2012

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Abstract:

Changes in technology are beneficial in almost all aspects of our lives. However, many unanticipated/undesirable consequences of technology exist. Some consequences are immediate, while others may not be known for decades. Current university students grew-up with technology and cannot imagine a world without it. They not only use technology, they are the future technology developers. By providing both examples and classroom exercises, this paper intends to create an awareness of the unanticipated/undesirable consequences of technology that can be incorporated into the classroom. These consequences impact both individuals and society as a whole and the concerns need to be addressed with students. Faculty should not be naysayers but should assist the students in drawing their own conclusions.

Keywords: CIS curriculum, Mobile, Social Networks, RFID, Shallow thinking, digital divide

I. Introduction

In the late 1980s, not long after the widespread use of the Internet began, apprehension about unanticipated/undesired consequences was expressed by Clifford Stoll [1989], a world-famous "digital detective" who isolated infiltrators of his Unix system. He hunted them because of an account that had not been authorized nor paid. This "case," known as "The Cuckoo's Egg," exemplifies one of the first "cautionary tales" to somewhat dampen the spirit of the excitement of the early Internet.

Today, almost twenty-five years later, we are familiar with the words "spam, virus, phishing, botnet, " etc., and we are advised to have "protection" to prevent attacks. However there may be additional unanticipated/undesirable consequences of technology. Many prestigious scientists, teachers, and other well-educated leaders are showering the public with a plethora of articles, research papers and examples of technology repercussions that should cause unease to parents, teachers, corporations, and policy-makers [Turkle, 2011] [Carr 2010].

Today, technology is much more than just computers, the Internet and things that go beep. Technology has made our life easier and better. It has changed the way we do things. It is fast paced and on-the-go. Nothing can stop us. We can practically do anything, anywhere within our reach. Changes in technology have been beneficial in almost all aspects of our lives and it is still changing. There really is nothing constant but change.

However, technology intrudes on our lives, monitors as well as guides us and coerces as well as aids us. Technology devices encroach into our own personal space: we carry them and wear them. Technology is embedded into everyday objects – toys, appliances, cars, books, clothing. It is part of our environment – in airports, garages, shopping malls, homes and offices. A techno-dependency exists: it is always-on, an interconnected web of systems, a hyper-connective, digital presence.

There is little argument that technology has improved lives – both personal and in the work place. Education has been enhanced: it is mandatory to have computer access to succeed in college, or even at the K-12 levels. However, students may become enamored with technology and often ignore human values, morals and ethics. Some even say an undesirable side to technology exists. Technology changes the way we learn, work and interact with others. Even game-playing is different with technology. Additionally, it is getting more difficult to analyze and evaluate the many changes occurring, often and quickly, in our society today. Is it possible that there is too much technology? Sometimes we adopt technology just for technology's sake, i.e., because it is available, attractive and popular, and then we do not know what to do with it. Once it is adopted, is there any assessment of its impact? Some consequences are immediate, such as improved productivity, while others may not be known for decades.

Current university students grew-up with technology and cannot imagine a world without it. They are not only current users of technology, but also future developers of software applications. Their view of technology will shape the future. What are the issues that need to be considered by these future technology developers – the students of today? As they create new uses for technology, they need to anticipate undesirable consequences of technology. "Making judgments about new computer technologies, and how they will affect us and the social fabric of which we are part, is not straightforward" [Sellen et al., 2009]. In order to provide for student learning, by providing some examples, this paper intends to create an awareness of the unanticipated/undesirable consequences of technology. It also provides some exercises that may be adopted to create a new awareness in both students and faculty of the unanticipated/undesirable consequences of technology on individuals and society.

II. Background and Examples

The unanticipated/undesirable consequences of technology adoption may not currently be addressed in a Computer Information Systems (CIS) curriculum. These side-effects impact both individuals and society as a whole. There are many examples of technology that impact lives and values, which need to be addressed with students. Below are just a few, with some references for additional exploration and rationale.

1. RFID Tags

Radio Frequency Identification (RFID) devices generate wireless radio frequency that uses electromagnetic fields to transmit data from a "tag' to a remote "reader" for identification and tracking. These are common today and are in use for product handling in commerce, for tracking of components in manufacturing, sometimes for tracking livestock, pets and even children. Some commercial establishments have mandated their use, as have some parts of the U.S. government. These devices are imbedded in U.S. passports. The technology enables tracking without consent and may lead to privacy issues [Molnar, 2005].

2. Mobile Computing

Smartphones connect us to the Internet and help us find restaurants, and provide directions and reading materials, if we want or need them. Laird [2012] claims that the average smartphone user "has 65 apps installed on his or her phone, but only uses 15 in a given week." Additionally, users of this technology may be tracked or traced through their usage. Most devices have Global Positioning Systems (GPS) built-in, which allows an individual's location to be accurately pin-pointed and recorded in a database. Additionally, what happens to that smart phone when the new improved version must replace it? As early as 2003 (Mayfield) there was concern about disposal of computers. Today, there is concern about disposal of hand-held devices using acceptable e-cycling methods, both the information stored on the phone and the physical device

[Laird, 2012]. An additional consequence of the instant access to information that mobile computing provides is an 'always-on' life style that may possibly shorten the lead-time for decision-making.

3. Social Networks

Social networks are used by an organization for marketing, by others to share information with friends. Some attribute the Arab Spring to the use of social networks [Hall, 2012]. All social networks are seemingly valuable and maybe friendly. Is there a downside to this use of technology? Privacy issues, social isolation and addiction are just three of the potential unanticipated issues. In a recent Washington Post article [Timberg, 2012], Katherine Losse expressed her concerns about the amount of personal information stored on Facebook. A recent experiment involved the ***dark side*** use of "bots" to influence social network discussions [Express-News, 2012]. Turkle [2011] is concerned about the changing social interactions and the impact of technology on relationships. Social Networks are changing the world; what is their impact? Is technology making us more connected or less? Both sides certainly may be argued.

4. Computer-Mediated Networking

Lewis [2007] provides some examples of the problems that can or may develop in relationships that occur with networking of individuals doing extensive computer-mediated communication. He claims that as much as one-third of the communications involve some form of deception or lies. Many of these concern the interactions underway, whether individuals remain honest throughout or deviate from their typical norm, how group decision-making occurs, and how successful the work becomes. As more critical decisions are being made over computer-mediated networks, the validity of those using those networks is important for the credibility of the conclusions [Jamieson, 2004].

5. Changes in the Workplace

Controversies about changes in the workplace have been documented over several eras: in the agricultural time, in the Industrial Revolution, and in the last decades, in the era of increasing automation and the information age. [Kling and Dunlop,1993]. Now in the digital era, workers who are accustomed to using computers and related devices in the workplace are expected to be more efficient and effective. To some extent this can be true, but often the many distractions in the variety of options offered to the worker can take more time, often on tasks not necessarily required [Campbell, 2007]. It is also been found that it is fairly common to have workers yield to the temptation of taking or sending materials from the workplace to use or sell elsewhere, violating corporate policy and often resulting in penalties to the worker [Carr, 2004].

An International Conference on Information Systems (ICIS) panel [Iacono, 2003] addressed several issues concerning outsourcing and the loss of in-house expertise, and changes in business processes that may not be beneficial to the firm. When outsourcing work to others outside the company, whether the work goes overseas or someplace more local, an opportunity for loss of interpretation of requirements is evident, resulting in the system being processed or implemented incorrectly. This loss may be due to the worker's fluency in a different language, but it could also be caused by a lack of the outsourced worker's cultural and corporate understanding of the problem that is being solved.

6. Copyright and Patent Concerns

With the ease of moving information from the computer screen to your thumb drive, without any approval or permission, it is clear that the violations of "copyright law" are easy, inexpensive, and done often. Copyright law was established to allow the "creator" of an original work to receive some remuneration for that work, including some recognition. Many of those creating music, art, literature, videos, etc. are therefore not being appropriately paid. When music is shared over the Internet, and copied from person to person without authorized permissions, violations abound. Even with some more "accepting" legal exceptions, such as the "fair use" option of the law, many creators lose the merit and pay they should be receiving. Since learning and building on previous efforts leads to improved future discoveries, ways to allow the creator to benefit are important to the creator as well as to society as a whole [WIPO, 2010].

7. Shallow Thinking

Many people who are constantly using mobile technology find that unexpected events often occur, and they are lured into living a fast, quick life taking care of "urgent tasks", often leaving another task. The practice of multi-tasking, whether around work demands or to moving quickly from one excitement to another, may lead to the use of only the shallow parts of the brain, called "shallow thinking." Some research has suggested that overuse of shallow thinking can lead to an eventual decline of the parts of the brain that are needed for deep analytical thinking. Over many years, after many generations, it is intimated that unused parts of the brain will eventually disappear in the species [Carr, 2010]. Neuroscientists predict that the impact of long-time "shallow thinking" may change the brain of future generations, making "deep thinking" unlikely. There are additional studies comparing Internet reading habits and paper-based reading habits [Loan, 2011] [Rich, 2009]. Is technology changing the way the human brain evolves?

8. Digital Divide

The digital divide is defined as "the gap between individuals, households, businesses, and geographic areas at different socio-economic levels with regard to their opportunities to access information and communication technologies and their use of the Internet" [Pascal, 2001]. This divide becomes more important as a great deal of information, including current events, is only available digitally. Students perceive this as a cultural or international issue, extending only to countries or entire regions. In some cases, a digital divide exists in their own country or neighborhood. When assignments in K-12 classes involve a computer, some may not have access or limited access. Libraries are now more computers than books, however, there are often long waiting lines and limited hours of operation, creating local digital-divides.

In order to evaluate the impact of these examples, students should base their decisions on valid data and accurately presented research. Some of the questions to ask include these: What are the anticipated/desirable consequences and what are the unanticipated/undesirable consequences of the technology? Who will the technology impact? Are individuals impacted, or society as a whole? How are they impacted? What population is impacted and where is that population located?

The issues in the examples are appropriate for in-class discussion and research, however, today's typical millennial students are experiential or active learners [Bart, 2011] and therefore, some exercises are provided.

III. Class Exercises

In this section the question addressed is: how can university professors incorporate this material into the CIS curriculum for students who are studying to be future information technology workers? We have already witnessed, starting over twenty years ago, a movement among university professors worldwide to incorporate studies of "societal and ethical issues" into the classroom. Almost every curriculum model in the computing and information technology

discipline has adopted these issues, along with several of the evaluation bodies that accredit university programs. Similarly, these technology concerns should be incorporated into the CIS curriculum. Provided are a few examples in CIS core courses identified in IS2010 [Topi et al., 2010].

Survey Course/Foundations of Information Systems

Almost every school has a required Information Systems survey course. Students believe that because they use mobile communications, they know everything about technology and there is nothing new or different for them to study. They often do not realize how reliant they are on technology. One assignment [Belanger and VanSlyke, 2011] to demonstrate how technology permeates their lives would be for them to exist for four hours without using *any* technology. By technology, it is meant not only the obvious mobile communications and computers, but also the embedded transit card, meal card, telephone system, etc. During the four hours of abstinence from technology, they would take notes (without their technology) and, after four hours, prepare a short paper reflecting on what they did during that period (not sleeping) and what they learned about themselves and technology.

Lair [2012] argues that we have more technology than we need. He recommends a "mapping out' of digital life and provides a template for students to evaluate their own 'digital life'. The students may learn that they have more technology than they need, and decide to eliminate some of the clutter.

Human-Computer Interaction (HCI)

One of the newer major topics in HCI is refining search engines. With the expansion of the Internet and the availability of more and more "hits," using a search engine often provides too many, often irrelevant, answers. However, at least eight-eight percent [Grimes & Boening, 2001] of students rely on the Internet for answers to their research questions, homework and papers. Given the study is over twelve years old, the percentage is probably higher today. Using a technique from Matheus [2010], generate five to ten questions to be answered using the Internet and then using the textbook. The questions may be from the test-bank or from ends of chapters, where the authors of the book have selected significant topics and generated appropriate answers. As students search, they record their time and answers, and the Internet sites visited. Their answers are then compared to the 'appropriate textbook answers'. The students are able to critique their findings and the search engine, along with the search terms that they used.

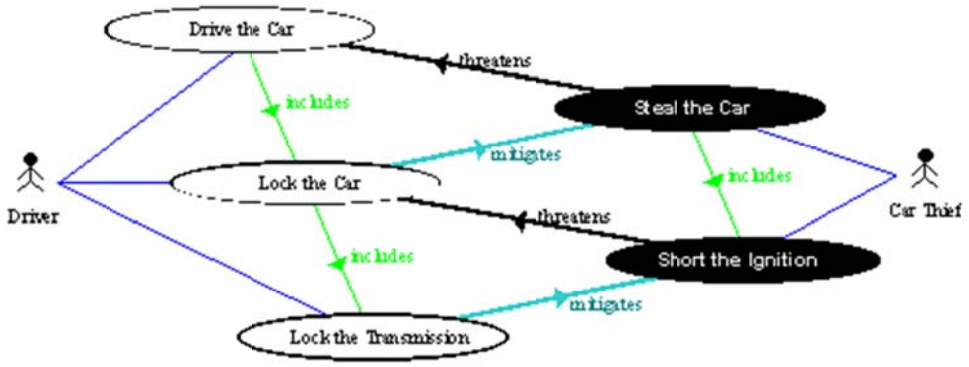
Another exercise, concerning designing for disabilities, is a report from Mason [2001]. It provides an excellent case of screen design that was unusable for color-blind users. The report can be incorporated into a discussion of screen designs that will be compliant with Section 508 of the United States Rehabilitation Act.

Database/Data Warehousing/Data Mining

The quality and quantity of data that is collected cannot be over-emphasized, however, creating this urgency in students is often very difficult. This data is being stored in data warehouses and being mined for security and marketing purposes. Have half the class search for liberal political articles, and the other half for conservative. After several days, using the same key-words, have them report on the new articles retrieved. Do both sides retrieve the same articles? This exercise generates a great deal of discussion about the quality and bias of data retrieved. Additionally, in the initial search and the final search, the students explore what percentage of the data was pertinent and how much time was spent going through irrelevant material.

Systems Analysis and Design

Misuse cases are appropriate for both a security class and a systems analysis and design class. They are used to determine security requirements, and can determine specific system threats or on-going, recurring threats [Alexander, 2003]. Often students are asked to develop use-cases, however, the downside of the process is often ignored. Using use-case diagrams, this assignment requires a simple use-case and its related misuse-case. Alexander [2003] provides an obvious misuse-case:



Use Cases for 'Car Security'

Using this example, when students develop use-cases for their project, they are also aware of the potential threats to the individual processes of the system. When security is incorporated into the system development process, the resulting system will be of higher security quality.

Telecomm/IT Infrastructure

The telecomm course addresses the required hardware and software, including the use of wired as well as wireless channels, complications of encryption, and issues concerning regulations. Even more interesting are the policies that regulate the industry. As students, most do not read their universities' telecommunication policies. As analysts, they will be required to understand and follow the applicable telecommunication legislation. Multi-national organizations must deal with cross-border telecommunication regulations. This exercise requires students to compare/contrast three international telecommunication policies. After reading the policies, they incorporate the standards and create their 'own' policy.

IV. Discussion and Conclusion

In order to create an awareness of the potential unanticipated/undesirable consequences of technology, this paper provides some examples and exercises to incorporate into the CIS curriculum. At the same time, faculty should not be naysayers, but should assist students in drawing their own conclusions. Too often, if they have not experienced a misadventure generated by technology misuse, they are blissfully unaware that the potential for a downside may exist.

If there are unanticipated/undesirable consequences to technology, they may affect individuals instantly or over various time periods. Time is an important component: over what period of time does the change occur? Some of these unanticipated/undesirable consequences of technology may affect individuals, organizations or nationalities. Perhaps enabling future technology developers to anticipate change and consequences may enable informed analysis, adjustment and decisions by individuals or organizations.

Organization attempt to predict, control or limit legal and physical consequences of industrial products on the environment and society. Almost every organization has legal counsel to analyze and prevent liability. The organization may also have environmental scientists responsible for adhering to environmental regulations. Currently no assessment exists for a similar impact analysis of software, hardware or Internet usage, especially with the creating of new products and systems. Now that there may be unanticipated/undesirable consequences of technology, it may be appropriate for organization to have staff to assess the impact of technology. Eventually, similar to the Environment Protection Agency (EPA) in the United States, there may be a need for national regulation of technologies. If we can incorporate an awareness of the unanticipated/undesirable consequences of technology into the CIS students, the future developers and users, they will be able to contribute to the assessment. It is difficult to avoid technology, but it may be to control its use.

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