Ethics and Artifacts

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Introduction

Engineers design stuff. And some of this stuff—cell phones, microwave ovens, automobiles—is part and parcel of our lives. We can hardly imagine life without technology, all products of engineering ingenuity. But is technology merely a tool or a representation of social, political, and ethical values? Do our artifacts reflect culture or help to create it? Or do technologies do both?

This paper explores the latter proposition: that artifacts clearly reflect values, and, as they are absorbed into the culture, contribute to changing societal norms. Langdon Winner examined this argument in his seminal 1986 *The Whale and the Reactor*. As Winner notes, the meaning of technology extends beyond simple usage; technologies play a role in reshaping that activity and hence changing its meaning.[1] This echoes a sentiment expressed two decades earlier by Marshall McLuhan, that our tools reshape who we are as humans. The relationship is reciprocal: we shape our tools and they, in turn, shape us.[2]

If technological artifacts are indeed value-laden and shape cultural mores, this has significant repercussions for engineering educators. Our students cannot design in a vacuum; they must consider how that particular item will reshape its users and how the values implicit in that object reflect a particular world view. Specifically, this paper examines theory, cases (one historical and one contemporary), and classroom integration.

Ethics is inherent in this topic, as each new technological invention is a triple-edged sword, with benefits, disadvantages, and unintended consequences. As budding engineers, our students must learn about designing for factors beyond simple usage.

Theory

We live in a technological cocoon dominated by gizmos and gadgets. Whereas in the past "technology" referred to specific devices, the predominance of technology in our lives indicates that it is more an environment; it is a ubiquitous presence, that provides the context for our existence.[3] On an average day, most, if not all, of our interactions involve some variant of technology, whether it's driving to work, using an elevator, or sipping from a water bottle.

During the initial explosion of consumer technology, technology as social progress was a "fundamental belief," continuing a perspective advanced during the Enlightenment. "Science is progressive," Thomas Jefferson declared in a letter to John Adams.[4] In the early 19th century, the view shifted to technocracy, the belief that "scientific and technological innovation [is] the basis for general progress,"[4] as epitomized in the mass production system introduced by Henry Ford. In the past few decades, however, the belief that technological progress more or less guarantees social progress has been questioned, as has the notion that technology itself is value-free.

According to philosopher Eric Katz, "Perhaps the oldest commonplace about the nature of technology is that technological artifacts are inherently neutral or value-free. Humans create technological objects for a specific range of purposes, but the actual use of the technology is subject to the intentions of the user."[5] A serious debate crystallized after the explosion of the atomic bomb, an action that psychologically leveled Manhattan Project civilian director J. Robert Oppenheimer and stunned others involved in its creation; Monsanto's Charles Thomas, for example, expressed grave concern after the Trinity test: "It is safe to say that nothing as terrible has been made by man before"; "The strong, sustained, awesome roar . . . warned of doomsday and made us feel that we puny things were blasphemous" remarked Thomas Farrell, the project's military deputy commander.[6] And novelist Joseph Kanon explained, "This was the real secret. Annihilation. Nothing else. . . . Now we would always be frightened."[7] Clearly, the bomb is not a "neutral" object; its only function is mass destruction. In fact, every technological artifact, be it a toothbrush or an ICBM missile, is designed for a purpose, an intent, and "purpose implies a value; there are no neutral purposes."[8]

Still, the concept of technological neutrality persisted; General David Sarnoff, a radio pioneer, received an honorary degree from the University of Notre Dame in 1955[9] and noted in his acceptance speech, "We are too prone to make technological instruments the scapegoats for the sins of those who wield them. The products of modern science are not in themselves good or bad; it is the way they are used that determines its [sic] value."[2]

Similarly, Simon Ramo, a founding member of the National Academy of Engineering, argues, "Surely everyone understands that science and technology are mere tools for civilized man,"[10] and Norm Chomsky has stated, "technology is basically neutral. It's like a hammer. The hammer doesn't care whether you use it to build a house or whether on torture, using it to crush somebody's skull, the hammer can do either."[11] Norman Balabanian characterizes those who espouse similar ideas, including Samuel Florman and Peter Drucker, as "happy technologists."[12]

The notion that technology is neutral suggests a separation between the artifact and its creator. Engineers, in particular, are perhaps more object-oriented than people-oriented, more susceptible to a sense of compartmentalization, which includes an ability to emotionally detach themselves not only from their creations but "from a sense of shared responsibility for the end results of technology."[13] Detachment provides a rationale for how the Manhattan Project scientists could develop an object capable of killing hundreds of thousands of people and how Nazi engineers could focus so intently on the creation of technology that destroyed millions during World War II. But separation of creator and creation does not provide an explanation for the view that technology itself is neutral, that morality is only apparent with use: a pen, for example, can be used for good (writing) or evil (a weapon). According to this argument, the artifact itself has no inherent value, and morality only emerges with use.

In the 1960s, University of Toronto professor and media theorist Marshall McLuhan wrote a great deal about the interaction of media and humans. For McLuhan, a "medium" is anything that transmits information; a light bulb, for example, is a medium that transmits information in the form of light. "Media" and "technology" are synonymous.[2]

McLuhan provides a convincing theoretical counter to the separation argument: all media, he declares, are "extension[s] of man": the hammer is an extension of the hand, eyeglasses an extension of the eyes, the wheel an extension of the foot.[14] Thus media are not separate from their creators but intimately intertwined. And if media/technologies are physical extensions of people, it follows that they may also embody other human characteristics, such as ethics and values. Furthermore, the user has only limited choice for using a particular technological artifact, as each has a built-in bias. According to social critic Neil Postman, "It has within its physical form a predisposition toward being used in certain ways and not others."[15] Each medium "massages"—and hence changes—the information that flows through it.[2] "The medium," McLuhan famously declared, "is the message."[14]

In 1980, Langdon Winner asked a simple question: do artifacts have politics? Other questions follow: Do the products of technology embody ethical values? How do those values affect society?[16] Others have advanced similar arguments for the non-neutrality of technology, noting historical roots. In his examination of the British textile industry during the Industrial Revolution, for example, David Dickson explains that "technological innovation was not so much determined by a concern for production efficiency, as it was a management tactic to maintain fragmentation of workers, authoritarian forms of discipline, hierarchical structure, and regimentation,"[12] offering an example of Postman's provocative comment, "Only those who know nothing of the history of technology believe that a technology is entirely neutral;"[15] Mark Sentesy, Pennsylvania State University, notes, "Technologies emerge from specific forms of civilization, so the values that belong to this civilization are exactly the values responsible for the existence of its technology."[17] In other words, because no technology is separate from the society in which it occurs, it naturally reflects the values of that society and, in fact, may create those values.

Winner notes a change in the way technology drives society that he traces to the 1950s, during that postwar boom when consumers were mad for products denied them by the war, when technology was still equated with progress. Rather than consumers needing products, the reverse occurred and products needed consumers: "The pattern . . . was certainly not one of tailoring technology to human needs. Instead, the practice was that of renovating human needs to match what modern science and engineering happened to make available."[1] The change was so gradual that we hardly noticed it.

At the same time, change can have been devastating societal consequences: "New technologies alter the structure of our interests, the things we think *about*. They alter the character of our symbols, the things we think *with*. And they alter the nature of community, the area in which thoughts develop."[18] Henry Ford's invention and marketing of an affordable automobile serves as a convenient example: not only did it transform the US into an asphalt tapestry, it fundamentally changed how we think about time and distance, how we cohabit space with other creatures, and how we view the planet's resources. In short, it dramatically changed society and our values; it changed ***who we are***.

Cases

While theories about technology are interesting and intellectually stimulating, engineering and technology students tend to be more practically minded and seem to resonate better to applications of abstraction, specifically in the form of cases. And cases, of course, have been a major pedagogical technique for at least two centuries.[19] The following cases focus on artifacts developed by engineers; each illustrates the non-neutrality of technology and reflects common themes of societal change.

IBM's Mechanical Tabulator

When Herman Hollerith, a US Census Bureau employee, invented a mechanical tabulator in 1890 in response to a bureau contest,[20] he focused on speed and efficiency, qualities absent in the bureau's antiquated hand tabulation. As a census tool, the tabulator allowed the bureau to maintain current information about the United States' burgeoning population. Recognizing the potential worth of data processing technology, Hollerith incorporated the Tabulating Machine Company in 1896 and 15 years later merged with two other firms to become the Computing-Tabulating-Recording Company. In 1914, Hollerith stepped aside and appointed a topnotch, charismatic salesman from National Cash Register, Thomas J. Watson, as general manager. After a number of modifications, the company emerged as International Business Machines Corporation in 1924, with an enlarged perspective on marketing.[20]

The Hollerith system is familiar to anyone who studied engineering and technology prior to the development of the personal computer: operators entered data on columned punch cards, which were fed into a tabulator. Brushes on the tabulator "read" the data and produced the results in seconds. Hollerith's machine exceeded the Census Bureau's wildest dreams, reducing tabulation time from 10 years to three months and saving taxpayers more than $5 million.[21] While the original machine used only punch cards designed for the 1890 census, subsequent versions featured key punches and automatic card feeders, allowing for a degree of versatility.[21]

While Hollerith provided the creative impetus and requisite engineering skills, it was Watson who brought the company to new heights, marketing IBM's products internationally and creating subsidiary companies overseas. Watson's combination of business acumen, charisma, and a decidedly autocratic bent propelled IBM to become one of the world's largest businesses and created a distinct culture within the company: meetings were run revival style, and the IBM Youth Club, open to children as young as three, inculcated corporate values.[20] In 1938, the company introduced the IBM anthem, "Hail to the IBM," which praised the virtues of its leader, as the verse below illustrates:

> Our voices swell in admiration;
> Of T. J. Watson proudly sing;
> He'll ever be our inspiration,
> To him our voices loudly ring;
> The I.B.M. will sing the praises,
> Of him who brought us world acclaim,

As the volume of our chorus raises,
Hail to his honored name.[22]

"World acclaim," however, was the direct result of Watson's ruthless business practices, which emerged during his time at NCR; Watson's job was to quash competition. To do so, "he adopted the tactics of the robber barons to set up a monopoly by using predatory pricing, threats of lawsuits, bribes and even smashed storefronts." In return for his efforts, he was found guilty in 1912 of "criminal conspiracy to restrain trade,"[23] although charges were later dropped on appeal,[24] and Watson moved to the then-fledgling IBM.

IBM's German subsidiary, Dehomag, was originally established as an independent company in 1910; World War I, however, had a deleterious effect on business, and Dehomag did not prosper until its affiliation with IBM.[25] The IBM approach was rather cunning and emphasized dependency. The company did not sell its machines to international subsidiaries; instead, it leased them and required use of IBM punch cards,[20] which kept the mother company's coffers overflowing with revenues. Dehomag alone used more than 1.5 billion punch cards annually for its 2,000 IBM machines.[20] The German state even installed them in concentration camps such as Dachau, which housed 24 assorted tabulators, sorters, and printers. In fact, Germany possessed the most sophisticated data processing equipment in Europe.[26]

In 1933, German statisticians launched the country's most complete census to date; an army of 500,000 pollsters queried the German population, including questions for women regarding their marriage date and number of children, intended, according to Luebke and Milton, "to guide 'positive eugenic' policies designed to promote the fecundity of 'racially superior,' 'Aryan' women."[27] Data were transferred to punch cards and then fed to the Hollerith machines, producing a profile of the German population.

Analysis of these data, however, revealed certain inaccuracies and gaps, attributable to ambiguous questions. In 1939, another census attempted to correct these deficiencies, particularly incomplete data concerning Jews. This time, the Germans were successful in identifying racial Jews in addition to observant Jews, recognizing an additional 240,000 non-practitioners and 115,000 *mischlinge* ("mixed blood"), as well as sorting out the Roma, whom the prior census had merely indicated as "Christian." Using the census data, German functionaries developed an "Ethnic Catalog" of non-Aryans residing in the state.[27] In addition, they identified residents' skills, and, more important, property and Jewish-owned businesses, yielding a total value of about 7,050 billion Reichsmarks,[28] a contemporary value of about $39 billion. They even counted cows in the fields,[20] which might be used to feed starving soldiers should be the war turn against Germany. The number of punch cards from the 1939 census filled 70 freight cars, requiring the Reich Office of Statistics to hire thousands of employees to process the information.[29]

After 1939, the technology was used to catalog the population of occupied territories, including Austria, Moravia and Bohemia, Poland, Vichy France, the Netherlands, and Belgium.[27] In the same year, IBM established a Polish subsidiary, Watson Business Machines, in Warsaw, to oversee the German "rape" of Poland.[30]

Data processing technology vastly simplified the identification process. Prior to automation, multiple offices were duplicating efforts; for example, the Racial Policy Bureau was registering all “aliens” residing in the state, the Reich Office for Genealogical Research was busy establishing a “racial pedigree” for each Aryan while Berlin’s Protestant churches were engaged in a similar enterprise, the Reich Health Office was developing a list of those who displayed signs of genetic diseases, and two offices, the Reich Central Office for the Fight against the Gypsy Plague and the Eugenics and Demographics Biology Research Unit, were cataloging the Roma.[27] Performing various sorts with the machines could produce results very quickly, avoid arduous manual counting and sorting efforts, and eliminate the numerous copies of forms sent to various offices.

Whether or not machine-produced data were used for deportations to the death camps is debatable. Luebke and Milton, writing in 1994, speculate that the data gleaned from the 1939 census were too dated for scheduling mass deportations occurring in the 1940s. Adolf Eichmann, head of Department IVB4 (Office of Jewish Affairs), noted the “insufficiency” of available data for developing deportation lists and resorted to using census data plus information from police registrations and the *Judenkartei* (registration cards) that each Jew was required to complete.[27]

However, more recent information reported by Edwin Black reveals that “temporary” censuses occurred on a regular basis in the Polish ghettos, with information collected at an enormous data center in Kraków, center of Nazi operations in Poland. Data manipulation was so sophisticated that statisticians could accurately report Jews per square mile of land, “with projections of decrease from forced labor and starvation,” and keep track of all available food, to calculate appropriate caloric intake for various ethnic groups.[30]

IBM machines were also used in the camps to catalog the prisoners, who had their data processing numbers tattooed on their forearms. Each camp had a special code, as did the “treatment” proposed and the status of the inmate; for example, a Jewish prisoner destined for death in the gas chambers of Auschwitz would have the codes 8, 6, and 001.[31]

The newly discovered documents include a memo written by employee Harold Carter that was generated during a federal investigation of IBM for trading with the enemy: “What Hitler has done to us through his economic warfare, one of our own American corporations has also done . . . . Hence IBM is in a class with the Nazis. . . . The entire world citizenry is hampered by an international monster.”[32] A 1941 memo to the State Department regarding a visit by IBM employee Harrison Chauncey notes his fears “that his company may some day be blamed for cooperating with the Germans.”[31] Despite significant publicity generated by the 2002 publication of Edwin Black’s encyclopedic, document-based *IBM and the Holocaust*, the company has never acknowledged its role.

IBM headquarters in New York was aware of German usage of its machines. Not only was it responsible for maintenance, but punch cards were not interchangeable. IBM engineers specially designed them for each individual task, “to capture the information going in, but also to tabulate the information the Nazis wanted to come out.”[33] The cards could be designed, for example, with columns for “Jew, Polish language, Polish nationality, the fur trade as an occupation, Berlin,” allowing the Nazis to pinpoint specific sectors of the Jewish population in a given country or city.[30] They could also distinguish “between a Jew who had been worked to death and one who had been gassed.”[31]

Furthermore, Watson frequently visited Germany between 1933 and 1939,[30] and in 1937, he met with Hitler to receive the Merit Cross of the German Eagle with Star for “service to the Reich.”[34] Although he acquiesced to public pressure three years later and returned it,[20] the fact that he qualified for such an award indicates the value Nazis placed on IBM’s contributions to their cause. In addition to receiving frequent detailed reports from his representatives in Germany and occupied territories, Watson personally approved expenditures for German facilities, including a bunker for the Hollerith machines located at Dachau for which IBM footed the bill; his approval was necessary “because he received a one-percent commission on all Nazi business profits.”[31]

The Holocaust certainly would have happened without IBM technology, due simply to dogged German determination to achieve a Jew-free Europe, but the tabulators resulted in accelerating the event: in Holland, which extensively used mechanical counting, 73% of the Jewish population was identified and deported, first to the Westerbork transit camp and then to the Polish death camps; in France, however, where the technology was less pervasive, only 23% suffered a similar fate.[26]

The Holocaust is a truly shameful time in human history and not only because of genocide. It was the state orchestration of that genocide that marks it as a unique occurrence, one enabled by the complicity of the professional classes, chief among them engineers. While it is relatively easy to pinpoint individual engineers such as Kurt Prüfer, the “wizard of cremation” at Topf und Söhne who designed crematoria ovens to be used only for mass disposition of human bodies,[35] the IBM engineers who designed the punch cards that cataloged the Jewish population of Europe played a pivotal role.

Furthermore, the machines themselves aptly illustrate Winner’s thesis that artifacts embody politics; Hollerith machines, working in concert with other extermination technology, could identify and eliminate all 11 million Jews from the planet within a year, according to Eichmann’s calculations.[36] In doing so, the technology directly supported Nazi ideology and dramatically reshaped the culture.

The Internet

Historical engineering cases have the distinct value of acquainting our students with the profession’s past. In our own time, however, we are experiencing a communications technology that is radically transforming our culture and ourselves: the Internet. Initial Internet development began in the 1960s, with “packet switching” and the ARPANET, and focused on time and information sharing. Efforts, however, were hampered by a lack of common technical specifications.[37] By the 1970s, the advent of transmission control protocol/Internet protocol allowed for more direct communications, and email first appeared.[38] The 1980s witnessed the advent of the Ethernet, which greatly simplified local area networking,[39] and the introduction of the World Wide Web.[40] By 1994, the development of user-friendly software, such as Mosaic and

Netscape, made the Web more accessible; some 11 million households in the US were "equipped to ride the information superhighway."[40] And the rest is history that we are currently experiencing; we can even carry the Internet with us, as the technology has spread to mobile devices to ensure constant connectivity.

For perhaps the first time in history, a technology has seeped into every crevice of our existence: we can use it for work, ordering food, leisure time activities, education, and entertainment. The world's museums lie literally at our fingertips. We can communicate with anyone, anywhere, anytime. We can record every minute with our lives and share it worldwide; and we can watch others doing the same. "Humanity is gripped," a pre-Internet Langdon Winner suggests, "by sheer technological driven-ness, perhaps more fully than ever before. . . ."[41]

In the three decades since that remark, "driven-ness" has turned into obsession, as evidenced by staggering statistics: for 2017, estimates project 4.77 billion cell/smartphone users worldwide,[42] with more than 3.5 billion Internet users, nearly 47% of the world's population.[43] In the US alone, 92% of the population owns a cell or smartphone, and 73% owns a computer or laptop.[44] We are wired as never before.

Statistics regarding social media usage are equally daunting; about 23% of the world's population regularly interacts via social media, which includes Facebook (approaching 2 billion), WhatsApp & Facebook Messenger (1 billion each), Instagram (600 million), Tumblr (550 million), and Twitter (313 million).[45] While these numbers are overwhelming, they pale in comparison to the actual size of the Internet: in 2015, ABC News estimated the total number of pages at 4.54 billion or the paper equivalent of 16 million trees.[46] As of January 2017, it has grown to 4.77 billion indexed pages; this number does not include sites in the Deep Web.[47] The remainder of this section will examine just one small aspect of the Internet: information filtering.

"Filter bubble" is a phrase coined by Eli Pariser, in his 2011 book of the same title; the subtitle, however, is more intriguing: *What the Internet Is Hiding from You*.[48] Pariser examines search giant Google and its retrieval methodology. He conducted a simple experiment, asking two friends of similar background and gender to google "BP." One received a list of websites dealing with investment strategies, while the other search produced information on the Deepwater Horizon spill. Even the number of websites differed.[48] The era of personalization hadarrived; starting in December 2009, content is no longer universally available and is customized for the individual user. As the Google website explains, "You want the answer, not trillions of webpages. Algorithms are computer programs that look for clues to give you back exactly what you want."[49]

Researchers, however, do not necessarily know what they want. The act of research implies collecting information from a variety of sources that present multiple perspectives, sifting through it, and developing a thesis. But Google's search regimen does not allow for that approach. When Pariser wrote his book in 2011, Google used 57 search "signals"; it now uses 200.[49] A user's search results list depends on factors relating to prior behavior and logistics (history, reading level, click through rate, location, etc.) and a whole host of design and content issues unrelated to the actual information on a site: loading time, links (number of internal, live or broken), URL length, PageRank standing, page formatting (Google likes bulleted and numbered lists), positive feedback from Facebook, Twitter, Pinterest. Google favors sites that include links to other Google-owned entities, particularly Chrome and YouTube; it dislikes sites with "content [that] provides value and unique insights."[50] Current efforts focus on mobile applications.[51]

PageRank is Google's method for judging the relative importance of a site based on the number and quality of internal links. Developed in 1996 by Google founders Larry Page and Sergey Brin, it is one of three major factors used for determining the location of a site in a results list. It is based on a 1-10 logarithmic scale,[52] with 500 million variables and 2 billion terms,[53] and is susceptible to manipulation.[54] While PageRank is no longer the primary determiner of ranking, it still plays an important role.

Every day, Google processes 40,000 queries a second,[55] with nearly a quarter of a million every minute, 14.4 million every hour. Daily, Google delivers highly filtered information to millions and millions of users, information that serves to confirm perspectives that users already hold, information that Google predicts its users want. But because Google makes the choice, not the user, the result is "cutting us off from dissenting opinion and conflicting points of view."[53] The entire approach is fraught with ethical issues such as autonomy, censorship, informed consent, monitoring, and privacy:[56] it strips users of choice regarding websites to view, displays only websites with "appropriate" content, monitors users' journeys through the Net, and may report and/or share user information with advertisers.[57]

And information filtering currently extends beyond search engines to social media, especially Facebook. There is a minor qualitative difference, however. Whereas with Google, algorithms choose which information users can access, with Facebook, the users serve as a filter by setting certain preferences, choosing who and what to like, and unfriending/unfollowing those expressing offensive opinions. *New York Times* columnist Frank Bruni explains, "We construct precisely contoured echo chambers of affirmation that turn conviction into zeal, passion into fury, disagreements with the other side into the demonization of it."[58]

This does not mean, however, that Facebook postings are free of algorithmic oversight. Given the number of postings an average user receives, about 1,500 weekly, some consideration of how to display that array is necessary. Enter the algorithm, which decides an order based on factors such as users' likes, contact frequency, and worthwhileness.[59] While the Facebook algorithm does not actively censor information, as does its Google counterpart, it relegates those posts of assumed lesser importance/interest to the lower reaches of the list, where most users do not venture.

In 2006, the company introduced a news feed algorithm that brought the world to Facebookers. Currently, 62% of US residents use social media sites for their news, with Facebook chief among them,[60] not knowing that company engineers had decided "decided that their ultimate goal would be to show people all that posts that really matter to them and none of the ones that don't,"[59] an ominous echo of Google's filter bubble. Indeed, according to Facebook data, the algorithm reduces exposure to different views by 8%, more than individual users' choices; sociologist Nathan Jurgenson explains, the "algorithm exacerbates and furthers this filter bubble."[61] Far from being more egalitarian, Facebook is similar to Google in presenting biased information, although it uses the guise of individual choice.

"When ideology drives the dissemination of information," Sue Halpern remarks, "knowledge is compromised."[53] Algorithms designed to judge content appropriateness restrict information to a small sphere of self-confirming perspectives, a filter bubble. Rather than being unbiased, they are written by value-laden humans and "contain many judgments about who we are, who we should become, and how we should live."[62] Furthermore, because algorithms reflect the values of their designers, they "inevitably make biased decisions."[63] Predictive algorithms are particularly troublesome; given sufficient information, people change their minds. But unless they also change their Facebook preferences, the algorithm plods on, providing a one-sided perspective.

Classroom Integration

Integrating cases such as those detailed above into a classroom setting involves creativity on the instructor's part, but the results are worth the effort. Teaching students to recognize the values inherent in the technology that they design will, according to university educator C. A. Bowers, provide "future technology experts a more complex understanding of the cultural and ecological implications they must consider."[64] While examining the ethics of technology is probably included in specialized STS courses, the topic is neglected in general engineering courses.[64]

A quick (filtered) Google search of the topic yields 38 million results, with the first 100 or so listing "ethics of technology" as either a topic in an engineering ethics course, a module in a non-engineering course,[65] a corporate class on the ethics of using technology,[66] or a specialized seminar.[67] Most notably, the University of Twente, The Netherlands, has a Ph.D. program in Ethics and Technology.[68]

Adding a case, such as the IBM mechanical tabulator, in an introductory engineering course can have dramatic effects: not only does it provide a lesson in the history of the engineering profession, but it is a shocking example of the values inherent in a seemingly benign machine. A side benefit is educating students about the involvement of a major US business in the Holocaust; and IBM was just the tip of the iceberg, one of hundreds of American businesses that had ties to the Third Reich.

Including ethics of technology in a design class is a particularly useful activity. Civil engineering students, for example, may view road design as relatively inert, ethically speaking. They tend to focus on technical details, such as roadway structural integrity, asphalt mix, and user safety. Two mini-cases in particular are enlightening: speed bumps and the low-hanging overpasses on the parkways to Jones Beach on Long Island.

Speed bumps seem to fulfill a clear function: to slow down drivers in neighborhoods where speeding might result in injury to pedestrians. However, as Bruno Latour famously noted, that bump is actually imparting a moral message and guiding human behavior: "Slow down before you reach me!" Following the bump's moral dictum might save lives and preserve the vehicle's shock absorbers.[69] In fact, many everyday objects communicate ethical actions, such as a car that won't start until occupants fasten their seatbelts. "When technologies fulfill their functions," Verbeek concludes, "they also help shape the actions of their users."[70]

Low overpasses on the approach to Long Island's Jones Beach communicate a more ominous social message, according to Winner's analysis. With a height of only 9', the 12' city busses would not fit; anyone traveling to the beach had to use an automobile, thus excluding "common" folk. The designer, Robert Moses, included his "social class bias and racial prejudice" into his road design, so only "upper and comfortable middle classes," presumably white, could access the recreational area.[16]

Internet search engines are also a fertile area for classroom exploration; Google provides a useful example of filtering and customization. Having students compare Google search results with those of other engines can be enlightening. For example, duckduckgo.com does not collect information on its users; consequently, users are not besieged by customized ads and pop-ups in the results list, and the engine returns far fewer results than does Google. In a search for "ethics of technology" -wiki, Google returned 182 million hits, which is unsearchable over the course of several lifetimes. Duckduckgo does not give a number of hits, but this user was able to scroll through all of the results rather quickly. Google results are a potpourri, including blogs and specious websites, whereas duckduckgo tended to return items from professional journals, government sites, and ethics centers. Google results probably include these as well, but the user has to slog through sludge to find them, at least in this type of general search.

If students repeat that search using DeepDyve.com, they will receive 149 results, all from peer-reviewed professional publications in a variety of fields: electronics, optics, science, medicine, nanotechnology, philosophy, to name but a few. The only drawback is that DeepDyve is a subscription service, although searches are free. An alternative to paying the $40/month fee is to show students how to copy-and-paste reference information from the search engine to their institution's electronic databases or interlibrary loan forms. Engines like DeepDyve are also ad-free, so they not only save students time but avoid anxiety-producing banners and pop-ups that may deflect concentration.

Engineering classes typically focus on theory and skill development, with, perhaps, with a dose of critical thinking and social implications. Virtually any course, however, also provides opportunities for integrating not just engineering ethics, but the ethics of technology. Class discussions, student activities, papers, research–all can alert students to issues other than usage.

Conclusion

In *You Are Not a Gadget*, Jaron Lanier provocatively suggests, "It takes only a tiny group of engineers to create a technology that can shape the entire future of human experience with incredible speed."[71] One day, our students will complete their degrees, embark on careers, and function as designers of technological artifacts that will affect the rest of us. In many cases, the predominant concern will be to develop an item that has a functional purpose: someone uses it for a specific reason.

But they may not understand that the design process also involves ethics, that technology not only enhances our lives but directs our behavior, that technology reflects not only function but values as well. Quantification is just one part of the design process; ethics completes it. Recognizing the ethics inherent in technology helps that "tiny group of engineers" design for the good of human experience, creating objects that reflect positive values and enhance the future of people and planet. As Sabine Roeser states, "Forward-looking responsibility and the emotions that are involved with it are especially important in the context of the moral responsibility of engineers in the design of technology, as design is concerned with things that are yet to come."[72]

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Paper ID #17689 Ethics and Artifacts Dr. Marilyn A. Dyrud, Oregon Institute of Technology Marilyn Dyrud is a full professor in the Communication Department at Oregon Institute of Technology, where she has taught for nearly four decades. She has been a member of ASEE for 32 years and is active in the Engineering Ethics Division, as past chair, and the Engineering Technology Division, as communi- cations editor the the Journal of Engineering Technology. Start studying ENGR 482 - Ethics & Artifacts. Learn vocabulary, terms and more with flashcards, games and other study tools.Â "Morality is inside the things." Bombs and other technological artifacts DO have moral properties. Dissatisfied with the philosophical tradition that holds subject and object to be radically different. The Moderate View. Intermediate between the common sense view and the strong view.