

Ethical Based Mathematical Model to Evaluate Software Engineering

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Abstract: Software engineering techniques and tools are required to develop or build any computer-based applications. The task of developing Software applications is a complex, expensive and ethical engineering which requires qualified software engineering professionally and ethically. Studies and literature denoted that software engineering professionals still facing problems concerning ethical aspects. Analysis shows that Islamic sources (Holy Qur'an and Sunnah) are the highest standard ethical principles for building individual, communities and Ummah (nation) levels. Islamic ethics are universal, stable, comprehensive, fair and standard which are suitable for all nations and times; and when followed leads to create an ethically great society. To effectively solve ethical problem in computer and software engineering field; we propose a new model, which mainly based on integrating an Islamic based solution to solve ethical related problems. This paper focuses on adopting new Ethical Based Mathematical module to evaluate software engineering people and model.

Key words: Mathematical Model • Ethical Principles • Software Engineering • Islamic Resources

INTRODUCTION

The world market for computer-based applications is worth hundreds of billions USD and it affects almost all peoples' life directly or indirectly. Farther more it includes a reasonable ratio of workforce. Software is heart of computer-based applications, which requires qualified professional and ethical software engineer. Computer ethics discipline is growing rapidly as computer technology grows and develops. Stanford encyclopedia of philosophy [1] considers computer ethics as the efforts of applying traditional ethical theories to the use of computer technology. It might be include standards of professional practice, codes of conduct, aspect of computer law, public policy and corporate ethics beside certain topics in the sociology and psychology of computing. Other LR defined computer ethics as examining "ethical problems aggravated, transformed or created by computer technology" [2]. This broad view of computer ethics employs concepts, theories and methodologies from applied ethics, sociology of computing, technology assessment, computer law and other relevant disciplines [3]. Computer ethics should be viewed as a branch of professional ethics, which is

concerned primarily with standards of practice and codes of conduct of computing professionals [4]. Gotterbarn has been involved as co-author for third version of the ACM Code of Ethics and Professional Conduct to establish licensing standards for software engineers [5, 6]. Codes of ethics facing several limitations that leads to lack of rules of offering adequate guidance in complex situations [7]. In his book pressman [8] denoted that: Software engineers must accept that their work involves wider responsibilities. They should behave in moral responsible way if they are to be respected as professionals. To understand software engineering ethics, we have to discuss the concept of ethics, its problems and its role in our life. Islamic viewpoint of ethic is a recognizable and effective that we have to adopt it [9]. This paper explains an enhanced version of a web-based database prototype with sample of implementation results.

Islam, Ethics and Statistics: Ethics can be defined as "Set of principles of right conduct", or "motivation based on ideas of right and wrong". Socrates encourages scholars and common citizen to turn their attention to the condition of man [10]. Aristotle uses "self-realizationism"

[10]; when a person acts in accordance with their nature and realizes their full potential, they will do goods and be content. Ethical and moral related problems facing software engineer in their work. It include professional and social responsibilities, quality, ownership and intellectual property rights, privacy and confidentiality, computer crimes and safety, liability, social and health impact on society and work place, security and reliability [11]. SW engineer hold responsibility for their participation in developing advanced software system that causes harms for people or environment such as intelligent and mass-destruction weapons. So they hold part of ethical and professional responsibility for using such weapons in war crime, destruction, harming or killing hundreds of thousands of innocent victims as well as the huge destructions of wealth and environment. Ethics is the corner stone in Islam. Its general understanding can be express as a “set of moral principles and guidance that recognizes what is right behavior from what is wrong or what one should do or not”. Islam is basically based on two sources: Holy Qur’an [12] and Sunnah of Prophet Mohammad PBUH. Qur’an consists of more than 6200 verses; with hundreds of verses focusing on ethical aspects [9]. Sunnah is defined by Muslim scholars as “all what prophet Mohammed PBUH says, acts, or agreed on”. Sunnah is mainly documented in several authenticated resources (Sahih al-bukhari, Sahih Muslim, Sunan Abi-Daud, Jamea al-Termethi, Sunan Ibn-Maja and Sunan al-Nisaae, Muatta Imam Malik, Musnad Imam Ahmed). Muslims’ life should be guided based on Islamic ethical principles [13-16]. Allah the almighty said in Qur’an [12] ”This day, I have perfected your religion for you, completed my

favor upon you and have chosen for you Islam as religion” [Quran 5:3]. Allah the almighty describes Prophet Mohammed PBUH that he is of great ethics. ”Prophet of Allah had been raised to a great spiritual dignity” [Qur’an 68:4]. Prophet Mohammed said “I was sent to complement the best of ethics”. Aisha, the wife of Prophet, said “prophet ethic was al Qur’an” [13]. Allah orders the Muslims to follow and obey Prophet Mohammed as a model “You have indeed in the Messenger of Allah an excellent example” [Quran 33:21]. Allah describes people of the best nation as: “You are the best of peoples, evolved for mankind, enjoining what is right (Ma’ruf), forbidding what is wrong (Munkar) and believing in Allah” [Qur’an 3:110].

The Qur’an and Sunnah use set of ethical terms to describe the concept of goodness such as: Sidq (Truth), Khayr (Goodness), ‘Adl (Equilibrium and Justice), Haqq (Truth and Right), Ma’ruf, Amanah (Honesty), Ikhlas (Sincerity) and Taqwa (Piety). A statistical result (term based frequency) for sample of ethical related terms used in Qur’an and Sunnah is shown in [9, 17]. Tables (1, 2) show statistics of how frequently ethical terms appears in Qura’nic verses and Prophet Sunnah.

Muslim’s scientists and scholars have great effort in producing books and articles to explain the concept of ethics in Islam. Muslim’s scientists consider ethics as the best honorable science or the crown of sciences, which leads to bring success, happiness for individuals, communities and society. Islamic scholars put several definitions for ethics as shown by Alfairuzabady, Ibn Mandhor, Alasfahani, Ibn rajab, Ibn Miskawah, Abo-hamid Al-Ghazali, Abdual-karim Zaydan and Mohammad Alghazali [16, 18-26].

Table 1: Sample of Good Ethical Terms in Quran and Sunnah

Good Ethical Characteristic		No. of Verses	No. of Hadith
Beneficence	الاحسان والشفاعة	82	69
Sincerity	الاخلاص والعزم والصلاح	143	103
Forgiveness	الاستغفار والتوبة والصفح	208	111
honesty	الامانة والنزاهة والامتنانة	65	66
Good model and Guidance	الاسوة الحسنة والارشاد والاصلاح	67	82
Keep promise and Secrecy	وفاء العهد وكتمان السر	31	50
Order goodness and Prohibiting badness	الامر بالمعروف والنهي عن المنكر	13	33
Believe & piety	الايمن والتقوى	595	145
Good ethics and dealing	الادب وحسن الخلق والمعاملة	61	250
wisdom	الحكمة والحلم	129	31
Thankfulness	الحمد والشكر والثناء	235	142
Patience	الصبر والمصابرة وكتمان الغيظ	108	64
Fairness	العدل والانصاف	23	62
Truth	الصديق	92	44
Merciful	الرحمة والرئفة والرفق	227	124
Mankind priority	تكريم الانسان	96	24
Science, Work	العلم والعمل	530	139
Thinking	التفكير والتدبير والتأمل	83	48

Table 2: Sample of Bad Ethical Terms in Quran and Sunnah

Bad Ethical Characteristic		No. of Verses	No. of Hadith
Abuse, Hurt	سوء المعاملة والأذى	127	79
Injustice, Tyranny	الظلم والطغيان	218	114
Sedition,	الفتنه	79	77
Corruption, sensuality	الفساد، وشهوانية	65	40
Lying, deception, slander	الكذب والخداع والافتراء	245	86
hypocrisy	نفاق	24	51
Denunciation of covenant	نقض العهد	9	36
Deviation	الانحراف	151	34
Treason	خيانة	10	30
Ignorance	جهل	23	29
Disclaimer of responsibility	تنصل من المسؤولية	44	7
Crime, aggression	الجريمة والعنوان	91	30

Analysis shown Islam considers ethics as an essential factor in building society based on Qur'an and Sunnah. It builds the mankind behavior to bring benefit, peace and prosperity [25]. The ethical behavior have multi dimension effects (international, National, Community/organization, family and individual). This unique multidimension and comprehensive model produces encyclopedic scientists such as: Al-khawarizmi, Ibn-Albetar and Ibn-Alhatham, Ibn-Rushd, Ibn-Hayyan, Alfarabi, Albairuni, etc. Each one of them was scientists in several fields such as Fiqh, Hadith, Language and Art, Mathematic, chemistry, physics, Medicine, or astronomy.

The main features of Islamic-based ethical principles include:

- Universe is created by Allah the almighty; mankind rule is to develop this universe according to creator instructions revealed through messengers. Islam is the last message to all mankind.
- All mankind acts consider as worshipping and accounted in the judgment day.
- Islam is a worldwide religion revealed by Allah to whole mankind. "We have not send thee but as messenger to all mankind, giving them Glad tiding and warning them against sin" [Qur'an 34:28].
- Islam guide people to optimum perfection. "Verily this Qur'an Doth guide to that which is most right-perfectness" [Qur'an 17:9].
- Guide society to the best empirically: As example; Islam converts Bedouin society in the Arab-land into modern successful society within few decades. A great Islamic nation leads the development and civilization building with great ethics such as justice, fairness, honest, truth, goodness as shown in the Umayyad, Abbasid and Andalusia eras.
- Building an integrated, comprehensive and consistent relationship between mankind and Allah, mankind among themselves, mankind and other creatures of Allah and mankind and environment. "We send thee not, but as Mercy for all creatures" [Qur'an 21:107].
- Islamic ethics are stable and standard. It deals with people in justice, fairness and equality regardless of their race, relationship, nation, religion, or color. Prophet PBUH said "all people are equal; there is no difference between Arabic and non-Arabic except in Taqwa (Piety).
- Islamic ethic work toward reactivating the purity (Fit'ra) of people as created by Allah the almighty. "So set your face towards the religion of pure Islamic monotheism; Allah's Fitra with which he has created mankind" [Qur'an 30:30].
- Islam is a whole life guidance to rebuild society through building of individuals; starting from day of birth and continuing through all his life.
- Islamic methodology of life is guided by Islamic ethics, which associated theoretical principles with implementation through set of worshipping and dealing acts. There are more than fifty verses in Qur'an mentioned to "those who believe and do deeds of righteousness".
- Islamic ethical principles associate mankind acts with his intension, which is known by Allah the almighty so people have to uniform both their inside intension with declared acts. "Except as Allah wills; for he knoweth what is manifest and what is hidden" [Qur'an 87:7]. Prophet PBUH said "All your acts are associated with your intentions".
- Islam considers human life a test for challenge between mankind and satan. Allah the almighty rewards and supports mankind with forgiveness and mercy (Tawba and Isteghfir) as supporting weapons

in this fight. Also Allah the almighty duplicating rewards for good deeds and canceling sins when we make Istighfar or Tawba. “Verily devil (Satan) is an enemy to you: so treat him as enemy” [Qur’an 35:6]; also “Allah who forgiveth Sin, accepteth repentance” [Qur’an 40:3].

1.6 billion Muslims including many thousands of software engineering professionals should have an effective role in Universe. The unethical behavior for some Muslims can be consider as an essential reasons for their weakness, which also leads to the unfair concept about Islam and Islamic ethics by some of the non-Muslims.

Islamic-Based Ethical Principles for Software Engineering: In this paper we discuss the dedicated ethical principles to guide software engineers in performing their work. Software engineering professionals have to commit them-selves to follow these principles in all software development phases: communications, data collection, analysis and requirements, design and specifications, construction, testing, deployment, evolution and maintenance. Other related part which shows the general Islamic ethical principle for any mankind was explained in [9]. This set of Islamic based ethical principles is dedicated for software engineering professionals. These ethical principles include:

- Professional software engineer have to work toward performing goodness and avoiding harmful acts that affects others.
- Professional software engineer may participate partially in the work but he has full ethical responsibility for the effect of the whole project.
- Professional software engineer have to work in consistent with goodness of nations’ (Ummah) interests, which are based on Islamic ethical values and should not make harm for nation. Prophet PBUH said “Every Muslim is shepherd (leader) and he is responsible for that which he shepherds”.
- Professional software engineer have to work in consistent with goodness of community or organization interests, which is consistent with the nation interest based on Islamic standards. The Prophet PBUH said “those who cheat us are not part of us (our Ummah)”.
- Professional software engineers have to ensure that

their products and related modifications meet the highest professional standards and not conflict with ethical values. Prophet in a Qudsi’s Hadith said “Allah love those who accomplish their job in its best (perfect) manner”.

- Professional software engineers have to maintain integrity and independence in their professional judgment and have to be fair according to ethical values. Allah Said in Qur’an “when you judge between others; you have to judge with justice” .[Qur’an 4:58]
- Professional software engineers (managers and leaders) have to promote an ethical approach to the management of software development and maintenance. They have to show honesty (Amanah) and equity in performing their duty.
- Professional software engineers have to build and successfully use their profession in their work and be consistent with the Nation (Ummah) interest.
- Professional software engineers have to be fair, cooperative and supportive of their colleagues and avoid selfishness and hypocrisy. Allah the Almighty said “Help you one another in virtue, righteousness and piety (Bir and Taqwa); but do not help one another in sin and transgression” [Qur’an 5:2].
- Professional software engineers have to participate in lifelong learning concerning the ethically practice of their profession. Prophet PBUH said” seek knowledge from birth to death”.
- Professional software engineers have essential and ethical responsibility to protect the confidentiality and security for client, employer or community and nation (Ummah).

From this set of ethical principles we find there are set of ethical terms used. These terms can be used in building statistical or mathematical model to evaluate the software engineer or software organization.

Software Engineering Ethical Evaluation Model: The other essential target is to develop an efficient and effective mathematical / statistical evaluation model for software engineering professionals based on Islamic-based ethical values. This evaluation model will be a supportive tool for software quality management. Based on the analysis of the Islamic ethical terms in Quran and Sunnah; we can extract and define Islamic-based Ethical Evaluation Model (IEEV), the Quranic-based Ethical Evaluation Model (QEEV) and

the Sunnah-based Ethical Evaluation Model (SEEV) and for software engineering. These models can provide an indication for ethical rank or level for people or organization, which is very helpful in decision making and evaluation for organizations or people.

The Islamic-based Ethical Evaluation Value (IEEV) of a person or organization can be calculated using the following equations.

$$IEEV = \sum_{i=1}^n IE_i * IW_i \quad (1)$$

Where: IE_i is the Islamic-based Ethical parameter I, IW_i is the weight of the Islamic-based Ethical Parameter i

$$IW = \sum_{i=1}^n IW_i \quad (2)$$

Where IW is the Total weight of the Islamic-based Ethical Parameters

The Quranic-based Ethical Evaluation Value (QEEV) of a person or organization can be calculated using the following equations.

$$QEEV = \sum_{i=1}^n QE_i * QW_i \quad (3)$$

Where: QE_i is the Quranic-based Ethical parameter I, QW_i is the weight of Quranic-based Ethical Parameter i

$$QW = \sum_{i=1}^n QW_i \quad (4)$$

Where QW is the Total weight of the Quranic-based Ethical Parameters

The Sunnah-based Ethical Evaluation Value (SEEV) of a person or organization can be calculated using the following equations.

$$SEEV = \sum_{i=1}^n SE_i * SW_i \quad (5)$$

Where: SE_i is the Sunnah-based Ethical parameter I, IW_i is the weight of the Sunnah-based Ethical Parameter i

$$SW = \sum_{i=1}^n SW_i \quad (6)$$

The weights shown in the above equations for the different ethical terms on Islamic (IW_i), Quranic (QW_i) and Sunnah (SW_i) are estimated based on the experience, work environment or survey study done. The other trend is to use the frequency of appearance of these ethical terms in Quran, Sunnah, or both. We can also integrated between the estimated and frequency to show more realistic result.

DISCUSSION AND CONCLUSION

To enhance human life in different aspects, we have to focus on enhancing software engineering with ethical based principles. This paper presented the concept of ethics, Islam and ethics, ethical principles of software engineering and proposing a mathematical model to evaluate software engineering people or organization. This effort is step toward solving current ethical related software engineering problems. It offers a good opportunity for software engineers (especially Muslims) to understand Islamic ethical principles and implement it since it represents the highest standard and comprehensive ethical values. It offers a quantifiable tool for evaluation and making the right decision.

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