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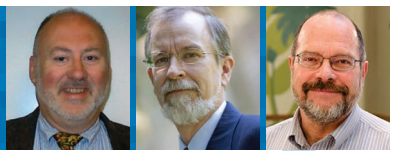

Evolving From Know-How to Know-What

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Computing is experiencing a "Cambrian explosion" of new technologies that promise great societal benefits but also create opportunities for misuse and societal harm. How to reduce this potential for harm is the objective of computing codes of ethics. Given the rash of ethical lapses related to computing, we ask whether codes of ethics are effective and, if not, why not?

Duke University civil engineering professor and well-known author Henry Petroski has written extensively on the subject of major bridge failures that have occurred once about every 30 years since 1847.[1] Petroski speculates that there are two intertwined reasons for this repeating pattern of failure: first, the failure happens because a novel bridge design is pushed beyond its safety limit. Second, and more interesting, the limit is exceeded because a new generation of designers and engineers forgot the critical lessons learned about failure by the previous generation, who themselves had pushed the limits of an earlier novel bridge design too far. Philosopher George Santayana's aphorism, "Those who cannot remember the past are condemned to repeat it," seems a fitting description.

The IT community has an analogous repeating two-decade cycle, this one related to the community's reawakening to the societal risks posed by ethical failures in the use of computing technologies. This cycle is reflected in the periodic updates in the community's computing codes of ethics. For example, the Association for Computing Machinery (ACM)—the world's largest scientific and educational computer society—last year updated, once again, its Code of Ethics and Professional Conduct.[2] This revision traces its origins to its 1992 Code of Ethics and Professional Conduct, which in turn revised the ACM's 1972 Code of Professional Conduct.[3]

The latest ACM revision owes itself in large part to, again, two intertwined factors. The first is what researcher

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Gil Pratt describes as the "Cambrian explosion" in emerging and novel computing capabilities, especially in the areas of artificial intelligence (AI), cloud computing, data analytics, facial recognition, quantum computing, and robotics that has taken place over the past decade.[4] This eruption of new powerful technologies promises great societal benefits, but there are also unmatched future opportunities for misuse that have created unease among the public and technologists alike.[5]

Second, the worries about the potential for future misuse are further amplified by the present ethically dubious applications or management of IT, as found in Facebook's highly publicized Cambridge Analytica privacy fiasco and Volkswagen's emissions cheating scandal, among a plethora of others that also helped spur the ACM ethics update. These incidents, coupled with the prospect that IT will become even more pervasive and capable, has eroded the public's trust that computing will be used in a manner where its benefits far outweigh the risks of its misuse.

Moved by the ongoing ethical lapses, including the unfair and discriminatory personnel practices often found in the IT industry and the future potential for harm that computing may create in a world where "computing technology is so interwoven into the fabric of daily life," the ACM takes the position that computing ethics now needs to "become the personal responsibility of every professional in our industry."[2]

> Only when the technology becomes mainstream do the ethical issues identified earlier become real—not predicted—problems.

The new code reiterates in its seven general ethical principles (see "ACM 2018 Code of Ethics: General Ethical Principles") that the ACM expects computing professionals to contribute to society and human well-being and importantly recognize that all people are stakeholders in computing. Furthermore, the ACM expects professionals to avoid harm, that is, unjustified negative consequences, caused by the use of the computing technology they develop, operate, or support.

Whether the new ACM Code of Ethics will be effective in changing the computing community's behavior in any meaningful way remains to be seen. What seems conclusive, however, given the ever-growing list of computing-related ethical lapses, is that past codes of computing ethics have largely been ineffective in preventing the unethical use of computing. The question is whether updated codes of ethics, such as the ACM's, end up being as ineffective and, if so, why?

DÉJÀ VU ALL OVER AGAIN

I contend that, like the bridge builders who pushed their designs past the limit, many of today's computer professionals have either forgotten (or never bothered to learn about) the past ethical transgressions that drove the creation of earlier computing codes of ethics. As in the case of bridge failures, many of today's ethical problems were identified when today's mainstream computing technology was just emerging two decades ago. However, it can take a decade or more for a novel computing technology to reach the point where it is used routinely in an organization. Only when the technology becomes mainstream do the ethical issues identified earlier become real—not predicted—problems, and by then it is just too late to do much to reverse them.

Looking back at the world of computing four decades ago, this becomes evident. Although today's emerging computing technologies have magnitudes more capability than their predecessors, their relative impacts on society likely will not. A comparable Cambrian-like explosion of computing technologies involving microprocessors, memory, networking, databases, and system architectures, to name but a few, took place during the

ACM 2018 CODE OF ETHICS: GENERAL ETHICAL PRINCIPLES

- Contribute to society and to human well-being, acknowledging that all people are stakeholders in computing.
- Avoid harm.
- Be honest and trustworthy.
- Be fair and take action not to discriminate.
- Respect the work required to produce new ideas, inventions, creative works, and computing artifacts.
- Respect privacy.
- Honor confidentiality.

late 1970s into the 1980s. Although the social benefits of these technologies were perceived as substantial, the potential for societal harm was also becoming more apparent. Incidents of computer-enabled criminal activity, costly government IT development failures, and IT operational failures, such as the infamous 1990 AT&T network failure, were being reported with growing regularity.[6]

Computing's increasing potential for harm in the late 1970s and early 1980s helped spur the development of computing ethics as a formal discipline in itself. Researchers Walter Maner and James Moor, among others, argued that the capabilities of IT over those of conventional technologies raised unique ethical questions.[7,8] Computing's malleability, complexity, speed, low cost, and ability to reproduce and store information all combined to create technology-enabled ethical situations unlike those experienced before. This required new ways of thinking about the ethical consequences of computing on both society and individuals.

The increasing worries about the potential negative societal impacts of computing coincided with a growing lack of trust, not only in business—which experienced such a rash of ethical lapses in the 1980s that the period gained the moniker "Decade of Greed"—but in technology and technologists in general. Investigations into the 1979 Three Mile Island accident, the 1986 NASA space shuttle *Challenger* explosion, and the 1986 Chernobyl meltdown, among other high-profile incidents, raised questions in the public's mind about how much, or even whether, ethical considerations held much sway in professional technical decisions.[9]

In this context of a computing Cambrian explosion and a widespread questioning of the ethics of technologists, the 1972 ACM Code of Ethics was updated in 1992. One objective of the update was to increase the public's trust in computing professionals. A *Communications of the ACM* article in 1993, for instance, described how the new code could help a computing professional's decision making when faced with a potentially unethical situation and made the point that a code of the ethics, such as the new ACM's, "holds the profession accountable to the public. This yields a major payoff in terms of public trust."[10]

The 1992 ACM code was widely embraced by the IT community and helped spur the creation of numerous courses on computing ethics in university computer science and engineering programs. It also helped stimulate the publication of numerous technical articles and books on the social impacts of computing and the need for incorporating computer ethics in technology and engineering management decisions.

SUCCUMBING TO THE TECHNOLOGICAL IMPERATIVE

However, by the late 1990s, interest in the topic of computing ethics began to wane. One reason was the rapid expansion of the computing industry during the so-called dotcom-bubble period. Making enormous amounts of money from hyping a "disruptive" computing technology that promised to "change everything" became a major motivator across the industry. Concern over computer ethics was hardly a priority in this "get rich quick" environment, and in many circles, ethics was seen as an inhibitor to one's personal profit-maximization strategy.[11]

The ethics of computing was also not at the forefront of thinking about computing in highest levels of the U.S. government, which had, early on, fully embraced the emergence of the so-called information superhighway, going so far as to exempt it from government regulatory oversight as a means to encourage technological innovation. Emerging computing technologies, such as the Internet, were viewed as being crucial societal transformative agents that would produce "an era of unparalleled [economic] promise," in the words of President Bill Clinton.[12]

The technological imperative, the idea that technology-driven progress is necessary, inevitable, and always beneficial to society in the final analysis of its risks and rewards, has always been strong in the U.S. psyche. In the 1990s, computing became synonymous with societal economic progress and productivity. It is little exaggeration to say that the prevalent attitude was that what was good for the IT industry was good for every country and that nothing was going to be allowed to inhibit the industry's growth. Worries over the potential misuse of computing fell into the dark shadows created by the bright spotlights trained on computing's potential benefits.

DROWNED IN DIGITAL CONVERGENCE

Another idea of the 1990s related to the technology imperative that helped undercut the concern for computing ethics was the concept of technological convergence, or synergy. This was the idea that the computing, communications, and entertainment technologies were on an unstoppable path of being integrated seamlessly together. In fact, convergence was seen by many scientists and engineers at the time as being indispensable for the U.S. computer and communications industries to remain competitive against the seemingly unstoppable Japanese industrial juggernaut.

Although there was some discussion about the possible societal impacts such a technological convergence might bring, debate centered more on what cultural practices needed to be changed in business, government, and education to fully benefit or profit from convergence. Opportunities for the ethical misuse of computing centered mostly on preventing intellectual property theft in such an integrated technical environment, with other possibilities for harm downplayed or not discussed at all.

At a 1995 National Research Council–sponsored international colloquium on technological convergence, futurist George Gilder summed up the prevalent feeling best when he stated, "I think the technology is enormously

beneficial . . . I don't think there is any significant downside."[13] In other words, whatever ethical risks or negative social disruption convergence might pose, the tradeoff was worth it, given the enormously potential benefits to be had.

HOSTAGE TO CULTURAL CAPTURE

A third factor in undercutting the importance of computing ethics in the 1990s was a form of cultural capture, which occurs when regulators start thinking like those they are supposed to regulate. As discussed, governments placed a very light regulatory touch on computing so as not to inhibit innovation. This, in essence, gave a green light to the belief in the IT industry that if an activity isn't clearly illegal, it's not prohibited, and, therefore, it is ethical to pursue.

FROM KNOW-HOW TO KNOW-WHAT

Although the dotcom crash served to undermine computer ethics as a professional priority, the 9/11 terror attacks coupled with the rise of search engines and social media helped bury it. Over the past 20 years, there has been a steady defining-down of computing ethics.

What would have been held up as examples of unethical uses of computing in terms of the 1992 ACM Code of Ethics, especially with regard to personal privacy and confidentiality, has now been normalized. Governments argue that we must give up our privacy to ensure security and social order, and the computing industry argues that we must give up our privacy so that it can meet our needs and desires better.

Although there is no going back to 1992 and starting over again, perhaps it is time to go back even further, to cyberneticist Norbert Wiener's 1950 groundbreaking book, *Human Use of Human Beings*, which is seen by many as the first book warning about the ethical issues of computers.[15] Wiener prophetically cautioned in his book that the "new industrial revolution" that computing would bring was a double-edged sword. Although computing "may be used for the benefit of humanity," he said, it could just as easily "be used to destroy humanity, and if not used intelligently, it can go very far in that direction."

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This created a situation where those most able to act ethically with regard to computing use were also those who would profit from ignoring ethics. Computing codes of ethics are, at their core, about trying to define what computers should not be used for, an idea that was anathema to the computing industry. No one was ever going to get financially rewarded for not selling a computing technology that might be used legally but unethically by a customer.

Even after the dotcom bubble burst and when it became clear that computing ethics were collateral damage in the race for riches, there was little introspection on the part of the computing industry. A major reason was the mass layoffs in the industry that took place.[14] Who has time to worry about computer ethics when you don't have a job?

What especially worried Wiener was that the main focus in the profession seemed to be concentrated on the "know-how" part of computing, that is, the technology needing development so that human tasks could be automated. Weiner held that what was distressingly missing was what he termed the much more important "know-what" element, "by which we determine not only how to accomplish our purposes, but what our purposes are to be."

In other words, what was the objective of automating specific work, and what were the unintended consequences of this automation? Should some work never be automated? Would anyone spend any time thinking about what these might be, Wiener wondered, or instead, would the effects of automating something that shouldn't have been automated be discovered only afterward, to everyone's regret?

Wiener argued that, with the automatic age at its very beginnings, it was the ideal time for scientists and engineers to take what he later labeled "an imaginative forward glance at history." This forward look, he said, was needed to avoid making preventable mistakes in applying computing in ways that might not only create direct harm but could also be exploited for unethical or inhumane purposes.

Laudably, the ACM Code of Ethics has emphasized the need to view computing from Weiner's know-what perspective and to acknowledge that all people are stakeholders in computing, not just IT professionals. This came through in the 2018 letter from the president of the ACM discussing the new code of ethics, who wrote that,

> *When the ACM Code of Ethics was last updated in 1992, many of us saw computing as purely technical. . . . Today, we find ourselves in situations where our work can affect the lives and livelihoods of people in ways that may not be intended, or even be predictable. This brings a host of complex ethical considerations into play.*[16]

The ACM is currently working to develop methods to incorporate ethical considerations into computer science curricula from primary through

graduate school, and it is helping IT professionals seeking advice on how to address ethical quandaries they may be encountering.

There have been multiple private efforts to implement Wiener's "imaginative forward glance" in an effort to better understand the ethical ramifications of emerging computing technologies. One is the nonprofit OpenAI, which was begun in 2015 by Silicon Valley entrepreneurs Reid Hoffman, Elon Musk, Peter Thiel, and others who were worried that AI might be misused. The organization seeks a "path to safe artificial general intelligence" and expects "to create formal processes for keeping [AI] technologies private when there are safety concerns."[17]

There has also been a resurgence of ethics courses at universities, along with novel ways to help students understand the ethical dilemmas they may face in their future careers. In addition, working computing professionals at Amazon, Google, and Microsoft have very publicly taken it on themselves to question whether it is ethical for their companies to be engaged in certain types of work.

All of these are encouraging signs that the ethical implications of computing are at the very least being discussed and, in some cases, acted on. The question is whether the interest will last any longer than it did back in the early 1990s. Furthermore, will these efforts have any real practical effects on IT professional decision making?

For instance, will there be concerted efforts on the part of IT professionals involved in the Internet of Things (IoT) to ensure that their company's devices are safe and secure and that the data gathered will be used ethically before the devices are sold, especially if their competitors do not take such steps? With the IoT marketplace projected to explode by an order of magnitude to a US$6.5 trillion market by 2024, it seems doubtful.[18]

How will governments' increasing desire to control their populations through the use of computing technology, such as in China, where this is seen as perfectly legitimate, further define what is considered ethical computing elsewhere? How will the world's militaries' fascination with AI-driven weaponry impact computing ethics?

The ACM Code of Ethics states that ethics is the personal responsibility of every IT professional. Perhaps it is time to say that it is the responsibility of every professional computing association and society as well. Instead of just publishing computing codes of ethics, the associations and societies as a group need to stand together and call out governments and commercial organizations for their unethical misuse of computing and recognize those organizations that use computing ethically. It is unfair to place all the responsibilities for ensuring that computing is used ethically on IT professionals alone if the associations and societies don't take public stands against misuse as well.

Toward the end of his book, Weiner wrote about the potential use of automation that "The hour is very late, and the choice of good and evil knocks at our door." He was reminding everyone that managing ethical risks is not about future technology decisions but the future of present decisions. The real question is, given the current Cambrian explosion of computing technology, which—good or evil—will be knocking at our door tomorrow?

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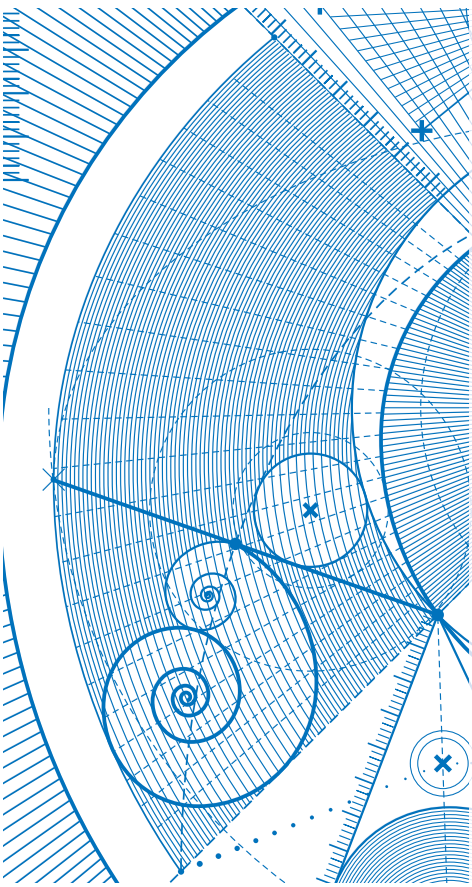

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