The ethical imperative in engineering education

A reflection on some of the moral lessons of the Holocaust

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2

> "The whole question comes down to this:
> can the human mind master what
> the human mind has made?"
> Paul Valery[1]

Our era is shaped by the seemingly unstoppable force of technification. We tend to perceive this force as a mostly positive development that has helped the spread of democracy and an unprecedented rise in prosperity around the world. But there are dark sides to technification that we should be aware of and make our students cognizant about. As we shall discuss below, study of the Nazi Holocaust can shed light into this force that currently shape our life in the economics, cultural and political realms.

There are dark sides to technification

From a technological point of view, the Holocaust is a historical paradigm. The genocides against the Armenians of Turkey and the Tootsies of Rwanda were conducted in a few weeks or months. The killings in Cambodia were concentrated in a single country as it was the case with the many victims of the "Dirty War" in Argentina or the ethnic cleansing campaigns in the Balkans. The Holocaust was an industrial-scale endeavor. Persecutions and killings took place over several years, across tens of different countries and regions with different languages and cultures. Millions of victims had to be tracked, deceived, rounded up, transported, killed and their belongings and bodies disposed of. Hundreds of thousands of perpetrators had to be selected, trained and supervised to execute orderly and efficiently the most savage of tasks. All this could not have been carried out without extensive use of the best technological knowledge and machinery available at the time.

Technology was indeed used in an unprecedented scale in the pursuit of the Final Solution. Chimneys, trains and high-technology chemicals, the very metaphors for the first and second industrial revolutions were the backbone of the Holocaust, which made extensive use of the best transport systems of the world at the time and state-of-the-art chemicals. At the Treblinka death camp, for example, almost 900.000 people were killed by a staff of only 120 over eighteen months[2] (p.111). The Nazi regime was even a pioneer in the use of technologies of the third industrial revolution by utilizing the latest computer technologies of the time[3], with the full knowledge and collaboration of the IBM company. The IBM Hollerith machine was used to manage census data, information on conscript labor and compile deportation lists[4] (p.110). The Nazi regime was also a heavy user of the existing electronic media for political propaganda. Powerful radio networks and documentaries and motion pictures produced by some of the top talents in Europe were used to promote their cause.

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1   Quoted in Winner, L. (1977). *Autonomous Technology: technics-out-of-control as a theme in political thought.* Cambridge, United State: MIT Press, p.13.
2   Stier, O.B. (2003). *Committed to memory: cultural mediations of the Holocaust.* Boston: MIT Press.
3   Leventhal, R. (1995). Information and Technology in the Holocaust. In *Responses to the Holocaust: a hypermedia source-book for the humanities.* Available from http://www2.iath.virginia.edu/holocaust/infotech.html. Internet; accessed 31 March 2011.
4   Stier, O.B. (2003). *Committed to memory: cultural mediations of the Holocaust.* Boston: MIT Press.

3

Some authors have argued that technology, as an embodiment of modernity, was more than an instrument of the Holocaust, it was its essence. One of the main referents in this line of thought is Zigmunt Bauman who famously stated that "…The Nazi mass murder of the European Jewry was (…) the technological achievement of an industrial society…"[5] (p.481). According to Bauman, "…the Holocaust is … related to the ability of modern bureaucracy to co-ordinate the action of great number of moral individuals in the pursuit of immoral ends…"[6] (p.18). These authors argue that after the Holocaust we must look at the impact of technology on society in different ways. According to Gernot Böhme, after the Holocaust technology can no longer be seen as a means for efficiently attaining pre-established ends. Rather, it must be seen as a total structure which makes new forms of human action and human relationship possible, while limiting the possibilities of others[7]. Similarly, Jacques Ellul has argued that technology becomes its own *raison d'être* and both a means and an end in itself[8]. Steven Katz calls this overpowering role of technology in society an "ethic of expediency" since "the only ethical criterion necessary is the … movement toward the technical goal to be achieved"[9] (p.266), irrespective of the human and social costs involved. In his seminal essay on education after Auschwitz Adorno warned that:

> **"…A world where technology occupies such a key position as it does nowadays produces technological people, … there is something exaggerated, irrational, pathogenic in the present-day relationship to technology… People are inclined to take technology … as an end in itself… The means … are fetishized, because the ends—a life of human dignity—are concealed and removed from the consciousness of people… It is by no means clear precisely how the fetishization of technology establishes itself within the individual psychology of particular people, or where the threshold lies between a rational relationship to technology and the over-valuation that finally leads to the point where one who cleverly devises a train system that brings the victims to Auschwitz…"[10] (p.200).**

One of those social mechanisms that might lead otherwise rational people to criminal behavior is the removal of the individual from the actual physical harming action. Only a few individuals might be capable of killing another human being, especially a defenseless child. However, when killing is the result of organized action where the concurrence of many are needed to produce the result and when our actions are physically far removed from their consequences, personal responsibility is diluted, moral dilemmas are avoided and challenges to one´s own religious or cultural beliefs are bypassed. As Bauman warned, killing from a distance and as a part of a large and hierarchical chain of production "…increases the physical and or psychic distance between the act and its consequences and achieves … the suspension of moral inhibition … quashes the moral significance of the act…"[11] (p.492). This process of physical, psychological and moral estrangement between violent acts and their consequences has been constantly increasing since the Holocaust. Think for example of guided missiles, biological weapons, armed drones or cyber warfare.

5   Bauman, Z. (December, 1988). Sociology after the Holocaust. *The British Journal of Sociology*, *39*(4), pp.469-497.
6   Bauman, Z. (1989). *Modernity and the Holocaust*. Ithaca, New York. Cornell University Press.
7   Böhme, G. (2012). *Invasive technification: critical essays in the philosophy of technology*. London: Bloomsbury Academic.
8   Ellul, J. (1964). *The technological society*. New York: Knopf.
9   Katz, S. (March, 1992). The ethic of expediency: classical rhetoric, technology, and the Holocaust. *College English*, *54*(3), pp. 255-275.
10   Adorno, T. W. (2005). *Critical models: interventions and catchwords*. New York: Columbia University Press.
11   Bauman, Z. (December, 1988). Sociology after the Holocaust. *The British Journal of Sociology*, *39*(4), pp.469-497.

These authors´ warnings about the potential dangers underlying technification are relevant because technification is not really optional. The only way to achieve sustainable growth is through technological innovation. New technologies always carry the potential to do harm. The internet, home of Wikipedia and the Khan free video education library, is at the same time a platform for hate speech, child pornography and the recruitment of jihadists. Mobile phones enable us to be in touch with our kids, call for road assistance and find out about flight delays, but at the same time, they are used as bomb detonators. Nuclear energy can light and heat but can (and has) produced large-scale devastation by error, accident or design. What downsides should we fear of genetic engineering, human cloning, synthetic life, transgenic food, self driving cars or autonomous armed drones?

Inventions cannot be dis-invented. Once something is invented, dissemination control is very complex and costly as international efforts to curb nuclear proliferation attest. So, if technological development carries an inherent potential for evil; can we trust the educated elites to ensure the responsible and ethical use of their creations? Are we sure that all our students will use their knowledge in an ethical way? Unfortunately history shows us this is not the case. The Holocaust is the prime exhibit of a technology-driven society that lost its moral compass.

Teaching the ethics of technology

This must lead us to revise whether and how we teach about the ethical implications of technology design and use, alongside the technical and business issues that we currently focus on. Teaching of technology should be shaped by moral and ethical values. Students who are immersed in a highly advanced age of technology should discover that pure rationality and scientific approaches to problems can produce destructive as well as beneficial consequences. We all agree on the power of education, but we should at the same time seek the education of power, meaning the power of the graduates who will be among the societies' elites in this technological era.

A most disturbing conclusion of research into the implementation of the Final Solution has been that given its scale, spread and duration, it amounted to an industrial enterprise that would have been impossible without the long-term, committed participation of thousands of German professionals and scientists, many of them graduates of or professors at some of the best universities. Those professionals developed "racial theories", conducted lethal medical experiments with prisoners, computed complex transport logistics and designed mobile and stationery gas chambers among many other services. According to Konrad Jarausch "…these dedicated (professionals) transformed somewhat haphazard violence into an inescapable process…" and "…though well trained and widely respected, (they) raised few moral objections to their participation in a genocidal regime…"[12] (p.10-11).

All the technologies that made the Holocaust possible were designed and fine-tuned by expert professionals, medical doctors, engineers, architects and others. I.G. Farben operated an experimental chemical laboratory staffed by chemical engineers *within the Auschwitz compound* to fine tune poison gas. Robert-Jan van Pelt's book on the architecture of Auschwitz, documents the detailed involvement of engineers and architects in the design of death camps[13]. As far as their artifacts worked "efficiently", in a certain amoral sense these engineers and architects felt they were "good" professionals.

12   Jarausch, K. (2001). *The conundrum of complicity: German professionals and the final solution*. United States: Konrad H. Jarausch.
13   Dwork, D., & Van Pelt, R. (1996). *Auschwitz: 1270 to the present.* New York: W. W. Norton.

5

Our aim ought to be that graduates are not only good professionals in a technical sense, but also in a moral sense. The crucial question for engineering ethics should be "…How does an engineer know that the values he embodies through his technological products are good values that will lead to a better world?..."[14] (p.571). As Short argued, "…an education system that fails in this respect risks turning out academically well qualified barbarians… For example, in January 1942 half of the Nazi functionaries who gathered at Wansee to organize the murder of European Jewry, possessed doctorates…"[15] (p.282).

The neutrality of technology

Many of the key professionals involved in the Nazi killing explained their behavior after the war adducing the "neutrality of technology". According to this view, technology is morally neutral and any analysis of technological developments must separate design and creation of artifacts from their use. The disturbing moral corollary of this view is that technological professionals are blind to the impact of their products on society (see Winner, 1977 for an in-depth discussion)[16] (p.13). The engineers of Topf, an industrial furnace company which was one of the main contractors in charge of designing and building the extermination camps ovens are a good example. From the perspective of the neutrality of technology those engineers ought to focus solely on the engineering issues problems with little or no regard for the ultimate uses of the artifacts.

These professionals claimed after the war that they were unaware of the ends that their machinery was fulfilling. But, how curious were they? It is well documented that Topf engineers came personally to Birkenau to solve technical problems, such as the cracking of the smokestacks or uneven heat transference. These engineers kept focusing on their technical goals well after they had no choice but to become aware of what their machinery was being used for. Albert Speer, an architect and Minister of Armaments and War Production during the Nazi regime who was in charge of the entire industrial system of Germany during the war is representative of this view of the neutrality of technology. He claimed in his memoirs that he was a pure technocrat unconcerned with ethics or politics and that "…The task I have to fulfill is an unpolitical one. I have felt at ease … so long as my person and my work were evaluated solely by the standard of practical accomplishments…"[17] (p. 112). Speer wanted to appear as what Jack Sammons calls a "Pure Technician", an expert who feels he is not accountable beyond his area of expertise. His technique, he claims, is morally neutral and he is to be judged only "…by whether his means are the most efficient ones toward whatever end is given to him…"[18] (p.125). Speer claimed his only responsibility was to have the trains working on time regardless of their "cargo", and to have the weapons factories delivering their output on time notwithstanding the use of slave labor to achieve their production targets.

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14   Katz, E. (2011). The Nazi engineers: reflections on technological ethics in hell. *Science and Engineering Ethics*, 17, pp.571–582.
15   Short, G. (2003). Lessons of the Holocaust: a response to critics. *Educational Review*, *55*(3)*,* pp.277-287.
16   Winner, L. (1977). *Autonomous technology: technics-out-of-control as a theme in political thought*. Cambridge, United State: MIT Press.
17   Speer, A. (1970). *Inside the Third Reich: memoirs.* New York: Simon and Schuster.
18   Sammons, J. L. (1992). Rebellious ethics and Albert Speer. *Professional Ethics*, *1*(3–4), pp.123-160.

According to Sammons, to be ethical one must rebel against the expectations and practices of one's profession "… we must stand apart from our professional roles in personal moral judgment of them…"[19] (p. 123). As Eric Katz concluded from his research on the work of Nazi engineers, "…it is the task of the ethical technological professional to avoid being captured by the realm of moral neutrality…"[20] (p. 576). This is a powerful statement that resonates well beyond the engineering discipline. A large number of German medical doctors used their expertise to kill or inflict pain, school teachers throughout Germany followed obediently guidelines that singled out and humiliate Jewish students. Chemical engineers used their best knowledge to develop poison gas that they knew had no application as fertilizer or delouser as it was at times euphemistically called.

Conclusions

Two points may be highlighted as way of conclusion from the previous discussion. The first one is that in our technologically-driven era the stance that the creation of technological artifacts is ethically neutral, and that only the use of these artifacts should bear judgment, is inadequate. This will be increasingly so as technological developments weave themselves ever more closely into human life (into clothing, bodies and genes, and eventually human minds). Winner has persuasively refuted the view of technological neutrality by casting doubt on the separation of the "making" and the "use" of technological artifacts. The technology of the Nazi regime illustrates powerfully Winner's thesis that artifacts embody political and social values. In his view, technological artifacts are "forms of life" which become embedded in and reshape human life. Although Winner stated this view 25 years ago, it rings very true in our current experience of lives and relations altered (not always for the better) by mobile phones, GPS enabled-devices, 24/7 connectivity, DNA traceability, global supply chains, computer viruses or killer drones. As Winner concluded: "…As they become woven into the texture of everyday existence, the devices, techniques, and systems we adopt shed their tool-like qualities to become part of our very humanity…"[21] (p. 12). His eloquent summary was "artifacts have politics". Eric Katz similarly concurs that "…Once we realize that technologies alter human life we will see that they are not neutral tools but value-laden systems…"[22] (p. 580).

The second conclusion is that study of the Holocaust is an invaluable resource to help understand and teach the ethical dimensions of professional work because it illustrates the lethal extremes to which amoral professional conduct can lead, transforming whole communities into victims or perpetrators. As Bauman expressed:

19 Sammons, J. L. (1992). Rebellious ethics and Albert Speer. *Professional Ethics*, *1*(3–4), pp.123-160.
20 Katz, E. (2011). The Nazi engineers: reflections on technological ethics in hell,. *Science and Engineering Ethics*, 17, pp.571–582.
21 Winner, L. (1977). *Autonomous technology: technics-out-of-control as a theme in political thought*. Cambridge, United State: MIT Press.
22 Katz, E. (2011). The Nazi engineers: reflections on technological ethics in hell., *Science and Engineering Ethics*, 17, pp.571–582.

"…the Holocaust is so crucial … because it reminds us … how formal and ethically blind is the bureaucratic pursuit of efficiency… I propose that the major lesson of the Holocaust is the necessity to… expand the theoretical model of the civilizing process, so as to include the latter's tendency to demote, …the ethical motivations of social action…" [23] (p.14-28).

Implications of this moral analysis for our teaching

We should now turn to the implications of this moral analysis for our teaching. If technologies have values embedded within them, then whatever scientists, engineers, technologists or designers create will embody a particular set of political, social, and cultural norms. Most students or young technologists believe that the artifacts they will create will lead to a better world. Google´s corporate slogan "Don't be evil", is a well known example of this mentality. The conversion of the Microsoft founder from ruthless businessman into full-time philanthropist might be understood as a derivation of this same outlook. Students also believe—somewhat paradoxically—that it is the user of technologies rather than their creators that bear the ultimate responsibility for the social impact, positive or otherwise of those technologies.

Think about the Internet surveillance technologies widely used by the Chinese government to silence dissent or persecute dissenters (just try to search "Tiananmen" in Chinese-based servers to have a feeling of the "Great Firewall"). Should the thousands of software engineers employed by the Chinese government for this purpose feel unencumbered by how their creations are used? How should the hundreds of engineers working in the military nuclear projects of North Korea or Iran (or those of their European suppliers) feel about the potential use of their designs and products?

One could argue that in totalitarian regimes those engineers are coerced to do such work. This may be true in some cases but the evidence from Holocaust studies suggests differently. After all, as the philosopher Leon Wieseltier has reflected, "…Obedience, like disobedience, is chosen… you cannot coerce somebody to believe; you can coerce them only to act as if they believe…"[24]. The historian Michael Allen in his research on engineers working for the SS found a convergence between professional goals and political values[25]. In other words, these engineers dedicated their best professional efforts to support the SS murderous operations because, to a large extent, they shared their views and goals. Most of these professionals were not *forced* to do their best efforts to create and improve products that were being used for killing unarmed persons. Furthermore, Allen and others[26] found that reprisals were surprisingly few for the small minority of individuals who refused to use their professional knowledge for harming people. Allen found that these professionals shared a fascination with technology with a full commitment with Nazi political ideas. For example, the whole legal edifice of "racial theories" of the Nazi regime was developed

23   Bauman, Z. (1989). *Modernity and the Holocaust*. Ithaca, New York:Cornell University Press.

24   Wieseltier, L. (October 5, 2012). Cartoons, videos, and the politics of blasphemy. *The New Republic*. Available from http://www.newrepublic.com/article/politics/magazine/108208/cartoons-videos-and-the-politics-blasphemy Internet; accessed 17 July 2013.
25   Allen, M. T. (2002). *The business of genocide: the SS, slave labor, and the concentration camps*. Chapel Hill: University of North Carolina Press.
26   *Browning, Ch. R. (1992). Ordinary men: Reserve Police Battalion 101 and the final solution in Poland.* New York: Harper Collins.

by scientists holding some of the most prestigious positions in biology and anthropology in Germany. As Frank Littell rhetorically asked: "…What kind of a medical school trained a Mengele and his associates? What departments of anthropology prepared the staff of Strasbourg University's Institute of Ancestral Heredity?…" [27] (p.215).

Having established that technological artifacts are not value-free and that those values cannot be expected to be inherently positive we come back to the starting point with some fundamental questions: What are the moral duties of universities in the education of the scientists, professionals and technicians that are most influential in our increasingly technological world? How can educators ensure that the ethical dimensions of professional behavior are as much part of their teaching as scientific and technological contents? How can our students and graduates know that the technologies they create embody positive social values that will improve the world? Those are essential philosophical questions to which we are unable to provide definitive answers, but morally, we can´t shy away from them. We should attempt to guide students through the consequences of professional choices and the moral connections between those choices and the way their creations may be used, misused or abused. Universities should think more deeply about the moral dimensions of their education of technicians, scientists and professionals. As Franklin Littell bitterly expressed,

> **"…the death camps were built by Ph.D.'s…since men and women of the universities…not (by) illiterate savages…systematized the killing program, study of the Holocaust leads directly to study of the programs and the goals of modern higher education. Must technological objectives prevail? Or are the pursuit of wisdom and the commitment to life still recoverable goals of the university?..."[28] (p.215).**
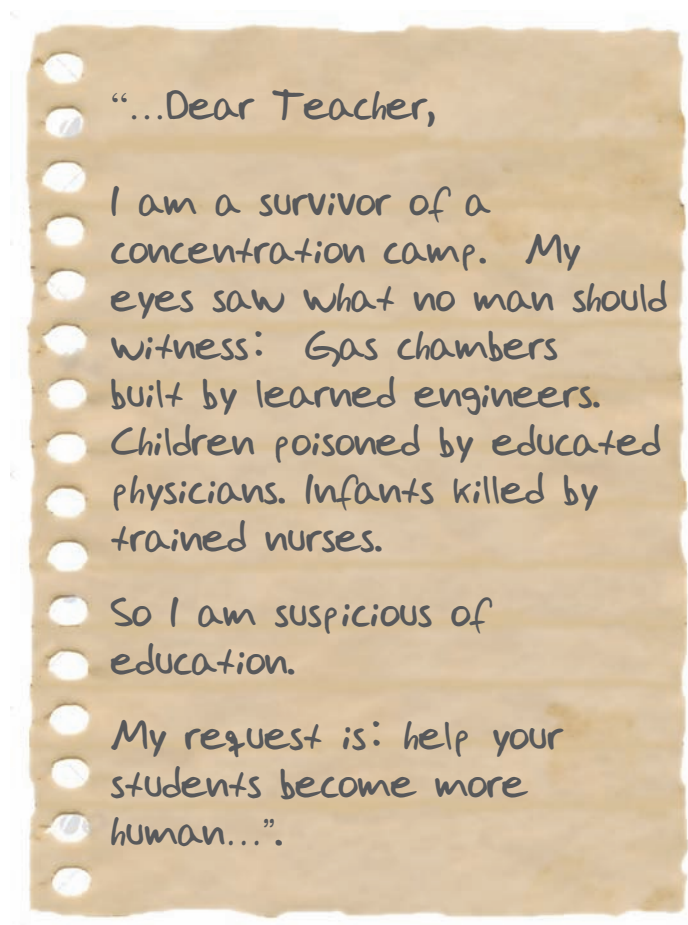
To live and work as ethical citizens and professionals, we should help our students develop a morally sensitive awareness of the political and social goals that might be served by their technological products. This is not an easy task. Faculties in modern universities in most countries work in isolated compartments.

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27   Shur, I.G., Littell, F. & Wolfgang, M.E. (1980). Reflections on the Holocaust: historical, philosophical, and educational dimensions. *Annals of the American Academy of Political and Social Science*, 450, pp.213-217.
28   Shur, I.G., Littell, F. & Wolfgang, M.E. (1980). Reflections on the Holocaust: historical, philosophical, and educational dimensions. *Annals of the American Academy of Political and Social Science*, 450, pp.213-217.

Science and Engineering are taught with little connection with the Humanities and focus on scientific and technical issues foremost. Little quality time and attention is available for discussing the moral, ethical or philosophical dimensions of the use of professional knowledge. External and internal rewards for faculty and students are mostly aligned with the technological and efficiency aspects of their creations. Few papers are rejected by scientific journals, tenures postponed or grants rejected because the moral dimensions of discoveries or developments are not thoroughly thought out.

We shall conclude by giving voice to a survivor of the Holocaust who in the 1970´s sent the following letter to a teacher[29] (p.245).

"...Dear Teacher,

I am a survivor of a concentration camp. My eyes saw what no man should witness: Gas chambers built by learned engineers. Children poisoned by educated physicians. Infants killed by trained nurses.

So I am suspicious of education.

My request is: help your students become more human...".

29   Ginott, H. (1976). *Teacher and Child: a book of parents and teachers*. Avon, State Pensylvania University.

"The world is a dangerous place to live; not
because of the people who are evil but because
of the people who don´t do anything about it"
Albert Einstein[30]

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30   Fritzhenry, R.I. (1993). *The Harper book of quotations*. 3r.ed. New York: Harper Collins, p.356.

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