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Engineering Ethics and Identity:
Emerging Initiatives in Comparative Perspective

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Abstract

This article describes and accounts for variable interests in engineering ethics in France, Germany, and Japan by locating recent initiatives in relation to the evolving identities of engineers. A key issue in ethics education for engineers concerns the relationship between the identity of the engineer and the responsibilities of engineering work. This relationship has varied significantly over time and from place to place around the world. One methodological strategy for sorting out similarities and differences in engineers' identities is to ask the "who" question. Who is an engineer? Or, what makes one an engineer? Where engineering ethics has attracted little interest in France and formal education in the subject might very well be seen as insulting, German engineering societies have, since the conclusion of World War II, demanded from engineers a strong commitment to social responsibility through technology evaluation and assessment. In Japan, a recent flourishing of interest in engineering ethics appears to be linked to concerns that corporations no longer function properly as Japanese "households." In each case, deliberations over engineering ethics emerge as part of the process through which engineers work to keep their fields in alignment with changing images of advancement in society.

Keywords: engineering education, ethics, history, France, Germany, Japan

Introduction

In 2000, the U.S. Accreditation Board for Engineering and Technology took a dramatic step by explicitly stating in its criteria that graduates of engineering programs have "an understanding of professional and ethical responsibility."[1] Seemingly working in parallel, the Japanese Accreditation Board for Engineering Education took an unprecedented step by requiring graduates of accredited programs to have an "understanding of . . . engineers' social responsibilities (engineering ethics)."[2] On the face of it, these two moves were quite similar and signaled rising interest in education in engineering ethics on a multinational scale. Other evidence for not only a cross-national expansion of interest in engineering ethics but also similarities in content comes from comparing new professional codes of ethics for engineers in different countries. For example, the French Charter for Engineering Ethics [*Charte d'Ethique de L'ingénieur]* issued by the Conseil National des Ingénieurs et Scientifiques de France, and the

German Fundamentals of Engineering issued by the *Verein Deustcher Ingenieure (VDI)* [The Association of German Engineers] appear to outline in similar terms engineers' responsibilities to the societies they serve.

But if one scratches slightly below the surface, contrasts begin to pour out, suggesting that emergent interests in engineering ethics may be following distinct trajectories in different countries. For example, in issuing its new criteria, ABET was concluding a decade-long deliberation to modify its previous, credit-based system of accreditation. Meanwhile, JABEE was only established in 1999 and with its new criteria was introducing the concept and practice of accreditation for the first time. Prior to the 1990s, neither engineering educators nor practicing engineers had judged the accreditation of engineering programs by an independent body to be a necessary or even desirable practice.

Contrasts in the contents and ordering of the educational criteria issued by these two bodies raise additional questions. In the American case, the first of the eleven learning outcomes is "an ability to apply knowledge of mathematics, science, and engineering" while the outcome pertaining to professional responsibility and ethics appears at the sixth outcome with its defined competence being "understanding" rather than an "ability to apply." Although one must be careful not to read too much into the ordering of criteria since all apply equally, this order does fit a dominant sense dating back to the early 20th century that engineering education consists of a technical core and a nontechnical periphery. Just as a switch of these two positions would likely be read as a a political move to elevate the importance of engineering ethics, so the noncontroversial ordering can be read as affirming a traditional hierarchy.

In contrast, in the JABEE criteria, what appear as two knowledge outcomes pertaining to the engineering sciences, i.e., "knowledge of mathematics, natural sciences and information technology, and the ability to apply such knowledge" and "specialized engineering knowledge in each applicable field, and the ability to apply such knowledge to provide solutions to actual problems," are found in the third and fourth positions in a total of eight criteria. The ethics criterion appears earlier, in the second position. Also, although it does stipulate "understanding" as its learning outcome, the engineering ethics provision appears alongside an understanding "of the effects and impact of technology on society and nature." Most remarkably, the criterion that readers encounter first is "the ability and intellectual foundation for considering issues from a global and multilateral viewpoint." What might such differences in content and order be contesting, or affirming?

Other contrasts emerge when one begins to look behind codes of ethics to the contexts of their approval. For example, in approving its Fundamentals of Engineering document, the VDI was reaffirming and updating a formal commitment to the professional and ethical responsibilities of working engineers that was first established in 1950. At the same time, while the document includes an endorsement of ethics education for engineering students, such is not a high priority and engineering institutions appear to have felt little pressure to do so. Far more important, as the Preface to the Fundamentals document puts it, is to prepare students to be "creators of technology."

In the French case, what is most notable about formal education in engineering ethics is that almost none of it exists. The organization that developed the Charter for Engineering Ethics, the Conseil National des Ingénieurs et Scientifiques de France (CNISF), coordinates the activities of alumni associations for engineering schools. It first adopted a code of moral obligations for engineers ["code de deontologie"] only in 1997 before revising it as the Charter for Engineering Ethics in 2001. The CNISF has no oversight responsibilities for engineering education or practicing engineers, and, according to Christelle Didier, an ethicist at Catholic University of Lille, "most engineers in France have never heard of CNISF . . . [and] there is a small chance that the code is known at all" by most French engineers.[3] At the same time, it is notable that, unlike the German code, the French Charter explicitly links engineering with the concept of progress, locating engineers as the source of innovation and engine of progress: "*L'ingénieur est source d'innovation et moteur de progress.*"[4]

What shapes the interest or disinterest of engineering educators in engineering ethics? A key variable is the relationship between the identities of engineers, e.g., what it means to be an engineer and who counts as an engineer, and the responsibilities of engineering work, including technical responsibilities. The contents of this relationship have varied significantly over time and from place to place around the world. As a result, when one inquires into what has counted as engineers, engineering knowledge, and engineering responsibilities at different times and places, the relatively straightforward questions--What sorts of ethical issues do engineers typically face on the job? and What types of education in ethics are appropriate for engineers?—become significantly variable in meaning and attract remarkably diverse answers.

For researchers and teachers interested in engineering ethics and students learning about professional practice in engineering, efforts to understand the issues that engineers face in one's own country can be informed by examining these in relation to issues that engineers face in other countries.[5] In addition, one's ability to understand and assess the extent to which what counts as engineering ethics in different countries may be converging in some sense may depend upon inquiring into how national differences developed in the first place. In concluding an important historical account of early French engineering, Ken Alder asserts that "[E]ngineers have been designed to serve."[6] Documenting how the contents of this service have varied greatly from country to country can provide one way of accounting for the unique character of challenges engineers face in the present and may be likely to face in the future.

One methodological strategy for identifying and sorting out international and temporal similarities and differences in what has counted as engineering ethics is to ask the "who question."[7] Who is an engineer? Or, what makes an engineer an engineer? Any inquiry into the identities of engineers leads directly to arenas of engineering education, for formative processes in education serve as key locations for negotiating and renegotiating the relationship between the person of the engineer and the definition and responsibilities of engineering work. Engineering educators typically bear primary responsibility for addressing and answering the question: What does it take to become a good engineer? Accordingly, examining the contents of engineering education as well as the evolution of struggles to adapt and change those contents can offer insight into how engineers have understood whom they are and what sorts of service they see themselves contributing through their work.

The analysis below illustrates the widely variable interests in engineering ethics by locating recent initiatives in France, Germany, and Japan in the context of brief historical accounts of the emergent identities of engineers. These accounts depend primarily upon the collection and analysis of primary and secondary documents, selected to identify dominant images of engineering identities. The historical accounts are supplemented by evidence from individual interviews and participant observation research among activists in engineering education from each country, both within those countries and elsewhere in the world. In each case, we find that deliberations over engineering ethics appear as part of the process through which engineers both respond and contribute to contemporary trends in society by working to keep their fields in alignment with those trends, especially changing images of advancement in society. Initiatives in engineering ethics typically emerge to fill some perceived existing or anticipated lack in the relationship between who engineers are and what they are supposed to do. What is this lack and who identifies it as such? Who cares about engineering ethics, and why?

A redundancy for French engines of progress?

French engineering educators have exhibited little or no interest in formal education in engineering ethics. As Didier explains, "To talk about the development of 'engineering ethics' in France is almost an impossible task. . . . [T]he academic subject doesn't exist in any state university: philosophy departments as well as the engineering departments take little interest in it. . . . [T]here is almost no ethical education within engineering curricula. . . . [T]here are almost no academic research programs on 'engineering ethics' . . . . The word 'ethics' does not appear in any professional organizations or trade-unions' publications until the [late] 1990s."[8]

The key to understanding this disinterest is to examine and understand the longtime elite status of French engineers. As the French journalist Jean-Louis Barsoux explains : "In France, engineering education does not play second fiddle to medicine, law, or architecture—it is *the* recognized way to the top, both socially and professionally."[9] Barsoux is referring to a special category of engineers, the so-called "state" engineers, i.e., people who work for the national government, hence the nation state. Although state engineers have been in the minority at least since 1900,[10] their education and status has provided the standard for measuring all French engineers.

In a sense, one can say that the morality of French state engineers is both established and demonstrated by their successful participation in a rigorous exam system. Students who aspire to become engineers have first to complete a *baccalaureat*, or high school diploma, with appropriate emphasis in math and science. They then undertake two grueling years of mathematically-intensive study in *classes préparatoires*, often held in the same buildings in which they completed the *baccalaureat*. At the conclusion of this process, prospective students compete for positions in the elite schools, the so-called *grandes écoles*, by sitting for the *concours*, a combined written and oral exam whose scores are published in local newspapers and determine who will be granted admission to which schools.

How could one's morality possibly be demonstrated by successful completion of this intellectual process? One important clue lies in the fact that the process of gaining entry into one of the elite schools is not called "admission" but "promotion," and that eventual graduates will forever identify themselves as cohorts based not on the year of graduation but on the year of promotion. In addition, the rankings continue through completion of their studies, at which point the highest-ranked students remain on pathways leading ultimately to senior positions in government ministries. In other words, by entering an engineering school, prospective state engineers join a system in which they eventually come to serve as both leaders and embodiments of French society. As such, they become legitimate engines of progress.

The word *progress* is significant here because a distinctive French image of progress as advancement towards an ideal future had scaled up among the literate public long before the French Revolution. In the 17th century, René Descartes had established the idea that nature could be seen as a huge mechanism, analyzable in mathematical terms, and 18th century *philosophes* had facilitated the scaling up, or popularization, of rationality as an ideal. Since God had created perfection in nature, as evidenced by the laws that govern it, a human society that had been prevented from advancement by centuries of rule by corrupt aristocracy and clergy could also pursue perfection by means of mathematics. Mathematical analysis would allow engineers to discover the laws that govern society and propose improvements to increase social order and advance it toward a future state of perfection. The use of reason to eliminate corruption was thus simultaneously an epistemological and a moral process.

In contrast with progress in other new countries, progress in France would require rational collective planning based on sound mathematical principles. [11] Such planning should occur in government, away from the inefficiencies and self-interested activities of private industry. The examples of the French commitment to rational planning are legion. For instance, in a history of public planning in France, Cecil Smith explains that "[e]ver since the birth of the Corps des Ponts et Chaussees in the 18th century, French state engineers have promoted the complementary notions of rational public administration in the general interest and planning on a national scale."[12](p. 659) Smith elaborates the case of Corps des Ponts director Louis Becquey who in the 1820s gained approval for a national plan for a system of canals in France. When private companies attempted to gain authority to develop projects and subsidies to complete them, akin to the experience in Great Britain, Becquey successfully "defended the interests of state engineers by arguing that the plans 'are in the public interest, for without [state engineers'] supervision, private companies would indulge in the meanest economizing'."[12](p. 659) At the end of the century, a Corps des Ponts chief engineer successfully resisted the encroachment of private interests into plans for the electrification of France as "ignorant greed [which] threatens to squander a national resource." [12](p. 685)

During the early 20th century, a group of graduates from the Ecole Polytechnique, the most elite of the technical schools (aka "*L'X"*), established the think tank *X-Crise* to promote an alternative philosophy to capitalism, communism, and fascism. They called it "planism."[13] Among them was Jean Coutrot, an engineer-intellectual and founder of the Center for the Study of Human Problems [Centre d'Etudes des Problemes Humaines]. According to Coutrot, the leadership of engineers was rooted in engineering analysis: "It is to the engineers, today, that it falls to construct better societies because it is them and not the legalists or politicians who hold onto the necessary methods."[13](p. 81) As historian J. Clarke explains, for Coutrot and other engineers who were concerned about the dehumanizing effects of mass production, communist collectivism, and fascist centrism, "the central problem of their time was the question of how to organize a society that was both rational and human."[13](p. 84)

After World War II, state engineers secured complete jurisdiction over electricity, train transportation, and atomic energy, all in the name of rational national planning in the general interest. As Smith explains, "they acted as planners, economists, urbanists—'inter-ministerial generalists,' drafting legislation and then the decrees to implement it." [12](p. 692) The influence of state engineers spread through a greatly enlarged "para-public" sector that included electric power, gas, coal, banks, airlines, telecommunications, Renault, and SNCF [railroad]. "As true as it is that public engineers acted as an elite all too confident in the power of 'superior light' [*lumieres superieures*] to determine the 'general interest,' Smith concludes, "it is no less true that for 250 years they sustained an ethos of public service rarely found elsewhere."[12](p. 693)

Engineering educators in France have placed highest value on mathematical knowledge since the eighteenth century when the most elite *grandes écoles* were founded, e.g., École des Ponts et

Chaussées (1747), École des Mines (1783), and École Polytechnique (1794). Historian Wolfhard Weber explains that Gaspard Monge, the “father of the École Polytechnique” which was founded during the Revolution, explicitly saw mathematical theory as a key tool for steering the present by enabling clear descriptions of the future: “Monge himself insisted that descriptive geometry was an answer to the French nation’s requirements. He said that this science had two aims. First, it would make it possible to represent three-dimensional objects in two dimensions, which was of course most important to designers. Second, Monge could fix the exact site of objects and of their several parts, and how they fit together. In this way, he brought together a series of factors fundamental . . . as he put it, for progress.”[14] The names of mathematician-engineers who taught at the top schools and served in the civil service constitute a virtual Who’s Who of the engineering sciences, including LaPlace, Carnot, LaGrange, Fourier, Prony, Coriolis, Navier, Cauchy, Poisson, and Ampere.

For French engineers, demonstrating the ability, commitment, and discipline to become proficient in the mathematical foundations of engineering is to demonstrate that one has the moral disposition to warrant the Republic’s trust and lead it in pursuit of an ideal future.[(d)] Students who have been promoted into the national system of rational deliberation and action geared toward increasing social order have already demonstrated everything necessary to warrant a position of national leadership. They have mastered all the principles and values that constitute engineering ethics in France; indeed, one might reasonably claim that engineering constitutes the dominant ethic of France. For students who have already demonstrated their character through their competence, enrollment in a course in engineering ethics might very well seem redundant, if not wholly irrelevant. It should be no surprise, then, that the annual military parade on Bastille Day, which publicly celebrates the accomplishments of the Republic, is led by second-year students from the École Polytechnique.

Nevertheless, as described earlier, presumably the collective organization of alumni associations did feel some sort of pressure to formulate and disseminate a code or charter. This move may perhaps be understood as one of many efforts in and around French engineering education to adapt to the increasing value accorded the private sector as a measure of national worth after the end of the Cold War. A U.S.-led shift in the dominant image of international relations from grand conflict between two philosophies of political economy to a model of economic competitiveness based in nation states has forced other countries to adapt to an American model of progress through the production of low-cost goods for mass consumption.[11] In response, and while keeping the main structures of engineering formation intact, the *grandes écoles* have initiated international exchange programs and new educational programs and career pathways oriented more toward private industry. In particular, expecting engineers to participate increasingly in international workplaces beyond Europe, schools have also begun expanding the non-technical dimensions of engineering education.

It is in this context that “ethical reflection on the engineering profession” has gained the slightest of footholds. In 1995, the Engineering Title Commission [Commission des Titres D’ingenieurs], established in 1934 to protect the formal title “graduate engineer,” updated its non-technical requirements to include “foreign languages, economic, social and human sciences and a concrete approach to communication problems as well as providing openings to ethical reflection on the engineering profession.”[15] Although established, this foothold has yet to generate much follow-up activity.

Assessment responsibilities for German creators of technology?

VDI's Fundamentals of Engineering guideline stands out by calling special attention to the engineer's responsibilities in technology assessment, i.e., evaluating and mitigating the impacts and effects of technological developments. The Fundamentals document calls, for example, for engineers to "accept responsibility for quality, reliability, and safety of new technical products and processes." Accepting such responsibility includes "informing customers about both appropriate use and possible dangers of misuse of new technical solutions." It involves designing technologies that take account of "the societal, economic and ecological feasibility of technical systems; their usability and safety; their contribution to health, personal development and welfare of citizens; their impact on the lives of future generations." [16]

This 2002 guideline was building on a previous VDI guideline issued in 2000 that elaborates in greater detail the engineer's responsibilities in anticipating and assessing the effects of new technologies. As assessment specialist Ildiko Tulbure explains, this document describes technology assessment as a methodical, systematic, and organized process of "analyzing a technology and its developmental possibilities; assessing the direct and indirect technical, economic, health, ecological, human, social and other impacts of this technology and possible alternatives; judging these impacts according to defined goals and values, or also demanding further desirable developments; deriving possibilities for action and design from this and elaborating these, so that well-founded decisions are possible and can be made and implemented by suitable institutions if need be"[17].

German engineers are to evaluate all technologies according to eight metrics of value in three categories, including functionality, economy, and material standard of living; safety, health, and environmental quality; and development of individual personality and quality of social life. The guideline is significant for engineers because if a particular technology fails to meet any of the standards, engineers can invoke its provisions and legitimately refuse to cooperate. The key point is that individual engineers are not left alone to evaluate the situation on the basis of personal conscience but can find support in a guideline that has been authorized by the engineering community as a whole.[18](p. 436)

The formal interest among German engineers in the impacts and effects of technologies on human society can be traced to the immediate post-WWII period. After having been shut down by the National Socialists in the 1930s, the VDI reopened in 1947 with an international conference on engineering education titled "Technology as Ethical and Cultural Task." The great significance of the topic was demonstrated when the VDI then organized four additional conferences between 1950 and 1955 on the general theme of technology and humanity. Of telling significance in this process was the development of an active collaboration between engineers and philosophers of technology in working committees designed to help insure that German engineers would develop technologies to benefit human society with a minimum of negative effects.[18]

The distinctive feature of this movement among engineers was to assert that the responsibilities of engineers extend beyond the nation state to humanity as a whole. At the first of the latter four conferences, participants drafted an "Engineer's Confession" that used a distinctly religious tone to offer a picture of engineering as a spiritual vocation. According to the Confession, those who accept this spiritual vocation "should place professional work at the service of humanity . . . [and] should work with respect for the dignity of human life and so as to fulfill his service to his fellowmen without regard for distinctions of origin, social rank, and worldview."[19] To include an explicit commitment to humanity as a whole constituted a distinct change for German engineers, who previously had understood that they were advancing human civilization by serving the German nation. At the same time, a significant continuity was the focus on technology as the means for fulfilling the engineering vocation.

Once again, we can understand this particular moral stance, asserting that engineers have a responsibility to evaluate technology's effects on humanity, by inquiring into the historical emergence of engineers' identities, in this case an emergent connection between engineering work and the German nation state. The constitution of the nation state in Germany has long been, and remains today, a site of significant struggle. During the Holy Roman Empire, German states had been prohibited from active warfare with one another, but during the latter stages they actively competed in arenas of high culture (art, music, etc.) to demonstrate their location on the cutting edge of civilization. In the 19th century, higher education and philosophy emerged and gained acceptance as key instruments of change. For example, in 1807, philosopher and public intellectual Johann Fichte spelled out the potential long-term significance of higher education in what he tellingly titled *Addresses to the German Nation*. "By means of the new education," Fichte argued, "we want to mould the Germans into a corporate body, which will be stimulated and animated in all its individual members by the same interest."[20] (p. 82) Germany could become great and lead civilization by actively creating higher-level human beings through the process of *bildung*. *Bildung* referred to the activity of self-cultivation through the study of texts from the classical period, which had established a higher level of civilization. Hence *bildung* was necessarily built on Greek and Latin.

The pathway to societal advancement lay in facilitating *bildung* among educated Germans, who would then implement their ideas in politics and social life. As historians Jan Masschelein and Norbert Ricken explain, "*Bildung* was given the endless task of developing, unfolding, and enlightening the human mind and making real the independence of human will and action from natural and social determinations, coercion and constraints." In this vision, God had created an ideal humanity that could be emancipated or released only through self-cultivation. "*Bildung* is the endless voyage of the individual toward him/herself as part of an ideal humanity," Masschelein and Ricken continue. "It was originally conceived as a critical and emancipatory enterprise, i.e., as a process in which human beings became truly free and in which they emancipated themselves from all kinds of power."[21](p. 140)

Throughout most of the 19th century, the professions of law, medicine, philosophy, and clergy held the monopoly on *bildung* in the institutions of the gymnasium, i.e., the elite secondary schools, and the new research university, beginning with the University of Berlin. German philosophers, led initially by Johann Gottlieb Fichte and then by Friedrich Hegel, took responsibility for rationally theorizing the emancipation of *geist*, a concept that referred to the combination of mind and spirit that constituted the essence of the God-created ideal humanity and was thought to be shared by all Germans. In the latter stages of the German Confederation, Prussia asserted its leadership by building a rational governmental bureaucracy whose existence demonstrated both *bildung* in action and the successful emancipation of *geist*. In the process, academic philosophy converged with government as philosophers, many of whom were employed within government, took responsibility for conceptualizing advancements in civilization while bureaucrats trained in law at universities would enact them.

The significance of *bildung* derived in part from its contrast with technical training and work. Throughout most of the 19th century, technical practitioners, who carried the generic name *techniker*, were denied access to *gymnasia* and, hence, could not complete the final examination, the *abitur*, whose passage granted a leaving certificate and the right to enroll at a university. Early attempts to enhance the cultural prestige of technical learning and work included creation of the Association for the Promotion of Technical Activity in Prussia (1821) by Prussian Finance Minister Christian Peter Beuth (1781-1853). The purpose of the Association was to conceptualize and promote a novel German approach to industry, in the face of the threat from Great Britain. Understanding *bildung* and cognizant of negative effects of industrialization on English workers and landscapes, Beuth sought to promote a distinctively German industrialism that imbued technology with art and emphasized aesthetics as an evaluative criterion.[22] Beuth surmised that industrialization could only gain acceptance among Germans as a site for the emancipation of *geist* if it emerged as the product of *bildung.* He thus stipulated that art and aesthetics be included in the curricula of nascent technical schools serving the lower classes of society. This sort of strategy would eventually work, but not until a hundred years later when the National Socialists opened up new educational pathways that gave members of the lower classes greater access to engineering education.

An educational movement that proved more successful during the 19th century involved establishing Higher Technical Institutes that included among their responsibilities fundamental research on *techniks,* a concept that referred both to technologies and the processes for their production. First established during the middle part of the century, the new institutes gained greater visibility and status during the 1870s and 1880s after the unification of Germany under the Prussian-led Second Empire. During this period, the main external rival was no longer France nor Great Britain but the United States, which was feverishly expanding its industrial production. Advocates for the Higher Technical Institutes also established a new form of quasi-academic secondary education in *Oberrealschulen,* whose "realism" included teaching modern rather than classical languages. In 1885, a VDI commission concluded a review of the structure of German education and its implications for engineers by demanding that the tracks students follow into and through the Higher Technical Institutes have the same legal standing as the pathway through *gymnasia* to university. "The engineer in the eyes of many," according to the Commission, "was – and partly still is – an advanced artisan, neither requiring nor deserving the higher *bildung* offered by the *gymnasium*. We declare that German engineers have the same needs with respect to their general *bildung* and wish to be subject to the same standards as the other higher professions."[23](p. 146) William II approved this request by giving Oberrealschulen graduates the right of admission to the engineering corps in 1892 and granting them equal status to graduates of the classical *gymnasium* in 1900, and by making the Higher Technical Institutes legitimate sites of higher education in 1899, which enabled their graduates to seek employment in the German bureaucracy.

It is instructive that the Higher Technical Institutes adopted the French word *ingénieur* to label their graduates, for this word was associated with high status. However, researchers at the Higher Technical Institutes were working not to advance society toward a future state of perfection but to demonstrate that quality *techniks* could be a legitimate site for enacting reason and emancipating *geist.* They worked to build a technical domain of knowledge that contrasted with mathematical French engineering by developing an arena of "scientific technology." As historian Karl-Heinz Manegold explains: "The task . . . was to reach an autonomous area of scientific technology in which it should become possible to reconcile scientific theory and the empirical practice of the trades; that is, in the conviction that technical science was not the same as applied science, in opposition to the view of the École Polytechnique in Paris."[24](p. 142) In the German context, to suggest that societal advancement could only be conveyed in mathematical form would suggest that the source lay outside of the German people and, hence, *geist* would have no significance or play no role. "The engineer would become scientifically bankrupt, so it was argued," reports Manegold, "if 'scientific' merely meant 'mathematical' or one-sidedly like 'mathematical-scientific'." [24](p. 153) Quality scientific technology involved working not from pure science "down" but from artifacts "up," theorizing ideal relationships sufficiently to advance practical tasks.

In the early 20th century, members of this elite group of engineers contributed to extending the practice of philosophy, as the articulation of emancipation, to include *tekniks.* In 1904, the German engineer Max Eyth argued in *Living Forces* contra the Hegelian philosophers and Prussian lawyers that technology rather than reason should be seen as the vehicle for the unfolding of *'geist'*, or mind/spirit. Historian Jeffrey Herf summarized Eyth's claim that "there was more *Geist* in a beautiful locomotive or electric motor than in the most elegant phrases of Cicero or Virgil. Technology, like poetry, dominates matter rather than serves it. . . . [T]echnology was actually more cultural than culture itself."[25](p. 159) Feeling empowered by an increasing national commitment to industry, engineers openly challenged the value of the universities and "praised their own achievements as 'national' ones and engineers as 'pioneers of German value and culture.'"[24](p. 156)

Elite German engineering intellectuals thus engaged in a kind of cultural politics that historian Karl-Heinz Ludwig described as the "anticapitalism of technicians." This philosophy held that "technology emanated from the deepest impulses of German Kultur;" that contemporary crises in German society, especially after World War I, "were not due to the machine but to its misuse by private capitalist interests"; that "the welfare of the national community could be protected only by a strong state"; and that "engineers had a central role to play in providing the expertise necessary for Germany in an age of technological warfare."[26] This engineering point of view found the development of National Socialism quite amenable to its goals, because the new political movement claimed to be oriented toward emancipating a German essence and it showed promise of overcoming the misdirections of a self-interested aristocracy by relying upon a charismatic individual. As historian Jeffrey Herf and others have shown, National Socialism appeared to offer engineers an opportunity to unleash modern technology from the constraints not only of the aristocracy but also of free-market capitalism and Social Democracy.[25] (p. 161)

During the Third Reich, the elite engineers tolerated and perhaps even supported the disempowering of Jews, who were doubly inappropriate because they fell outside the German essence and because they served as the purveyors of free-market capitalism. However, most engineers evidently did not anticipate the inhumanities of the Holocaust. Through a deliberate political neutrality oriented only to technical work, they stumbled into the role of collaborators who sanctioned through inaction, and sometimes obedience, a willful and active misuse of *tekniks* to undermine humanity rather than advance it. When a reconstituted VDI was struggling to understand what had taken place and how engineers should position themselves to regain the path of positive contributions, they therefore had to extend their reach beyond a German essence to include humanity in general. The Engineer's Confessions stipulated that "The ENGINEER should not bow down to those who disregard human rights and misuse the essence of technology; he should be a loyal co-worker for human morality and culture."[19] Note that the shift from civilization to humanity did not threaten the engineers' priority on German leadership in *tekniks*. Rather it meant that engineers had to re-conceptualize *tekniks* to acknowledge that technical advancements with serious negative consequences could not longer constitute societal advancement.

Why then a commitment to updating guidelines and reports in 2000 and 2002? Like the French, the Germans are working to adapt to a world dominated by economic competitiveness, with its emphasis on low-cost production for mass use. On the one hand, German engineers and engineering institutions are struggling to build a system in which "stopping the design" is acceptable as a strategy for reducing costs.[27] On the other hand, a reaffirmation of a responsibility to engage in technology assessment offers evidence that *tekniks* is still about emancipating *geist*. Abandoning in engineering education the commitment to quality, now including assessment alongside precision, would undermine the legitimacy of engineering work by breaking its continuing link to German national identity.

Building a household for professionals in Japan?

While a concern for moral responsibility has arguably always been paramount for Japanese engineers, the active involvement of professional engineering societies in formal ethics instruction and training, especially as continuing professional development, is quite new. As philosopher Heinz Luegenbiehl explains, "Japan does not have a tradition of professions." [28](p. 9) The emergence and recent activism of professional societies in Japan is linked, at least in part, to the emergence of popular concern about misdeeds by Japanese corporations.

For example, at the 2004 World Conference on Continuing Engineering Education in Tokyo, four presenters of new initiatives by professional engineering societies found justification for their efforts in ethical failures by Japanese corporations.[29, 30, 31, 32] As one leader of the social movement of engineering associations, Hideo Ohashi, put it in 2000, "An unbelievable critical accident that happened at JCO's Tokai facility . . . left severe damages to the public confidence on technology and subsequently on engineers. . . . In recent years a number of incidents have resulted from the lack of ethics of the corporate executives or the engineers, drawing public criticism."[33] Researchers in business ethics have reported similar phenomena. Wokutch and Shepard, for example, maintain that high-profile accidents, disclosure of concealed trading losses, and publicized neglect of sexual harassment have had the effect of eroding public trust in corporations.[34](p. 535) [(e)]

In Japan, the phenomenon of lost public trust has special meaning and significance. To Ohashi and other engineering activists, the implications are self-evident: "This clearly indicates the importance for the engineers not to merely obey blindly the directions given by the organization, but to be able to judge what they should do or not to do according to the engineers' ethics."[33]

To understand the rapid increase of activities to supplement engineering training with engineering ethics at the levels of both undergraduate and continuing education, it is important to understand first that Japanese engineers typically identify and position themselves as members of a household. As described by anthropologist Dorinne Kondo, the household, or *ie* (pronounced ee-aa), is the key site of obligation and responsibility for Japanese people. "The *ie* is not simply a kinship unit based on blood relationship," Kondo explains, "but a corporate group based on social and economic ties." The key feature is that one's essential identity as a person does not exist prior to the household but is defined in terms of one's position within it. "Subordinating one's individual desires to that of the household enterprises takes on the character of moral virtue," Kondo continues. "Pursuing one's own plans and disregarding the duties toward the household smacks as selfish immaturity."[35](p. 131)

The household serves as a center for emotional belonging and attachment, or *uchi*. Kondo explains that "*Uchi* defines who you are, through shaping language, the use of space, and social interaction. It instantly implies the drawing of boundaries between us and them, self and other." *Uchi* means 'inside;' [and] like *ie*, this inside is not necessarily limited to the family or the household [but] can be any group: company, school, club, or nation."[35](p. 141) The Japanese image of belonging thus begins with boundedness, the separation of inside from outside, and any felt sense of responsibility beyond the household is defined in terms of prior obligations within it. Also, one uses the *ie* to reason upward or outward from the household as *ie* to the company as *ie* and, further, to the nation and globe as *ie.*

Young people begin competing to demonstrate their appropriateness for corporate households long before entering higher education, in kindergarten or even pre-school. The country is widely known for what the Japanese call "examination hell," the lifelong preparation for the College Entrance Examination that defines their pathway into higher education and, hence, future life course. As ethnographer Ezra Vogel wrote in 1971, "No single event, with the possible exception of marriage, determines the course of a young man's life as much as an entrance examination, and nothing, including marriage, requires as many years of planning and hard work. . . These arduous preparations constitute a kind of rite of passage whereby a young man proves that he has the qualities of ability and endurance for becoming a salaried man."[36]

Though this emphasis on an exam as an indicating of moral appropriateness parallels the French case above, the contrasts are instructive. Examinees in Japan are not so much revealing innate individual merit as demonstrating a mature other-directedness developed and achieved through the disciplined acceptance of hardship. It is in this sense that preparation for the exam is about "polishing the heart" [*kokoro*]. As Kondo puts it, "In Japanese society generally, hardship is considered one pathway to mature selfhood . . . . Without undergoing suffering, one was condemned to remain childlike. . . . Hardship would temper youthful immaturity. . . . [E]ndurance and perseverance are among the most frequently cited virtues in Japanese society. . . . Learning to stick to a task, no matter how difficult or unpleasant, thus strengthens the *kokoro.*"[35](p. 109)

Good scores do mean top schools, as in France. Students with the highest scores can enter engineering programs at prestigious national, formerly imperial, universities such as the Universities of Tokyo, Kyoto, Nagoya, Osaka, Tohoku, Hokkaido, and Kyushu, as well as at such well-known private universities as Keio, Waseda, and Kogakuin Universities in Tokyo and Doshisha University in Kyoto. However, in contrast with French engineering students, students have little left to demonstrate in school to warrant good employment. Typically, a Japanese four-year college student will regard their four years in college as their vacation years for their entire life.[37] Although engineering students would rightly claim that they have more work than others, university life still constitutes something of a time-out from household duties. One has departed from the family household of origin but has not yet transitioned into the corporate household that will define one's identity and obligations for the balance of one's working life.

This distinctive approach to reckoning identity and responsibility through households was the product of significant work over a considerable period of time, most notably during the establishment of the Japanese nation state under what Westerners call the "Meiji Restoration." Historian Masako Shibata maintains that, in contrast with Germany, the restoration to authority of the Meiji Emperor after a 250-year hiatus was an "abrupt formation" prompted by the "Western threat to national sovereignty marked by the 'Blackship Turmoil' of 1853."[20] (p. 76) Japan had long resisted European colonialism during the feudal Tokugawa period by strictly isolating itself and channeling trade through a single port. But the world changed for Japan when U.S. Commodore Perry arrived in a black battleship, backing with the threat of force its "request" to open up direct trade with Japan. The experience brought dishonor to Japanese leaders, the Shogunate lost its governing authority, and it was overthrown by a collection of lower-ranking warriors (*samurai*).

The new imperial government explicitly restructured Japan as a nation state, judging that only a well-organized nation state could compete with the United States and Europe. However, to build a state that would have legitimacy in Japanese terms, the Meiji government built itself as a "family state," extrapolating meanings from the realm of the family to include the Emperor. [20](p. 76) As one government leader put it, "The emperor is to his subjects, as a parent to children. In other words, a state is an expression of a family. The emperor rules commoners as parents guide their children with mercy."[38](p. 214) Thus, the Meiji government used a variety of strategies to transform a feudal diversity into an organic unity, from quickly building an educational system for all Japanese children to making Shinto a national ideology to negotiating a civil code. Binding the people to the Emperor as their leader as children are to their parents recreated them as "a people with a common ancestry."[20]

United by a threat to their survival, the Japanese people sought not to realize some national essence traceable to Romans and Greeks but to gain power. The Meiji Restoration was, in a way, an independence movement that lacked a prior colonial period. Survival could best be assured through the fulfillment of obligations to the new family state, grounding an unusual openness to identifying and importing from the West sources of power and influence, especially industrial production, on the condition that such imports could subsequently be made Japanese. In addition, the acquisition of power would be guided by adapting the Confucian ethic of harmony into a national objective. "The proper regulation of the self enables maintenance of harmony within one's family," observes B.B. Lanham about the Confucian code. "This in turn paves the way for the proper governing of the nation and ultimately the world."[39](p. 5) A Japanese nation that advanced would be one that not only survived but also achieved internal harmony in the near term and external harmony eventually.

A key vehicle of nationalization was the institutionalization of property ownership through a family institution particular to the powerful *samurai* class, the *ie*. Initially, the Meiji government had used state funds to establish industries that it deemed essential to compete with the West. Then in 1877 it established stock exchanges in Tokyo and Osaka and in 1880 undertook a mass sell-off of state-owned enterprises, except munitions, to businesses owned by *samurai* families. A commercial code in 1893 authorized these businesses, as *zaibatsu*, to incorporate, buy firms, form new firms and raise capital from investors. And in 1898, after nearly two decades of heated debate, the government formally sanctioned *samurai* leadership and hegemony by making the *ie* a legal national entity, giving the head of household property rights over the entire household and outlawing as barbarian patterns of succession by women that had been common among peasants and merchants. The main industrial zaibatsu that employed the bulk of Japanese engineers until WWII emerged during this time: Mitsui, Sumitomo, Mitsubishi, Yasuda, Asano, Kawasaki, Furukawa, Nissan, Nichitsu, Mori, Nisso, and Riken. [40](p. 23)

Another key example of selective import followed by a process of Japanization was in education. In 1868, Yozo Yamao, who had been studying abroad in Glasgow, returned home to become vice minister of education with the goal of establishing an engineering school. To opponents who said the graduates would be useless without industries to work for, he uttered the oft-repeated statement "Even if there is no industry at present in Japan, if we train a man, he will cultivate an industry. [32] The Imperial College of Engineering was founded in 1873 with Scotsman Henry Dyer imported to serve as its head. The government then systematically replaced British professors with Japanese graduates until finally, in 1886, fully merging the College into the University of Tokyo as its Department of Technology.

The Department of Technology became the main origin for a direct line of ascendance of engineers who entered the most powerful corporations and eventually became managers and directors. One of the first replacement faculty had been Fujioka Ichisuke, who became one of the founders of Toshiba. Hitachi had eleven directors prior to 1941 and all but one came from the Engineering Department at the University of Tokyo Other graduates founded Toyota and Nissan [41], p. 143-6).

The conclusion of World War II terminated the state-led nationalism that had led ultimately to aggressive military expansion as the main strategy for insuring survival of the national household. Occupation authorities dismantled the legal structure of the Japanese *ie* and the rigid patriarchal hierarchies of the *zaibatsu.* As historian Mark Fruin observed, "In the Occupation view of Japanese culture, the *ie* system allowed household heads an unwarranted amount of civil and moral authority over their children, other household members, and relatives. Just as this authority tended to be absolute within a lineage group organized around a system of common property, so too the same authority was extended to the emperor of Japan in his assertions of headship over all Japanese" [42](p. 246-7). The Occupation administration confiscated stock from the *zaibatsu* and put it up for sale in an equity market. Japanese bankers and financial managers bought the stock, initiating a new form of corporate organization, the *keiretsu.*

Although *keiretsu* were formally separated from family ownership, the household structure continued to serve as an informal template for worker tasks, identities, and responsibilities. Thousands of former *zaibatsu* engineers and technical workers were in search of new centers of belonging. Although the family state was dishonored, the pursuit of harmony in the national household continued in a shift of emphasis to economic development through science and technology. Indeed, shortly after Emperor Hiroito announced Japan's surrender in 1945, Prime Minister Suzuki Kantaro issued a call for national survival through science and technology: "It is essential that the people should cultivate a new life spirit of self-reliance, creativity and diligence in order to begin the building of a new Japan, and in particular should strive for the progress of science and technology, which were our greatest deficiency in this war."[43](p. 161)

During the postwar period, according to Kondo, the metaphor of 'company as family' resonated in large firms. It was also during this period that "the 'Japanese employment system—characterized by welfare paternalism, promotion of seniority, so-called lifetime employment, and worker identification with the firm—[became] a social reality." Still a template for corporate organization, the *ie* was a "zero-point of discourse, constitutive of identity" and, above all, "link[ed] . . . to task performance—that is, to work, and to merit, rather than to mere passive belonging."[35](p. 174-5)

At the same time, the distinction between inside and outside that defines the corporate household, as well as the entailed idea that employees pursue national harmony through the fulfillment of corporate obligations, just might be at the center of problems Japanese companies are experiencing in the present, both abroad and at home. As business ethics specialists Richard Wokutch and Jon Shepard maintain, the sharp separation between those inside and those outside has long produced such shortcomings within Japan as mandatory retirement ages of 60 or younger, the shifting to subsidiary firms of "3K" jobs (*kiken* [dangerous], *kitani* [dirty], and *kitsui* [demanding]), and significantly reduced opportunities for women, foreigners, and some minority groups. [34](p. 530-531) But such shortcomings have been treated as such more by outsiders than insiders. Wokutch and Shepard point out that "[t]he employment of overseas nationals has brought out into stark relief the great difficulty Japanese have in accepting foreigners as full-fledged members of the corporate family." They also join others in noting "[t]he serious difficulties Japanese employers have run into in the United States on such issues as product safety, corporate philanthropy, industrial espionage, and discrimination on the basis of race and sex."[34](p.535) The increasing visibility of such concerns amounts to an indicator that the corporate household in Japan is no longer wholly contained within the national household. That is, the great success of the Japanese economic strategy for national development has extended corporate households beyond the boundaries of the nation, confronting them with new pressures and granting them new, multinational identities.

One way the successful extension of the Japanese corporate household beyond Japan may be generating a significant popular reaction at home may be in the experience of "loss of public trust" for Japanese corporations. When viewed through the household model, Japanese companies that function successfully in multinational environments may, on the one hand, be successfully extending Japanese identity to others outside Japan. But on the other hand, they may also be putting that identity at risk. Multinational Japanese companies may appear to Japanese people as losing their Japaneseness. To the extent the latter may be occurring, the most likely scenario of emergence is that they are accommodating themselves to a Western corporate model built around "enlightened self-interest." That is, they may be behaving as corporate individuals charged with benefiting society by serving themselves first and maximizing self-interest. Yet, given the household model, traveling down such a path risks, to invoke Kondo's terms, "disregarding the duties toward the household," failing to demonstrate "moral virtue," and even "selfish immaturity."

Recent actions by professional engineering societies suggests they may be interpreting the failings of corporations in just such terms for, in a way, the success of efforts to define a Japanese "professional" depends upon an interruption in the flow of responsibility from workers through the corporate household to the national household. When working engineers attend continuing education classes in engineering ethics at night, they receive a booklet documenting their accomplishments as 'individual' professionals. But these new professionals are not being trained to become autonomous agents who, through the force of character and the effects of education, are accepting a charge to exercise independent judgment. The movement does not include, for example, a call for supporting whistleblowers, people who risk job and career in the name of individual honesty and autonomous judgment, for whistleblowers still "are perceived as untrustworthy and would not be accepted by Japanese society."[44] Rather, as movement leader

Hideo Ohashi says, the new engineering professionals are "judg[ing] what they should do or not to do according to the engineers' ethics." [33] The difference is subtle but significant. Rather than educating autonomous individuals, professional engineering societies are offering themselves as *uchi,* new centers of belonging responsible for defining "engineers' ethics" in order to help them struggle with change.

As mentioned above, the Japanese Accreditation Board for Engineering Education was established only in 1999 and soon thereafter defined the obligations that promote its identity as a household. Remember that the first criterion, or primary obligation, for engineers from accredited programs was to demonstrate not an ability in math and science or in engineering analysis but, surprisingly from a EuroAmerican point of view, the "ability and intellectual foundation for considering issues from a global and multilateral viewpoint." The provision responds to a fear. One can successfully consider issues from a global and multilateral viewpoint only if one is able to rise above self-interest, overcome selfish immaturity, and locate one's concerns and interests in relation to those of others engaged in the general pursuit of harmony.

Also in 1999, the Japanese Society of Civil Engineers amended its "Beliefs and Principles of Practice for Civil Engineers," replacing it with the "Code of Ethics for Civil Engineers." It is instructive that the Beliefs and Principles had not been updated since 1938 and had been of relatively little consequence during the interim period. The new Code does not mention responsibility to one's employer until the eighth of fifteen provisions. Rather, the Code first reminds civil engineers that they should "adhere to the ethical principles of self-disciplined moral obligation when applying advanced technology" and then repeatedly articulates their responsibilities to society at large. Thus, for example, the first provision states that the civil engineer shall "[a]pply his/her technical skills to create, improve, and maintain 'beautiful national land,' 'safe and comfortable livelihood,' and 'prosperous society', thus contributing to society through his/her knowledge and virtue with an emphasis upon his/her dignity and honor." Note the explicit inclusion of women through the grammatical choice of "his/her." For Japanese civil engineers, to follow the provisions of the Code and fulfill obligations to society as a whole is also to accept the Japanese Society for Civil Engineers as a household through which obligations can legitimately be formulated and fulfilled.

In 2000, the Japanese Diet underwrote the legitimacy of this movement to professionalize engineers by transforming the "Consulting Engineers Law" into the "Professional Engineers Law." Its main provision not only emphasized the link between the individual engineer and the national household but also charged engineers with the obligation to help insure that Japanese corporations remain Japanese. The provision stipulates that "Engineers should not only posses the capability to take charge of their duties, but they should also have ethics that places the responsibility toward society and public benefits as the premise for the activities by corporations and other entities." The national movement to professionalize engineers is profound, responding to an externally-induced transformation of the corporate household with an innovative move to legitimize a new household, the engineering profession, that functions both as an aid to corporate households that retain a primary obligation to the national household and as a pathway for engineers to bypass or work around corporate households that fail in order to define and fulfill their obligations at the national level. Although it is difficult to speculate on the most likely future relationships between corporate and professional households, even the Japanese Diet has endorsed an effort to find a distinctively Japanese pathway in an era defined by economic competitiveness. As Hideo Ohashi eloquently put it, "We need a revolution of our consciousness, from ignoring to respecting professionals . . . The recovery of competitiveness should not be the final target. We dream of a society whose keywords are safe, reliable, healthy, peaceful, and heart-warming."[33]

Conclusion: Asking the "who question"

As this small set of cases suggests, asking the "who question" leads to the finding that emergent interests in education in engineering ethics are following distinct trajectories in different countries. In France, formal education in engineering ethics has attracted little interest. It would likely be seen as insulting to elite engineers who know by their very promotion into higher education that they have demonstrated every dimension of individual merit, including moral responsibility, that the French nation deems important to certify them as national leaders. In this context, for lesser schools to adopt education in engineering ethics would constitute an open admission and acceptance of subordinate status.

In Germany, a longtime commitment to social responsibility through technology evaluation and assessment has gained renewed, if not enhanced, significance when that responsibility was put at risk in a new international context emphasizing low-cost production for mass use. For German engineers, engineering ethics amounts to a unique tool for the defense of the German nation.

In Japan, the recent flourishing of ethics instruction by professional engineering societies as well as great interest in engineering ethics demonstrated by the new accreditation body offers a case in which continued commitment to the nation may depend upon a significant internal innovation, namely societal permission for the engineering profession to develop as a new household alongside existing corporate households. The Japanese professional appears to be emerging as someone who has found a new, untarnished pathway to fulfilling obligations to the national whole.

Beyond attention to national differences, pursuing the "who question" also directs one's attention to ways in which the emergence of engineering ethics follows different trajectories and has a range of implications within particular countries as well. It matters who openly advocates instruction in engineering ethics, who passively ignores such initiatives, and who open resists, for such is often an indicator of who is content with their current identity and who is seeking a change. For example, to ethicist Christelle Didier, rising international interest in engineering ethics provides a new source of legitimacy for her efforts to integrate Catholic ethics with engineering at the Catholic University of Lille.

Finally, asking the "who question" can help clarify what counts as the problem of engineering ethics in transnational spaces. The findings above suggest that, at present, the so-called "global" is a relatively placeless place. In other words, in the context of long historical trajectories of engineering education and practice, what gets named the "global arena" tends to appear as a relatively undefined, residual space. The space appears to have substance and force because it seems to be placing specific demands, challenging national trajectories to move in particular dimensions, especially toward low-cost production for mass use. But in every case, the real force of the global lies it how its challenges are internalized, frightening those who locate themselves within a nation about what they value most in themselves, such as state agency in France, quality technology in Germany, and a harmonious future in Japan. As a result, education in engineering ethics frequently emerges as much a defensive strategy to reassert existing identities as an effort to build something entirely new.

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(d) Christelle Didier maintains that it is important to call attention to the historical emergence among engineers of a distinctive ideal of service, understood as the mediation of social classes. In other words, social order is not increasing if classes are in conflict (personal communication).

(e) Thanks to the anonymous reviewer who offered evidence that the ethical concern may extend beyond corporations to include engineers as people. Some members of the Aum Shinrikyo cult that released nerve gas into the Japanese subway system were engineering students.