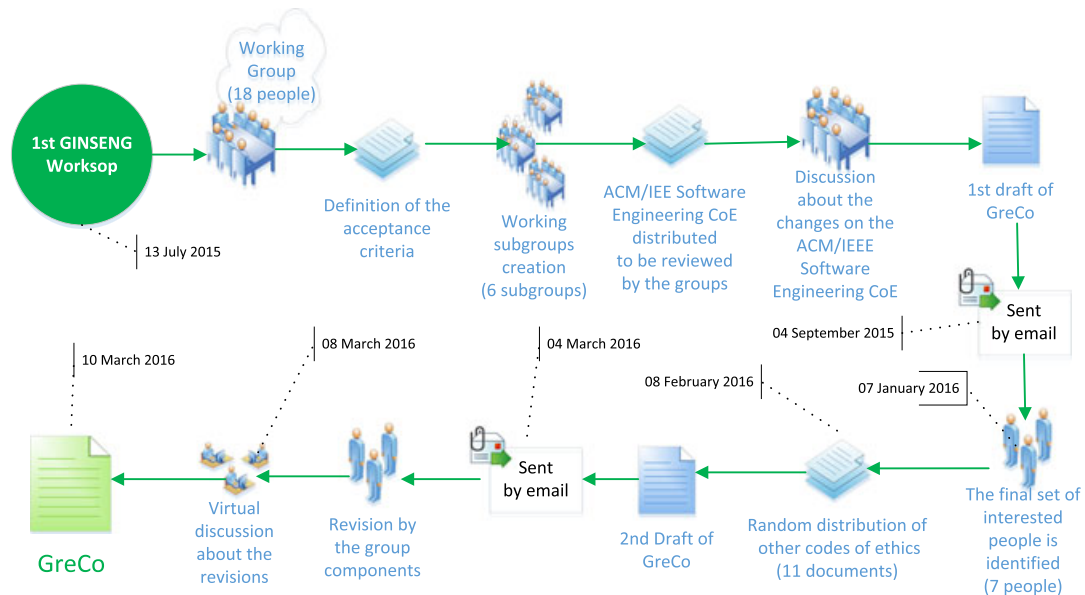


FIGURE 1 Steps to develop GreCo

Practices (GreCo) emerged during the GInSEng Workshop (first Green in Software Engineering Workshop). After the various speeches and paper presentations, a working group was set up to think about how to develop the code in accordance with Green principles (*Green in software*).⁸ This resulted in the development of a first version of the GreCo, which was the foundation for the code presented in this paper. We foresee that the principles of our green code of ethics will be incorporated into existing codes, signifying that in the future there will be no differentiation between green and “conventional” software.

The present paper is organized as follows: The methodology carried out to develop the code is presented in Section 2, while the new principles which take the Green aspects into account are shown in Section 3. Section 4 provides a summary of the aim and the outcome of this proposal, outlining some conclusions; finally, the Appendix includes the original code of ethics that has been taken as a basis for the development of the proposal.

2 | METHODOLOGY

When developing the GreCo, a cooperative, iterative, and dynamic methodology was used, taking advantage of the knowledge and expertise of all the researchers involved in the GInSEng Workshop.

The process that the working group followed in order to share knowledge and gather the information required to set up GreCo is depicted in Figure 1.

We shall now go on to provide a detailed explanation of each step, from the conception of the idea until the final version of the code. The idea of creating a Green code emerged at the first Green in Software Engineering Workshop (GInSEng), which took place during the 10th International Conference on Global Software Engineering (held on July 13, 2015). The workshop organizers proposed the creation of a working group to think about the importance of having this kind of code of ethics. All the attendees were interested in the idea and believed that the code was necessary. The working group, composed of 18 people,

worked together on the following: (1) the definition of the acceptance criteria that would be applied so as to add or not to add a principle of a given code of ethics, and (2) which code of ethics it would be necessary to work on. The criteria defined to add a principle of a code of ethics to the GreCo were as follows:

- The principle is specific to software engineering.
- The principle is not specific to software engineering but can be adapted to it.
- The principle is based on Green IN software engineering.
- The principle already considers aspects related to sustainability.

The group also decided that, owing to the time restrictions resulting from how the workshop was organized, they would work solely on the modification of the “Software Engineering Code of Ethics and Professional Practice”. This particular code was chosen because it was considered to be that which was most closely-related to our objectives.

The “Software Engineering Code of Ethics and Professional Practice” is formed of 8 basic principles. Six groups were formed in order to study all of them and to determine how to adapt them in such a way as to take Green aspects into account. Each group had to work on adapting 1 or 2 principles by applying the acceptance criteria defined. At the end of the workshop, all the modifications made by each group were discussed. The main aspects discussed at that time were related to the domains of the principles, because some of them were more focused on Green BY rather than on Green IN.^{2,9} Any conflicts were solved, and a first version of the code was obtained because of this process. The modifications and the new subprinciples that were included in this first version are shown in the final version as underlined sentences, to enable readers to keep track of the

²“Green IN IT: when IT itself has an impact on the environment” “Green BY IT: when IT provides tools for making tasks environments friendly”

TABLE 1 Additional CoEs studied

Identification	Ref.	Title	URL
ACM	15	ACM code of ethics and professional conduct	https://www.acm.org/about-acm/acm-code-of-ethics-and-professional-conduct
PMI	16	Code of ethics and professional conduct (PMI)	http://www.pmi.org/About-Us/~media/PDF/Ethics/PMI-Code-of-Ethics-and-Professional-Conduct.ashx
BCS	17	Code of conduct for BCS members	http://www.bcs.org/category/6030
NREP	18	Environmental professionals NREP Code of ethics	https://www.nrep.org/ethics.php
CE4SP	19	A code of ethics for sustainability Professionals	http://atkinson.com/a-code-of-ethics-for-sustainability-professionals/
ISSP	20	Code of ethics International Society of Sustainability Professionals	https://www.sustainabilityprofessionals.org/sustainability-professional-certification/ethics
ASCE	5	The ASCE code of ethics	http://www.asce.org/code-of-ethics/
ABET	21	Code of ethics of engineers (ABET)	http://sudaryanto.staff.gunadarma.ac.id/Downloads/files/25755/Tugas+3++Ethics+code+ABET.pdf
EA	22	Code of ethics (Engineers Australia)	https://www.engineersaustralia.org.au//sites/default/files/shado/About%20Us/Overview/Governance/codeofethics2010.pdf
NSPE	6	NSPE Code of ethics for Engineers	http://www.nspe.org/resources/ethics/code-ethics
CEPIS	23	CEPIS Code of Best Practices for Green ICT	http://cepis.org/media/CEPISCodeofBestPracticesforGreenICT1.pdf

modifications and the new sub principles obtained in that first version (see Section 3). This first version was sent to all the working group members by email by September 4, 2015, and they agreed with all the modifications.

As a second step, the workshop organizers asked about members' intentions to continue working on improvements to the code, and by January 7, 2016, seven members had agreed to participate in the development of the final version of GreCo. In obtaining a more complete code, other significant codes of ethics were analyzed so as to study whether they should be considered. We discarded some documents because they were not focused on the same objectives as the GreCo. For example, the Karlskrona Manifesto was not included because it provides indications about the relationship between sustainability and software systems, but it does not provide aspects related to the code of ethics. In fact, this manifesto states that "it is necessary to revise code of ethics and practice to incorporate principles and explicitly acknowledge the need to consider sustainability as part of professional practice," which is precisely the goal of this work.¹⁰ Other documents^{11,12} were also discarded because they did not provide any principle related to sustainability or that could be adapted to sustainability. The code of ethics¹³ proposed previously was also discarded because, despite mentioning that it was necessary to "take due account of the limited availability of natural and human resources," this is too general a statement. The same occurred in one study,¹⁴ in which the authors affirmed that "members shall take all reasonable steps to avoid waste of natural resources, damage to the environment, and damage or destruction of man-made products". Once the invalid documents had been discarded, 11 documents were chosen (codes of ethics along with a code of Green practices report—see Table 1). These codes of ethics were distributed randomly among the participants, and each member had 1 month to provide new principles or subprinciples that were inspired by the assigned codes. This distribution took place on February 8, 2016. More principles were thus identified for inclusion in the GreCo. The workshop organizers coordinated the inclusion of the new recommendations. The document produced was shared online and some time was provided to add comments and resolve conflicts or doubts (this process took place virtually). The main problems detected during this second revision phase were principally related to duplicated principles (eliminating those considered redundant or changing the drafting of the principle if necessary) or misunderstandings regarding some of the information added (that were clarified by the corresponding authors). The outline can be found in the final version of the code presented in Section 3, in which the improvements obtained in this second round, the modifications and the new subprinciples are written in bold italics.

Table 2 presents a correlation between the number of the particular principle and the specific code of ethics on which it is based, in order to help the reader identify the origin of each new principle. We have placed a tick in the cell in which a correlation exists.

In the final step, the integrated version was sent (March 4, 2016) by email to the authors of this paper; they reviewed it and made comments for the production of the final version of the GreCo presented herein (March 10, 2016).

TABLE 2 Correlation between new subprinciples and the CoE

	IEEE/ACM	ACM	PMI	BCS	NREP	CE4SP	ISSP	ASCE	ABET	EA	NSPE	CEPIS
Introduction P1										X		
P1.02b			X	X								
1.05										X		
1.09						X						
1.10										X		
1.11		X										
1.12												X
2.10			X									
2.11					X							
3.17					X							
3.18		X										
3.19		X										
3.20												X
4.04								X				
4.07										X		
4.08												X
5.13										X		
5.14		X										
5.15									X			
5.16											X	
5.17												X
5.18					X							
6.14										X		
6.15												X
8.5b						X	X					
8.10								X				
8.11						X						
8.13							X					
Remaining principles	X											

3 | GREEN CODE OF ETHICS FOR SOFTWARE ENGINEERING AND PROFESSIONAL PRACTICES (GRECO)

As mentioned above, the “Software Engineering Code of Ethics and Professional Practice” code was taken as the basis for the development of the “Green Code of Ethics for Software Engineering and Professional Practices”. The complete code can be found in *Appendix A*, because in this section we focus solely on the principles that we considered needed to be rewritten and on the new ones.

We have included a preamble with the aim of highlighting the purpose of the GreCo, while the rest of the structure has been maintained; that is, we have not modified the 8 main principles: public, client and employer, product, judgment, management, profession, colleagues, and self.

The modifications are then set out in detail. For each explanation of the principle or subprinciple, we indicate (in brackets) whether it is a modification (M) or a new principle (N). In order to make it easier to identify the parts that have been changed, we have highlighted them in **bold italics**. Moreover, in making the parts obtained because

of the first version of the code identifiable, they have been emphasized by underlining them

PREAMBLE

We proclaim this “Green Code of Ethics for Software Engineering and Professional Practice” (GreCo) to be a common standard of achievement for all those concerned with software, society and the environment. Every individual, profit and non-profit organisation who commits to and keeps this code of ethics constantly in mind, shall strive by teaching and education to promote respect for the principles stated in this document.

PRINCIPLES

Principle 1: PUBLIC

Software engineers shall act consistently with the public interest, ***and use their knowledge and skills to create solutions for a sustainable future***. In particular, software engineers shall, as appropriate (M):

1.02b *Make decisions and take action based on the best interests of society, public health, privacy, security, safety and the wellbeing of others and of the environment (N).*

1.03. Approve software only if they have a well-founded belief that it is safe, meets specifications, passes appropriate tests, and does not diminish quality of life, diminish privacy or harm the environment. The ultimate effect of the work should be to the public good. With regard to the "environment", this can relate directly to the direct and indirect contribution of software to CO2 emissions, and/or energy-unaware practices (M).

1.04. Disclose to appropriate persons or authorities any actual or potential danger to the user, the public, or the environment that they reasonably believe to be associated with software or related documents. Software engineers are encouraged to assess the negative impact of non-Green practices (M).

1.05. Cooperate *with and involve the community in decisions and processes* in efforts to address matters of grave public concern *that may impact upon them and the environment*, caused by software, its installation, maintenance, support or documentation, and assess the negative impacts of Green software (M).

1.06. Be fair and avoid deception in all statements, particularly public ones, concerning software or related documents, methods and tools. With regard to "deception", in Green software engineering, software engineers are strongly encouraged to be transparent and honest/precise about energy-related concerns and measurement/reporting (M).

1.07. Consider issues of physical disabilities, allocation of resources, economic disadvantage and other factors that can diminish access to the benefits of software. In relation to the "allocation of resources", software engineers should be Green-aware as regards the way in which resources are managed/used. With regard to diminishing access to benefits, this is, for example, when CO2 emissions of certain aspects of software exceed the acceptable level (M).

1.09. *Donate some fraction of their revenues to voluntary or non-profit initiatives that are advancing the practice of sustainability (N).*

1.10. *Balance the needs of the present with the needs of future generations by identifying consequences and outcomes which do not compromise the ability of future generations to enjoy, at the very least, the same environmental, health and safety conditions as the present generation (N).*

1.11. *Avoid harm to others. Harm means injury or negative consequences, such as undesirable loss of information, loss of property, property damage, or unwanted environmental impacts (N).*

1.12. *Engage and learn from their stakeholders as regards sustainability performance (N).*

Principle 2: CLIENT AND EMPLOYER

2.10 *Proactively and fully disclose any real or potential conflicts of interest, along with interests related to Green aspects, to the*

appropriate stakeholders (N).

2.11. *Fully disclose in writing to employers/clients all known positive and negative impacts of the software on the environment (N).*

Principle 3: PRODUCT

3.01. Strive for Green software, high quality, acceptable cost and a reasonable schedule, ensuring significant trade-offs are clear to, and accepted by, the employer and the client, and are available for consideration by the user and the public (M).

3.07. Strive to fully understand the specifications for the software and Green software on which they work (M).

3.08. Ensure that specifications for the software on which they work have been well-documented, satisfy the users' requirements, Green requirements and have the appropriate approvals (M).

3.09. Ensure realistic quantitative estimates of cost, scheduling, personnel, quality and outcomes on any project, including Green software projects, on which they work or propose to work, and provide an uncertainty assessment of these estimates (M).

3.10. Ensure adequate testing, debugging, review and usage of measures of the software and Green software and related documents on which they work (M).

3.11. Ensure adequate documentation, including gadgets for Green monitoring, significant problems discovered and solutions adopted, for any project on which they work (M).

3.16. Include reengineering practices to improve or to maintain an existing piece of Green software (N).

3.17. *Use the best principles of Green software engineering during the software development process to protect and enhance environmental quality (N).*

3.18 *Strive to achieve the highest quality, effectiveness and dignity in both the processes and products of professional work (including environmental aspects) (N).*

3.19 *Provide comprehensive and thorough evaluations of computer systems and their impacts (also environmental impacts), including analyses of possible risks (N).*

3.20. *View and assess their products and/or services from a life cycle perspective, considering the impacts that occur both early on (e.g. production and transportation of materials and components or provision of services) and at later stages (e.g. use, maintenance, and disposal) (N).*

Principle 4: JUDGMENT

4.01b. Software engineers should apply technical judgment by taking into account Green constraints (N).

4.04. Not engage in deceptive financial practices such as bribery, double billing, or other improper financial practices, such as financial activities than might cause environmental damage (M).

4.07. *Respect the dignity of all persons, both present and future generations (N).*

4.08. Adopt a big-picture approach to identifying the environmental impacts (both positive and negative) of their operations (N).

Principle 5: MANAGEMENT

5.01. Ensure good management for any project on which they work, including effective procedures and Green processes for promotion of quality and reduction of risk (M).

5.03b Ensure that software engineers know the Green regulations at national and international levels (or good Green practices if laws do not exist) (N).

5.04. Assign work only after taking into account appropriate contributions of education, sustainable principles and experience, tempered with a desire to further that education, sustainable principles and experience (M).

5.13. Communicate honestly issues associated with a particular software engineering project with regard to possible outcomes and risks which may negatively affect present or future generations (N).

5.14. Acknowledge and support the proper and authorized uses of an organisation's computing and communication resources (N).

5.15. Conduct reviews of the sustainability of the products or Systems for which they are responsible before giving their approval (N).

5.16. Adhere to the principles of sustainable development in order to protect the environment for future generations (N).

5.17. Develop and articulate a Green ICT policy tailored to their organisation's use of ICT (N).

5.18. Take all appropriate measures to prevent any conflict of interest that could compromise environmental aspects during the development of the software (N).

Principle 6: PROFESSION

6.02b. Promote public knowledge of the sustainable principles of software engineering and Green software (N)

6.05. Not promote their own interest at the expense of the profession, client or employer. Promote sustainability-related interests, even at the expense of the client or employer (M).

6.07. Be accurate in stating the characteristics of software and Green software on which they work, avoiding not only false claims, but also claims that might reasonably be supposed to be speculative, vacuous, deceptive, misleading, or doubtful (M).

6.08. Take responsibility for detecting, correcting, and reporting errors in software, even those that cannot be considered as classical software errors, e.g. overuse of resources, and associated documents on which they work (M).

6.14. Sharpen their perception of public concerns, and include inter alia, social, safety and environmental considerations in their work (N).

6.15. Establish internal progress-reporting mechanisms so as to monitor the implementation of a Green Software policy (N).

Principle 7: COLLEAGUES

7.06b. Assist colleagues to become fully aware of best practices in Green software engineering, and of Green measures in general (N).

Principle 8: SELF

8.02. Improve their ability to create safe, reliable, **Green**, and useful quality software at reasonable cost and within a reasonable time (M).

8.03. Improve their ability to produce accurate, informative, and well-written documentation, in an electronic format, when possible (M).

8.05b. As professionals, recognise that they have a responsibility to keep learning and constantly informing themselves about the emerging science and practice of sustainability - both what is happening to their world, and what can be done about it in software development (N).

8.10. Make decisions and take action based on the best interests of the whole of mankind, in harmony with sustainability aspects such as: the interests of individuals (health and welfare), society (public safety and cohesion), the environment (reduction of carbon footprint), economic (long term investment) and technical (long time usage of software) (N).

8.11. Promote changes in others with regard to Green software engineering principles, by exemplifying that change in their own personal and professional lives (N).

8.13. In the community of sustainability practice, seek first to find opportunities to work together with others and build on complementary strengths, rather than to compete for primacy; and consider the opportunity to bring about change as being more important than that of making money (N).

4 | USING GreCo: DO'S AND DON'TS

A code of ethics is a series of principles that establishes what is good, bad, permitted, or desired as regards an action or a decision. It is not obligatory to comply with it, but rather a personal decision (made by either the individual or the institution) concerning those aspects that

TABLE 3 The 5 W's of GreCo

What	Green IN software engineering
Who	Software professionals (at any level)
Where	In daily professional company practices
When	During the complete software lifecycle
Why	To reduce the negative and unforeseeable impact of software on the environment

should guide daily tasks, with the objective of respecting and fomenting certain practices that are considered to be desirable. In this respect, our code of ethics, which is a professional practices code of ethics, can be applied by those companies or people that develop software and are sensitive to the impact that it may have on the environment. They will thus be able to decide whether to incorporate one or various of the principles or sub principles included in the code of ethics into their work.

The code is oriented toward being used throughout the entire software development life-cycle, for software processes, products, or services.

As stated previously, these principles, like other codes of ethics, are not mandatory, and we simply provide a list of recommendations to take into account if the person or company is concerned about Green aspects.

This code of ethics can be used along with other codes of ethics and it is not mandatory to comply with all the principles provided.

Table 3 shows the 5 W's of the Green Code of Ethics for Software Engineering and Professional Practices.

5 | CONCLUSIONS

Greenability has, in recent years, begun to move from being a trend to becoming a reality; environmental concern has made its mark on society. Innumerable techniques, procedures, and improvements have been undertaken in all facets of industry in the quest to make technology environmentally friendly; IT has been no exception to this movement. There have been major efforts focused on reducing the energy consumption of the hardware aspect of IT, and important efforts in the development of Green software have recently been made by means of new Green principles in software engineering.⁸

In this paper, the concept of "code of ethics" has been considered as the starting point to direct software engineering practitioners' gaze toward Green software development. Codes of ethics are a starting point from which to develop rules and regulations that professionals have created in their effort to make it clear how to develop the subject of the profession, in addition to how best to do so. In this respect, the authors of this paper have chosen the "IEEE/ACM Software Engineering Code of Ethics and Professional Practice" as the basic code, to which they propose an extension that addresses many Green aspects. The proposed Green code of ethics, called GreCo, represents the integrated effort of a working group of 7 researchers who have analyzed 11 codes of ethics and best practices in source code with the goal of detecting Green-oriented practices and new principles, all in the quest to complete and extend the basic code of ethics.

GreCo thus brings together and presents a set of principles and subprinciples whose objective is to support software engineering professionals' activities. The aim is to obtain more environmental friendly software, or Green software. GreCo could be considered as a valid first version of a "Green Code of Ethics", because it has been built with the collaboration of several researchers from different groups and countries, all of whom provided their respective points of view regarding how to incorporate Green aspects into the software engineering code

of ethics. However, we believe that more validations (by means of personal interviews or online surveys) are required from other actors such as the authors of the IEEE/ACM code of ethics, professionals, researchers, and industry; these could provide us with other perspectives that would allow us to validate and improve the code.

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APPENDIX A

This section presents the Computer Society and ACM Approved Software Engineering Code of ethics (Copyright (c) 1999 by the Association for Computing Machinery, Inc and the Institute for Electrical and Electronics Engineers, Inc). This code of ethics, which has been taken as the basis on which to develop GreCo, is shown in its original form.

1. | Principles

1. | Principle 1: public

Software engineers shall act consistently with the public interest. In particular, software engineers shall, as appropriate

- 1.01. Accept full responsibility for their own work.
- 1.02. Moderate the interests of the software engineer, the employer, the client, and the users with the public good.
- 1.03. Approve software only if they have a well-founded belief that it is safe, meets specifications, passes appropriate tests, and does not diminish quality of life, diminish privacy or harm the environment. The ultimate effect of the work should be to the public good.
- 1.04. Disclose to appropriate persons or authorities any actual or potential danger to the user, the public, or the environment that they reasonably believe to be associated with software or related documents.
- 1.05. Cooperate in efforts to address matters of grave public concern caused by software, its installation, maintenance, support, or documentation.
- 1.06. Be fair and avoid deception in all statements, particularly public ones, concerning software or related documents, methods, and tools.

1.07. Consider issues of physical disabilities, allocation of resources, economic disadvantage, and other factors that can diminish access to the benefits of software.

1.08. Be encouraged to volunteer professional skills to good causes and contribute to public education concerning the discipline.

2. | Principle 2: client and employer

Software engineers shall act in a manner that is in the best interests of their client and employer, consistent with the public interest. In particular, software engineers shall, as appropriate

- 2.01. Provide service in their areas of competence, being honest and forthright about any limitations of their experience and education.
- 2.02. Not knowingly use software that is obtained or retained either illegally or unethically.
- 2.03. Use the property of a client or employer only in ways properly authorized, and with the client's or employer's knowledge and consent.
- 2.04. Ensure that any document upon which they rely has been approved, when required, by someone authorized to approve it.
- 2.05. Keep private any confidential information gained in their professional work, where such confidentiality is consistent with the public interest and consistent with the law.

2.06. Identify, document, collect evidence, and report to the client or the employer promptly if, in their opinion, a project is likely to fail, to prove too expensive, to violate intellectual property law, or otherwise to be problematic.

2.07. Identify, document, and report significant issues of social concern, of which they are aware, in software or related documents, to the employer or the client.

2.08. Accept no outside work detrimental to the work they perform for their primary employer.

2.09. Promote no interest adverse to their employer or client, unless a higher ethical concern is being compromised; in that case, inform the employer or another appropriate authority of the ethical concern.

3. | Principle 3: product

Software engineers shall ensure that their products and related modifications meet the highest professional standards possible. In particular, software engineers shall, as appropriate

- 3.01. Strive for high quality, acceptable cost, and a reasonable schedule, ensuring significant tradeoffs are clear to and accepted by the employer and the client and are available for consideration by the user and the public.
- 3.02. Ensure proper and achievable goals and objectives for any project on which they work or propose.
- 3.03. Identify, define, and address ethical, economic, cultural, legal, and environmental issues related to work projects.
- 3.04. Ensure that they are qualified for any project on which they work or propose to work by an appropriate combination of education and training, and experience.
- 3.05. Ensure an appropriate method is used for any project on which they work or propose to work.
- 3.06. Work to follow professional standards, when available, that are most appropriate for the task at hand, departing from these only when ethically or technically justified.

3.07. Strive to fully understand the specifications for software on which they work.

3.08. Ensure that specifications for software on which they work have been well documented, satisfy the users' requirements and have the appropriate approvals.

3.09. Ensure realistic quantitative estimates of cost, scheduling, personnel, quality, and outcomes on any project on which they work or propose to work and provide an uncertainty assessment of these estimates.

3.10. Ensure adequate testing, debugging, and review of software and related documents on which they work.

3.11. Ensure adequate documentation, significant problems discovered, and solutions adopted, for any project on which they work.

3.12. Work to develop software and related documents that respect the privacy of those who will be affected by that software.

3.13. Be careful to use only accurate data derived by ethical and lawful means, and use it only in ways properly authorized.

3.14. Maintain the integrity of data, being sensitive to outdated or flawed occurrences.

3.15. Treat all forms of software maintenance with the same professionalism as new development.

4. | Principle 4: judgment

Software engineers shall maintain integrity and independence in their professional judgment. In particular, software engineers shall, as appropriate

4.01. Temper all technical judgments by the need to support and maintain human values.

4.02. Only endorse documents either prepared under their supervision or within their areas of competence and with which they are in agreement.

4.03. Maintain professional objectivity with respect to any software or related documents they are asked to evaluate.

4.04. Not engage in deceptive financial practices such as bribery, double billing, or other improper financial practices.

4.05. Disclose to all concerned parties those conflicts of interest that cannot reasonably be avoided or escaped.

4.06. Refuse to participate, as members or advisors, in a private, governmental or professional body concerned with software related issues, in which they, their employers or their clients have undisclosed potential conflicts of interest.

5. | Principle 5: management

Software engineering managers and leaders shall subscribe to and promote an ethical approach to the management of software development and maintenance. In particular, those managing or leading software engineers shall, as appropriate

5.01. Ensure good management for any project on which they work, including effective procedures for promotion of quality and reduction of risk.

5.02. Ensure that software engineers are informed of standards before being held to them.

5.03. Ensure that software engineers know the employer's policies and procedures for protecting passwords, files, and information that is confidential to the employer or confidential to others.

5.04. Assign work only after taking into account appropriate contributions of education and experience tempered with a desire to further that education and experience.

5.05. Ensure realistic quantitative estimates of cost, scheduling, personnel, quality, and outcomes on any project on which they work or propose to work, and provide an uncertainty assessment of these estimates.

5.06. Attract potential software engineers only by full and accurate description of the conditions of employment.

5.07. Offer fair and just remuneration.

5.08. Not unjustly prevent someone from taking a position for which that person is suitably qualified.

5.09. Ensure that there is a fair agreement concerning ownership of any software, processes, research, writing, or other intellectual property to which a software engineer has contributed.

5.10. Provide for due process in hearing charges of violation of an employer's policy or of this Code.

5.11. Not ask a software engineer to do anything inconsistent with this Code.

5.12. Not punish anyone for expressing ethical concerns about a project.

6. | Principle 6: profession

Software engineers shall advance the integrity and reputation of the profession consistent with the public interest. In particular, software engineers shall, as appropriate

6.01. Help develop an organizational environment favourable to acting ethically.

6.02. Promote public knowledge of software engineering.

6.03. Extend software engineering knowledge by appropriate participation in professional organizations, meetings and publications.

6.04. Support, as members of a profession, other software engineers striving to follow this Code.

6.05. Not promote their own interest at the expense of the profession, client or employer.

6.06. Obey all laws governing their work, unless, in exceptional circumstances, such compliance is inconsistent with the public interest.

6.07. Be accurate in stating the characteristics of software on which they work, avoiding not only false claims but also claims that might reasonably be supposed to be speculative, vacuous, deceptive, misleading, or doubtful.

6.08. Take responsibility for detecting, correcting, and reporting errors in software, and associated documents on which they work.

6.09. Ensure that clients, employers, and supervisors know of the software engineer's commitment to this Code of ethics, and the subsequent ramifications of such commitment.

6.10. Avoid associations with businesses and organizations which are in conflict with this code.

6.11. Recognize that violations of this Code are inconsistent with being a professional software engineer.

6.12. Express concerns to the people involved when significant violations of this Code are detected unless this is impossible, counter-productive, or dangerous.

6.13. Report significant violations of this Code to appropriate authorities when it is clear that consultation with people involved in these significant violations is impossible, counter-productive or dangerous.

7. | Principle 7: colleagues

Software engineers shall be fair to and supportive of their colleagues. In particular, software engineers shall, as appropriate:

- 7.01. Encourage colleagues to adhere to this Code.
- 7.02. Assist colleagues in professional development.
- 7.03. Credit fully the work of others and refrain from taking undue credit.
- 7.04. Review the work of others in an objective, candid, and properly-documented way.
- 7.05. Give a fair hearing to the opinions, concerns, or complaints of a colleague.
- 7.06. Assist colleagues in being fully aware of current standard work practices including policies and procedures for protecting passwords, files and other confidential information, and security measures in general.
- 7.07. Not unfairly intervene in the career of any colleague; however, concern for the employer, the client or public interest may compel software engineers, in good faith, to question the competence of a colleague.
- 7.08. In situations outside of their own areas of competence, call upon the opinions of other professionals who have competence in that area.

8. | Principle 8: self

Software engineers shall participate in lifelong learning regarding the practice of their profession and shall promote an ethical approach to the practice of the profession. In particular, software engineers shall continually endeavor to:

- 8.01. Further their knowledge of developments in the analysis, specification, design, development, maintenance and testing of software and related documents, together with the management of the development process.
- 8.02. Improve their ability to create safe, reliable, and useful quality software at reasonable cost and within a reasonable time.
- 8.03. Improve their ability to produce accurate, informative, and well-written documentation.
- 8.04. Improve their understanding of the software and related documents on which they work and of the environment in which they will be used.
- 8.05. Improve their knowledge of relevant standards and the law governing the software and related documents on which they work.
- 8.06. Improve their knowledge of this Code, its interpretation, and its application to their work.
- 8.07. Not give unfair treatment to anyone because of any irrelevant prejudices.
- 8.08. Not influence others to undertake any action that involves a breach of this Code.
- 8.09. Recognize that personal violations of this Code are inconsistent with being a professional software engineer.