THE ENIGMA OF ENGINEERING'S INDUSTRIAL EXEMPTION TO LICENSURE: THE EXCEPTION THAT SWALLOWED A PROFESSION

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I. INTRODUCTION

A license has become almost as common for workers in the United States as goldbricking.[1] Nearly a third of America's workers must have some form of government-issued license to do their jobs.[2] This number is almost seven times higher than it was just fifty years ago[3] and is a striking shift from a time before the Civil War when anyone could engage in virtually any occupation or profession without a license.[4] Today, every state requires some form of licensing for an average of ninety-two occupations.[5] With so many occupations involved, anomalies are bound to emerge. Morris Kleiner offers these examples:

> In Minnesota, more classroom time is required to become a cosmetologist than to become a lawyer. Becoming a manicurist takes double the number of hours of instruction as a paramedic. In Louisiana, the only state in the country that requires licenses for florists, monks were until recently forbidden to sell coffins because they were not licensed funeral directors.[6]

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[1] American workers average "stealing" about 3½ hours a week from their employers at a cost of about $137 billion a year. *Bosses: Goldbricking Costs Firms $137B*, PHILA. DAILY NEWS, Nov. 17, 1983, at 18.

[2] Morris M. Kleiner, Op-Ed., *Why License a Florist?*, N.Y. TIMES, May 28, 2014, at A35. Focus of this article is on the most demanding form of licensing, referred to as "license," "licensure," or "licensing." Government typically uses it to license persons who pass an examination and satisfy education, experience, and character requirements. Less demanding forms of licensing include certification, in which authorization is granted after verification of persons' education or expertise in that field and does not preclude others from practicing the occupation, and registration, in which a person merely declares that he or she is practicing, provides contact information and pays a fee.

[3] During the 1950s, about 4.5% of the American workforce worked on jobs requiring a license. Morris M. Kleiner, *A License for Protection: Why are States Regulating More and More Occupations?*, 29 REG. 17, 17 (2006).

[4] COUNCIL OF STATE GOV'TS, OCCUPATIONAL LICENSING LEGISLATION IN THE STATES 19 (1952).

[5] Adam B. Summers, *Occupational Licensing: Ranking the States and Exploring Alternatives*, REASON FOUND. 5 (2007), http://reason.org/files/762c8fe96431b6fa5e27ca64eaa1818b.pdf. "The most regulated state in the nation is California, which requires licenses for 177 job categories . . . ." *Id.*

[6] Kleiner, *supra* note 2.

While amusing, these anomalies are a reminder that occupational licensing[7] can be duplicitous. Its proponents typically defend it as necessary for protecting the public from incompetents and charlatans, but the Council of State Governments used an old joke to make the important point that licensing also can be motivated by the self-interest:

> Not long ago the Governor of a midwestern state was approached by representatives of a particular trade anxious to enlist the Governor's support in securing passage of legislation to license their trade.
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> "Governor," the men said, "passage of this licensing act will ensure that only qualified people will practice this occupation; it will eliminate charlatans, incompetents or frauds; and it will thereby protect the safety and welfare of the people of this state."
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> The Governor, from long experience, was somewhat skeptical. "Gentlemen," he asked, "are you concerned with advancing the health, safety and welfare of the people under the police powers of this state, or are you primarily interested in creating a monopoly situation to eliminate competition and raise prices?"
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> The spokesman for the occupational group smiled and said, "Governor, we're interested in a little of each."[8]

The joke's punch-line highlights the significant economic and social benefits that result from attaching a mandatory license to an occupation.[9]

Even with monetary benefits to be reaped from licensing, American engineers have been surprisingly ambivalent toward licensing, if not outright rejecting of it. In a striking enigma, an overwhelming majority of engineers—somewhere around eighty percent[10]—do not pursue licensing as a professional

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[7] The term "occupational licensing" includes licensing of the professions, such as law and medicine, and occupation groups, such as barbers.

[8] COUNCIL OF STATE GOV'TS, *supra* note 4, at 1.

[9] Kleiner, in a study conducted with Alan B. Krueger, concluded that requiring a licensing for an occupation can increase salaries by as much as fifteen percent. Kleiner, *supra* note 2. For a survey of literature on the issue of occupational licensing's economic benefits, *see* REED NEIL OLSEN, *The Regulation of Medical Professions*, *in* 5870 ENCYCLOPEDIA OF L. & ECON. 1018-54 (Boudewijn Bouckaert et al. eds., 2000), *available at* http://encyclo.findlaw.com/5870book.pdf.

[10] This figure represents a consensus. *See, e.g.*, M. J. Kolhoff, *For the Industry Exemption . . .*, *in* ENGINEERING PROFESSIONALISM AND ETHICS 526, 526-27 (James H. Schaub et al. eds., 1983); Craig Musselman, *The 80% Myth in the Engineering Profession*, NAT'L SOC'Y PROF. ENGINEERS (Sept. 13, 2010), http://community.nspe.org/blogs/licensing/archive/2010/09/13/the-80-myth-in-the-engineering-profession.aspx. In 2001, the California Society of Professional Engineers published a 1995 estimate prepared by the National Council of Examiners of Engineering and Surveying (NCEES) that reported approximately 2.2 million engineers practicing in the United States and that approximately 400,000 of them, or eighteen percent, were licensed. *An Introduction to*

engineer.[11] But even more befuddling is why the states, every one of which requires a license to practice engineering,[12] allow the lion's share of engineering to be done by unlicensed persons, especially in light of the state's assertion that engineering licenses are necessary for the public's protection.[13] Every state exempts from licensure engineers whose practices fit within one or more of five categories: (1) engineers working under the supervision of a licensed engineer who takes responsibility for the unlicensed engineer's work; (2) engineers employed by public utilities; (3) engineers employed by the federal government; (4) engineers employed by a state government; and (5) "in-house" engineers employed by a manufacturing or other business firm (known as the "industrial exemption").[14]

The policy underlying these exemptions, especially the industrial exemption, is perplexing. It begs the question of how an engineer's working for an industrial firm protects the public and makes licensing unnecessary. No state exempts a lawyer or physician from licensure simply because he or she is employed by the government or a corporation. How does a state justify requiring a florist to have a license, no matter where he or she works,[15] but does not require

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Professional Engineering Licensing in California and Other States, CAL. SOC'Y PROF. ENGINEERS 3 (2001), http://www.cspe.com/GovtAffairs/TitleActStudy.pdf. The engineering specialty in which the largest number of practitioners were licensed, according to the NCEES statistics, was civil engineering. *Id.* Forty-four percent of civil engineers were licensed. *Id.* In the other engineering specialties, twenty-three percent of mechanical engineers were licensed; nine percent of electrical engineers; eight percent of chemical engineers; eight percent of industrial engineers; thirteen percent of agricultural engineers; and seventeen percent of mining and metallurgical engineers. *Id.*

[11] The designation "professional engineer" in the profession refers to those engineers who have obtained licensure. *See* Karen Chassie, *The PE License: Certifying Competence*, IEEE POTENTIALS, Aug./Sept. 2001, at 14.

[12] "Engineering" is defined variously by the states. They typically define it very broadly as providing, for remuneration, any service or creative work that entails application of engineering principles and principles of mathematical, physical, and engineering sciences. The definition applied by state governments in regulating engineers typically employ a much broader, all-encompassing definition.

[13] For example, the New Hampshire Board of Professional Engineers asserts on its website that the board's purpose is "to regulate the practice of Professional Engineering in this State to safeguard life, health, property, and to promote public welfare." *Welcome to the NH Board of Professional Engineers*, ST. N. H. BOARD PROF. ENGINEERS, http://www.nh.gov/jtboard/pe.htm (last visited Oct. 13, 2014). The Kentucky Board of Engineers and Land Surveyors asserts on its website that the state's engineering licensing law was enacted in 1938 "to protect the public health, safety, and welfare." *About Us*, KY. BOARD ENGINEERS & LAND SURVEYORS (2012), http://kyboels.ky.gov/Pages/default.aspx.

[14] *See Demonstrating Qualifying Engineering Expereince for Licensure*, Nat'l Soc'y prof. Engineers, (July 28, 2007), http://www.nspe.org/resources/licensure/resources/demonstrating-qualifying-engineering-experience-licensure.

[15] Since 1936, Louisiana has required florists to be licensed. Dick M. Carpenter II, *Testing the Utility of Licensing: Evidence from a Field Experiment on Occupational Regulation*, 13 J. APPLIED BUS. & ECON. 28, 30 (2012). The requirement is set out in LA. REV. STAT. ANN. § 3:3808 (2014).

an engineer, whose negligence can kill,[16] to obtain a license simply because he or she works for an industrial firm?

As incompatible with protecting the public as the industrial exemption seems to be, the courts have made clear that the states are free to persist in such policies. In such matters as licensing, the states have virtually unfettered discretion. The United States Supreme Court has declared that regulatory licensing is one the government's strongest powers to be wielded as it deems necessary for protecting society.[17]

Even if the policy of the exemptions does not violate due process rights, it is difficult to defend as good government. Indeed, the exemptions raise suspicions that their enactment had more to do with politics—protecting the private interests of industrial firms and others—than with good government.[18] Unlike any other profession, engineering has always been dominated by large industrial interests, which often have much political power.[19] Although engineers provided the genius and ingenuity for America's industrialization, they did so as employees of business entities and entrepreneurs. Little has changed. As Edwin Layton observed, engineering has always involved an attempt—with mixed success—to blend science and business. "[T]he test of an engineer's work," he said, "lies not in the laboratory, but in the marketplace."[20] Engineers' success has always been tied to industry's success,[21] and today the overwhelming majority of engineers—as many as ninety percent[22]—work for large manufacturing

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In 2010, the legislature abolished the four-hour subjectively-judged demonstration section of the floral exam, but a written exam still is required. Jacob Sullum, *A Victory for Floral Freedom in Louisiana*, REASON.COM (July 12, 2010, 12:52 PM), http://www.reason.com/blog/2010/07/12/a-victory-for-floral-freedom-i.

[16] Doug McGuirt notes two major disasters attributed to "engineering oversights" that motivated legislators to enact engineering licensing laws. Doug McGuirt, *The Professional Engineering Century*, NAT'L SOC'Y PROF. ENGINEERS (June 2007), at 24-29. These disasters were the 1928 collapse of the St. Francis Dam near Los Angeles that killed more than 500 persons and the 1937 school explosion in New London, Texas, that killed about 300 persons. *Id.*

[17] Dent v. West Virginia, 129 U.S. 114, 122 (1889).

[18] *See* George Stigler, *The Theory of Economic Regulation*, 2 BELL J. ECON. & MGMT. SCI. 3, 3 (1971) ("The state—the machinery and power of the state—is a potential resource or threat to every industry in the society. With its power to prohibit or compel, to take or give money, the state can and does *selectively* help or hurt a vast number of industries.") (emphasis added).

[19] EDWIN T. LAYTON, JR., THE REVOLT OF THE ENGINEERS: SOCIAL RESPONSIBILITY AND THE AMERICAN ENGINEERING PROFESSION ch. 1 (1986). Only large organizations could take advantage of engineers' knowledge of science because "large works are more likely to involve complexities than are small ones; and the larger the project, the more likely it is that such difficulties will transcend the capabilities of artisans and businessmen." *Id.* at 2.

[20] *Id.* at 1.

[21] ANDREW ABBOTT, THE SYSTEM OF PROFESSIONS: AN ESSAY ON THE DIVISION OF EXPERT LABOR 156 (1988).

[22] Carl Nelson & Susan Peterson, *Ethical Decisions for Engineers: Systematic Avoidance and the Need for Confrontation*, *in* ENGINEERING PROFESSIONALISM AND ETHICS 330, 334 (James H. Schaub

businesses, exempting them from licensure in states recognizing an industrial exemption.[23]

This article probes the soundness of the policy underlying the industrial exemption. It concludes that, although emergence of the exemption was a natural consequence of engineering's close alliance from the very start with big business, the exemption has thwarted engineering's development as a bona fide profession. It also concludes that only with elimination or a significant reengineering of the exemption can the profession truly expect to attain profession status. Such a rethinking about the exemption will come only with a major change in attitude by engineering practitioners as to what it means to be an engineer.

The article begins its probe in Part II with a brief history of engineering licensing. This section identifies the primary factors that spurred the sudden push for engineering licensing at the beginning of the 20th Century and concludes that it resulted from two major instigators. One was the Progressive reform movement, which pushed for bureaucratic regulation as the solution to the dangers emerging from the nation's rapid industrialization and urbanization. The Progressives sought licensing as a means for protecting the public from incompetents and charlatans. The other motivating force was an awakening by some engineering leaders to the economic benefits to be reaped from licensure. Finally, the section traces the backlash by industry, engineering's close partner, to licensing that resulted in the industrial exemption. Part III focuses on the policy and rationale underlying the industrial exemption. It considers the defense of the industrial exemption articulated by an engineer working in industry, M. J. Kolhoff, and rejects his arguments as untenable, resting politics and monetary self-interest of powerful business firms that employed large contingencies of engineers. Moreover, it concludes that the exemption has been a significant factor, coupled with lack of control of engineering by engineers in industry, for relegating engineering to a mere occupation group status. Finally, Part IV endeavors to show that the industrial exemption is dangerous to engineering because it facilitates business-controlled engineering, which has been a significant factor in some major disasters and failures, including the 1986 *Challenger* disaster and the 2010 BP oil spill in the Gulf of Mexico. It also asserts that the industrial exemption is dangerous for engineering because it has necessarily meant engineers' loss of control of industrial engineering and has contributed to a change in attitude concerning personal responsibilities. If engineering is ever to achieve profession status, the root cause of its relegation to a mere occupation group, the industrial exemption must be eliminated or significantly pared.

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et al., eds., 1983); *see also* ROBERT J. BAUM, ETHICS AND ENGINEERING CURRICULA 15 (1980). Elliott Krause puts the number at eighty-five percent. ELLIOTT A. KRAUSE, DEATH OF THE GUILDS: PROFESSIONS, STATES, AND THE ADVANCE OF CAPITALISM, 1930 TO THE PRESENT 61 (1999).

[23] Eligibility for an exemption can depend on the exemption statute's wording.

II. A BRIEF HISTORY OF ENGINEERING LICENSURE IN THE UNITED STATES

Occupational licensing in general did not become a significant facet of American society until the closing years of the 19th Century.[24] Before then, only practitioners of the "learned professions" of law and medicine required a government-issued license.[25] By the years before the Civil War, when engineers were just beginning to emerge as an occupation group, licensing had lost much of its significance. Not only did licensing seem inconsistent with the Jacksonian democracy ideals that dominated early 19th Century thought, but the Civil War shook the nation into a reconsideration of its basic institutions—even rethinking what it meant to be a nation. Norman Spaulding explained that this national introspection caused the professions, even the most highly respected practice of law, to retreat "to organizational structures that provided collective, less directly political, venues in which to secure professional authority."[26] In the respite of the post-war years, the occupations, even law and medicine, were wide open to most anyone.

During this time, the nation's industrialization gave rise to the forerunners of today's engineers. From the beginning—and it has never changed—engineering was closely tied to industrial interests. Engineering emerged in the 19th Century in response to industry's call for scientific knowledge in the development of steamboats, steam engines, locomotives, canals, and the like.[27] The first engineers were a tiny cadre of experts who practiced what was then called the "mechanics arts," which involved applying scientific principles to industrial products.[28] These experts worked almost exclusively as employees of large-scale business organizations and the military.[29] Large outfits were the only ones that could afford to employ them. Small firms did not have the resources to deal in the products that needed their expertise.[30] Engineering's close alliance with big business became a persistent theme of the profession that endures today.

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[24] COUNCIL OF STATE GOV'TS, *supra* note 4, at 16-17.

[25] Douglas A. Wallace, *Occupational Licensing and Certification: Remedies for Denial*, 14 WM. & MARY L. REV. 46, 46 (1972).

[26] Norman W. Spaulding, *The Discourse of Law in Time of War: Politics and Professionalism During the Civil War and Reconstruction*, 46 WM. & MARY L. REV. 2001, 2094 (2005). Spaulding asserts that the nation's constitutional crisis spilled over into a question of even law's legitimacy, causing a retreat of the venerable legal profession. *Id.*

[27] Bruce Sinclair, *Episodes in the History of the American Engineering Profession*, *in* THE PROFESSIONS IN AMERICAN HISTORY 127, 128-29 (Nathan O. Hatch ed. 1988).

[28] *Id.* at 128-30.

[29] LAYTON, *supra* note 19, at 2.

[30] *Id.*

A. Early Years of Licensing

During the 17th and early 18th centuries, only physicians and lawyers had to have a license to do their jobs.[31] Restrictive licensing for medicine and law began to disappear during the early 19th Century[32]. The waning of these professions came at the hands of reformers, caught up in the zeal of the Jacksonian era (from about 1820 to 1845) to equalize American society by opening the professions to the masses.[33] By 1850, licensing of physicians had ended entirely.[34] Practitioners of alternative medicine, especially homeopathy,[35] increased in number and gained popularity, notably garnering the support of well-to-do and politically powerful individuals.[36] The homeopaths were able to leverage this popularity into achieving repeal of licensing laws that restricted the practice of medicine to "regulars," or physicians of traditional remedies of bleeding and mercury-based cathartics.[37] Only vestiges of licenses for lawyers remained at the middle of the 19th Century. In 1851, for example, Indiana's new constitution opened the practice of law to everyone by providing that "[e]very person of good moral character, being a voter, shall be entitled to admission to practice law in all courts of justice."[38] About the only governmental restraint on the practice of law anywhere by 1850 was passage of an examination administered by a court, usually the local trial court, and a number of states did not require even that.[39]

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[31] Wallace, *supra* note 25, at 46.

[32] COUNCIL OF STATE GOV'TS, *supra* note 4, at 18-19.

[33] *See* Rebecca Roiphe, *A History of Professionalism: Julius Henry Cohen and the Professions as a Route to Citizenship*, 40 FORDHAM URB. L. J. 33, 40 (2012).

[34] COUNCIL OF STATE GOV'TS, *supra* note 4, at 18.

[35] "[H]omeopathy is premised on four cardinal principles: (1) most diseases are attributed to an infectious disorder known as the psora (itch); (2) the body contains a spiritual force (vitalism) which directs its own healing process; (3) remedies are discerned by giving healthy patients repeated doses of many common remedies and recording the symptoms they produce (proving), then applying those substances, in highly diluted doses, to conditions with those symptoms (Law of Similars); and (4) remedies become more effective with greater dilution (Law of Infinitesimals) and become more diluted when shaken or agitated (potentizing)." Patrick L. Sheldon, *The Truth About Homeopathy: A Discussion of the Practice and the Dangers that Inhere*, 8 QUINNIPIAC HEALTH L.J. 289, 290-91 (2005).

[36] Homeopathic physicians gained popularity among "wealthy and cultured Americans who objected to the 'sledgehammer' doses of medicines then in vogue." JOHN S. HALLER, JR., A PROFILE IN ALTERNATIVE MEDICINE: THE ECLECTIC MEDICAL COLLEGE OF CINCINNATI 19 (1999).

[37] Robert L. Numbers, *The Fall and Rise of the American Medical Profession*, *in* THE PROFESSIONS IN AMERICAN HISTORY 51, 54 (Nathan O. Hatch ed. 1988). *See also* HALLER, *supra* note 36, at 19.

[38] Maxwell H. Bloomfield, *Law: The Development of a Profession*, *in* THE PROFESSIONS IN AMERICAN HISTORY 33, 35 (Nathan O. Hatch ed. 1988) (citation omitted).

[39] COUNCIL OF STATE GOV'TS, *supra* note 4, at 19.

Licensing's virtual disappearance by the Civil War has been described as a "remarkable reversal."[40] In addition to the Jacksonian reformers' push for opening the professions to everyone and the political power gained by "outsiders," the Council of State Governments has identified three other factors that precipitated rejection of occupational licensing during this period. They were: (1) governments' adoption of a *laissez-faire* policy toward the growing industrial sector; (2) a shortage of professionals to serve the nation's exploding population; and (3) a preference for decentralized government in the new, unsettled areas, which typically resulted in loose regulatory standards for business and occupations.[41]

During this time of *laissez-faire*, the number of engineers remained small. Between 1816 and 1850, the number of engineers in the United States grew from an estimated thirty to 2,000.[42] Nearly all of their work involved canal building and railroad construction, and such projects were where individuals gained their skills and knowledge in the mechanic arts—through on-the-job training.[43] Sunny Auyang describes these early engineers as mostly uneducated and from the lower classes of society.[44] "Even among leading engineers . . .," Auyang says, "[t]he majority had been apprenticed to millwrights, barbers, carpenters, stone masons, instrument makers. Because of their humble origins, these pioneering engineers were often stereotyped as craftsmen incapable of scientific reasoning."[45]

As technology incorporated scientific principles, it gradually moved beyond the capabilities of an artisan or businessman whose limited understanding of science and physics could not keep pace. Institutions and specialty schools began springing up around the country to fill the gap and to supplant on-the-job training.[46] The Rensselaer Polytechnic Institute in Troy, New York, and the Maryland Mechanics' Institute, both established in 1824, were among the first to offer programs intended to transform the old workforce into technicians through night classes and magazines.[47] These casual educational endeavors were unsuccessful because lessons had to be taught on such a basic level that they had little value for on-the-job application.[48] What was needed was not knowledge of science and physics as much as understanding of its methods.[49] Engineering took

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[40] *Id.*
[41] *Id.*
[42] LAYTON, *supra* note 19, at 3.
[43] *Id.*
[44] SUNNY Y. AUYANG, ENGINEERING—AN ENDLESS FRONTIER 115 (2004).
[45] *Id.*
[46] Sinclair, *supra* note 27, at 129.
[47] *Id.* at 129-30.
[48] *Id.*
[49] *Id.* at 130.

on an emphasis on application—on form and method.[50] After a coalition of scientists and industrialists gained control of the Franklin Institute in Philadelphia, it initiated in 1836 a new curriculum to train engineers in these methods, and it became one of the first successful programs.[51] The institute's curriculum laid the foundation for development of formal, full-time, university-level engineering education and a decided shift away from apprenticeship training.[52] Molded by the collaborative work of scientists and industrialists, engineering began to take definite shape. Bruce Sinclair has observed that "scientists saw career opportunities in teaching, research, and publication, while the entrepreneurs visualized greater profits from an applied-science-based industry . . . ."[53] At times, either the science side or the entrepreneur side of the coalition dominated, setting off an incessant debate over whether engineering should be more science or more art or application.[54]

Before the Civil War, other privately-funded institutions began to offer programs similar to the Franklin Institute's offering.[55] In 1862, the Morrill Act provided funding for public agricultural and mechanical colleges, and public institutions began offering courses in civil, mechanical, mining, and chemical engineering.[56] By 1896, an engineering student could choose from 110 colleges offering an engineering curriculum, and the number of students skyrocketed from around 1,000 in 1890 to around 10,000 in 1900.[57]

As deaths resulting from failure of the industrial revolution's machinery mounted,[58] the profession's leaders resolved that the profession should police itself through formation of engineering societies. Civil engineers organized societies of local engineers in Boston (1848), New York (1852), St. Louis (1868), and Chicago (1869).[59] In 1869, the New York society morphed into the American Society of Civil Engineers (ASCE), which began pushing for attaining recognition of engineering as a learned professional on par with medicine and

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[50] *Id.*
[51] *Id.*
[52] *Id.* at 132.
[53] *Id.* at 132-33.
[54] *See* LAYTON, *supra* note 19, at 26-27.
[55] Sinclair, *supra* note 27, at 131.
[56] *Id.*
[57] LAYTON, *supra* note 19, at 4.
[58] For example, boilers exploded routinely, reaching a rate of about 400 a year by 1900. AUYANG, *supra* note 44, at 292. In 1865, about 1,700 passengers of the steamboat *Sultana*, mostly Union soldiers returning home from Confederate prison camps, were killed when the vessel's boiler exploded on the Mississippi River. Miss. Historical Soc'y, *Surviving the Worst: The Wreck of the Sultana at the End of the American Civil War*, http://mshistorynow.mdah.state.ms.us/articles/319/surviving-the-worst-the-wreck-of-the-sultana (visited Jan. 11, 2015).
[59] LAYTON, *supra* note 19, at 29. Although the New York society called itself the American Society of Civil Engineers, it functioned as an organization for New York engineers. *Id.*

law.[60] At about the same time, mining engineers organized the American Institute of Mining Engineers (AIME), which functioned principally as an arm of the mining and metals industries.[61] Engineers continued to organize regional societies, but ASCE's and AIME's formation and function as national societies began to overshadow the regional organizations.[62]

ASCE began setting the pace for moving engineering into profession status. Its membership requirements were higher than other societies: members had to have practiced engineering for five years and "be in charge of engineering work."[63] Those requirements were upped in 1891 to having ten years of practice, being in charge of engineering for at least five years, and being able to do design work.[64] These high standards, however, became a stumbling block to ASCE's supplanting regional societies and specialty groups. Unable to meet ASCE's requirements, engineers either broke off into splinter groups or worked exclusively with local societies.[65]

Engineers working in industry, however, provoked the most difficult internal problems for ASCE. These individuals dubbed themselves as mechanical engineers, but often they were only glorified plant managers or superintendents with little or no formal engineering training.[66] ASCE leadership began to loath the close affiliation such engineers had with industry and initiated toward the end of the 19th Century a fight for engineering's independence from industry's control.[67] It understood, however, that outside influence exerted by the likes of railroads and other major industrial firms had to be appeased, which frequently led to compromises concerning ASCE policies.[68] Concerning the ASCE's attempts to attain profession status for engineering at the time, Edwin Layton observed:

> By the end of the nineteenth century, leaders of the ASCE viewed the progress of their society with a satisfaction bordering on complacency. The success of the ASCE rested on its very high professional standards of membership and the diversity of occupational roles open to civil engineers. Corporation employees were not in ascendency; nor was any single industry dominant. Presidents of the ASCE took a high degree of professional autonomy for granted. They depreciated the disagreements between civil engineers serving as expert

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[60] *See id.* at 29-30.
[61] *Id.* at 29.
[62] *Id.*
[63] *Id.* at 29-30.
[64] *Id.* at 30.
[65] *Id.* at 31.
[66] *Id.*
[67] *Id.* at 32.
[68] *Id.*

> witnesses before the courts and suggested, instead, that the professional engineer ought to serve the courts themselves rather than the litigants. Such a role implied that engineers should be independent of specific commercial interests.[69]

The nemesis of the ASCE's attempts to move engineering into profession status was the AIME. The institute's obvious purpose was to serve the mining industry's interests, and it showed no interest at all in developing engineering into a profession.[70] Virtually anyone could obtain full membership.[71]

As industrialization resulted in rapid change of American society, engineering benefitted greatly. Industrialization created a bounty of engineering jobs, and engineers suddenly grew in numbers, wealth, and influence. Between 1850 and 1880, the number of engineers in the United States jumped from about 2,000 to about 7,000.[72] By 1920, that number had multiplied to about 136,000.[73]

But the more engineers grew in numbers, the less engineering moved toward profession status. In the closing decades of the 19th Century, engineering was badly splintered, and engineers debated vigorously whether their best interests lay in independence from business or in casting their lots with it. Generally, engineers opted for the middle road. They rejected AIME's extreme business leanings, but they spurned ASCE's push for independence as being unable to serve the needs of engineering specialists emerging in industry.[74]

Engineers favoring the middle road position organized the American Society of Mechanical Engineers (ASME) in 1880.[75] A coalition of engineers, inventors, and others established the American Institute of Electrical Engineers (AIEE).[76] More than previous societies, these new organizations better reflected the general attitude of the growing number of engineers working in industry. Neither organization saw a need for the independence from business advocated by ASCE or for maintaining a close union between engineering and business as practiced by AIME.[77]

Nearly all of ASME's leaders were owners of industrial firms, which blunted any discussion of independence.[78] ASME restricted membership to individuals who were in "responsible charge" of engineering projects, but it was sufficiently loose in enforcing the requirement that more than half of its members

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[69] *Id.* at 33.
[70] *Id.* at 34.
[71] *Id.*
[72] *Id.* at 3.
[73] *Id.*
[74] *Id.* at 35.
[75] *Id.*
[76] *Id.*
[77] *Id.*
[78] Sinclair, *supra* note 27, at 135.

were managers or owners of industrial firms.[79] An early ASME president described society members as "good mechanics by instinct, good men by original construction, good fellows by nature and habit and training."[80] Nonetheless, at least until the 20th Century, professional engineers rather than business interests remarkably controlled ASME's affairs and policies.[81]

The coalition of engineers, inventors and industrialists established the AIEE so the United States would have a representative organization at Philadelphia's International Electrical Exposition in 1884.[82] AIEE was the American counterpart to the British Institute of Electrical Engineers, and its first president, Norvin Green, president of Western Union Telegraph Company and a physician and politician, was not an engineer.[83] Notwithstanding Green's leadership and the large number of non-engineer participants, AIEE remained committed to professional engineering ideals. This commitment resulted primarily from the institute's focus on electrical engineering. Unlike the other engineering specialties, electrical engineering did not evolve from an old artisan craft but was involved with application of science and physics.[84] To belong to AIEE, engineers had to have been involved in some capacity with engineering for five years, have been in responsible charge of engineering projects for two years, and been able to design engineering systems.[85] At first, business interests were denied full membership, and this did not create any strife until after the turn of the century.[86]

Known as the "founder societies," ASCE, AIME, ASME, and AIEE endeavored to operate as federations of all engineering specialties at the end of the 19th Century,[87] but this was not successful. Although specialty groups enjoyed much self-governance within these societies, they still broke away to form their own specialized society groups. The Naval Society of Architects and Marine Engineers began in 1893, followed by the American Society of Heating and Ventilating Engineers in 1894, the American Railway Engineering Association in 1899, the American Electrochemical Society in 1902, the Society of Automotive Engineers in 1904, the Illuminating Engineering Society in 1906, the American Institute of Chemical Engineers in 1908, and the Institute of Radio Engineers in 1912.[88] These groups broke off from the founder societies in

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[79] LAYTON, *supra* note 19, at 36-37.
[80] Sinclair, *supra* note 27, at 137 (citation omitted).
[81] LAYTON, *supra* note 19, at 37.
[82] *Id.* at 38.
[83] *Id.*
[84] *Id.* at 38-39.
[85] *Id.* at 39.
[86] *Id.* at 39-40.
[87] *Id.* at 40.
[88] *Id.* at 41.

disagreement over the proper balance between business and professional interests. These new groups sought a closer alliance with business.[89]

B. Vying for Professionalism at the Beginning of the 20th Century

Rapid industrialization after the Civil War quickly transformed American society from agrarian to urban. Industrialization resulted in domination of society by manufacturing firms and corporations.[90] Advances in science and technology gave rise to many new occupations such as plumbers and electricians, and individuals working in these new positions began organizing societies to promote their mutual interests.[91] Several of these societies began pushing for occupational licenses in hope that restrictive licenses would create monopolies of jobs that would reap economic benefits.[92]

Significant changes in society brought on by the nation's rapid industrialization also increased pressure on governments to begin licensing and regulating occupations. Urbanization changed the way consumers interacted with providers of goods and services. Unlike inhabitants of rural areas, city dwellers often did not know the persons from whom they bought their goods or on whom they depended for important services.[93] Not only were these providers of goods and services strangers to their customers and clients, but they suddenly began using mysterious, newly-invented instruments, such as the ophthalmoscope,[94] resulting from scientific breakthroughs. Such instruments allowed physicians and scientists to pierce into a realm previously not knowable by unaided human senses—or at least make the claim that they could. Consumers did not have the understanding, experience, or education to verify these claims.[95] They had no way of testing their suspicions of being cheated. Helpless, they supported regulatory laws proposed by progressive reformers for imposing bureaucratic regulation, including licensing, for protecting the public

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[89] *Id.* at 41-42.

[90] COUNCIL OF STATE GOV'TS, *supra* note 4, at 17.

[91] *Id.* at 20. Regular physicians organized the American Medical Association in 1847. Others following suit in organizing effective national organizations, including pharmacists and civil engineers in 1852, architects in 1857, dentists in 1859, and veterinarians in 1863. *Id.*

[92] *Id.* at 20-21.

[93] Marc T. Law & Sukkoo Kim, *Specialization and Regulation: The Rise of Professionals and the Emergence of Occupational Licensing Regulation*, 65 J. ECON. HIST. 723, 729-31 (2005).

[94] *Id.* German ophthalmologist Hermann von Helmholtz is credited with developing an instrument in 1850, which he described as "a combination of glasses, by means of which it is possible to see the dark background of the eye, through the pupil, without employing any dazzling light, and to obtain a view of all the elements of the retina at once, more exactly than one can see the external parts of the eye without magnification . . . ." J. M. S. Pearce, *The Ophthalmoscope: Helmholtz's Augenspiegel*, 61 EUROPEAN NEUROLOGY 244, 247 (2009) (citation omitted).

[95] Law & Kim, *supra* note 93, at 729.

from incompetent and cheating providers.[96] Joining beleaguered consumers in seeking the government's intervention were honest providers who believed that licensing was an effective way of purging "bad apples" from their ranks and avoid their spoiling everyone's reputation.[97]

Legislators responded to these calls by enacting legislation requiring competency examinations as a requisite to obtaining a license to practice any number of professions and occupations. At the close of the 19th Century and in the early years of the 20th Century, the states quickly began enacting "[l]aws to license doctors, plumbers, barbers, [beauticians,] funeral directors, nurses, electricians, horseshoers, dentists, and the practitioners of many other occupations. . . ."[98] States adopted most of these licensing laws between 1900 and 1920, a time when progressivism was at its peak of influence. Marc Law and Sukkoo Kim note a jump in medical malpractice lawsuits during this era and concluded that it may have resulted from plaintiffs' using licensing laws, which favored the regulars, to establish a standard of acceptable medical practice.[99] Before licensing laws, plaintiffs had difficulty establishing that the practices of "quacks" were contrary to acceptable standards.

During this period, however, consumers did not show signs of being concerned by the practices of engineers, probably because they rarely encountered engineers—certainly not as routinely as they did doctors, veterinarians, barbers, hairdressers, electricians, plumbers, and lawyers. Consumers rarely had cause for consulting an engineer, and engineers then, as now, had little cause for interacting with the public; they did their work for the most part as employees of industrial and manufacturing firms. So long as the business firms took responsibility for their engineering employees' work, no one expressed concern. Engineering leaders deemed industrial managers to be far better judges of their engineering employees' competence than the public or government.

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[96] Page Smith describes the progressive movement at the beginning of the 20th Century as the outgrowth of "the Protestant Passion, the desire to redeem the world, . . .which brought on, in large part, the American Revolution itself. Prior to the Civil War it manifested itself most strikingly in the antislavery movement, but it had a dozen familiar forms: temperance, the women's rights movement, the peace movement, the reform of prisons and mental institutions, justice for the Indians, reform of clothes and diet, and dozens of others . . . . [P]rogressivism was the brief crystallization of accumulations of reform sentiment, a nationwide political revival meeting of a kind not uncommon in our history when rational men and women pledged 'their lives, their fortunes and their sacred honor' to make the world new once more[,] . . . and it was in a sometimes uneasy alliance with the new scholarship, with science, and the handmaid of science, research." PAGE SMITH, 7 AMERICA ENTERS THE WORLD: A PEOPLE'S HISTORY OF THE PROGRESSIVE ERA AND WORLD WAR I 345-46 (1985).

[97] *Id.* at 347-48.

[98] Lawrence M. Friedman, *Freedom of Contract and Occupational Licensing 1890-1910: A Legal and Social Study*, 53 CALIF. L. REV. 487, 489 (1965).

[99] Law & Kim, *supra* note 93, at 750-53.

Engineers themselves were, for the most part, dismissive of calls for licensing by the Progressives. A few favored licensing, but most agreed with the *laissez-faire* and anti-licensing positions of their industrial allies. One aspect of progressive reforms, however, did significantly affect development of engineering. Progressives were successful in fighting corruption in city governments, and much of the corruption involved civil engineering projects, such as sewers, streetcar systems, and streetlights.[100] As graft involving such projects ended, civil engineers were able to attain a new level of professionalism.[101]

With a flood of new, young graduates of recently formed engineering schools joining engineering ranks, the profession made a radical change at the beginning of the 20th Century. For the most part, these new engineers went to work for industrial firms, which were riding the crest of industrialization and booming. Bruce Sinclair describes the transformation:

> Partnerships and owner-manager firms in the mechanical industries, the kind of enterprises that had set the style of professionalism, were increasingly being replaced by corporate structures. Instead of a manager engineer intimately familiar with the shop floor, these new corporations featured engineering departments separated not only from the shop floor but from the firm's financial administration, too. And in those larger organizations the drive for system and order . . . tended increasingly to make engineers, especially junior ones, identical units in the corporate machine.[102]

In the estimation of Ralph Nader, the multitude of junior engineers taking jobs at business firms were assuming positions of "minion to corporate management."[103] Indeed, industry managers continued to assert control of even the engineering societies to which the engineers belonged. For example, in 1909, Morris L. Cooke, a notable mechanical engineer and Philadelphia's city engineer, sought to convene a session at ASME's annual meeting on the increasing problem of urban air pollution.[104] Anticipating that his proposal would draw opposition, he supported it with a petition signed by many prominent ASME members, but, after managers at New York Edison and New York Central

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[100] Sinclair, *supra* note 27, at 138.
[101] *Id.*
[102] *Id.* at 137-38 (citation omitted).
[103] Ralph Nader, *The Engineer's Professional Role: Universities, Corporations, and Professional Societies*, *in* ENGINEERING PROFESSIONALISM AND ETHICS 276, 278 (James A. Schaub et al. eds., 1983).
[104] Sinclair, *supra* note 27, at 140.

Railroad voiced strong opposition to the program, the planning committee turned down Cooke's proposal without explanation.[105]

Not only were 20th Century engineers still controlled in many ways by outside industrial interests, they were badly splintered into quarreling factions, typically at odds over how close engineering should be allied with business. The young societies that broke away from the founder societies at the turn of the century did so to forge bonds with business that were so tight the societies often functioned more as trade associations than as engineering societies.[106] For example, the Society of Automotive Engineer deemed one of its missions to be helping small, fledgling automotive companies compete with the automotive giants by working for adoption of technical standards.[107]

Notwithstanding engineering's close ties with business, engineers working in industry maintained strong interest in professionalism. Engineering leaders were confident that engineering had a sound claim for asserting that engineering was a bona fide profession. Their claim rested on three themes. They saw engineers as the agents of technological change and, therefore, the vital force behind human progress.[108] They perceived that, because engineers were objective thinkers and problem-solvers, they were best suited for leading societal reforms, and the leaders believed that engineers had a duty to make certain that technological change was beneficial to society.[109] In other words, they considered engineering's relation to science to be a sufficient basis for engineering's claiming profession status. They asserted that engineering's close tie to business should be ignored because corporations merely were the machines or vehicles by which engineers plied their professional skills.[110]

Hence, voices of reform, such as that of Morris Cooke, calling for an end of engineering's alliance with business went unheeded. Engineers at the beginning of the 20th Century tenaciously clung to the notion that had defined engineering from its earliest days: its interests were identical to those of the firms where engineers worked.[111] Only a handful of engineers, virtually all civil engineers, saw any merit to joining in the licensing movement that was occurring among the other professions.

Instead of supporting outside regulation such as government licensing boards, engineers conceived professionalism to be tied to self-regulation. ASCE preferred self-regulation to government licensing on the rationale that only

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[105] *Id.*
[106] LAYTON, *supra* note 19, at 42.
[107] *Id.*
[108] *Id.* at 57.
[109] *Id.*
[110] *Id.* at 58-59.
[111] Sinclair, *supra* note 27, at 141.

engineers should pass judgment on the work of engineers.[112] ASCE's publication, *Engineering News*, for example, editorialized in 1908 that regulation focused on the engineer as an individual rather than on what truly mattered, the engineer's work.[113] The public would be better protected by focusing on the latter.[114]

Although engineers generally failed to appreciate the benefits to be reaped from licensing, the point was not missed by small pockets of engineers organizing themselves around local societies. One of the most profound demonstrations of those benefits came at the hands of physicians who were practicing traditional medicine—the regulars. They showed that licensing could be an effective means of not only of attaining profession status, but also of reengineering a profession to exclude "detractors."

C. Medical Profession Shows How to Use Licensing to Reengineer a Profession

The transformation that licensing laws caused in the medical profession is a graphic illustration of how licensing laws can be used to elevate an occupation group into profession status. The battle in medicine between the regulars and practitioners of alternative medicine[115] came to a head in West Virginia in 1881 when the state's legislature passed a law restricting lawful medical practice to traditional medicine.[116] The "regulars" pushed through the legislation that effectively shutout practitioners of alternative medicine and secured professional standing for the regulars, allowing them to reengineer and control medicine as a profession.[117]

The West Virginia story culminated in the landmark Supreme Court decision in *Dent v. West Virginia*.[118] Although the decision has all but been forgotten in administrative law texts,[119] it was monumental in establishing a state's broad power to define and regulate a profession in contravention of the sacrosanct freedom of contract.[120]

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[112] SARAH K. A. PFATTEICHER, DEATH BY DESIGN: ETHICS, RESPONSIBILITY, AND FAILURE IN THE AMERICAN CIVIL ENGINEERING COMMUNITY, 1852-1986 at iv-v (1996).
[113] *Id.* at 121.
[114] *Id.*
[115] *See supra* text accompanying note 35.
[116] *See* JAMES C. MOHR, LICENSED TO PRACTICE: THE SUPREME COURT DEFINES THE AMERICAN MEDICAL PROFESSION 2-3, 63-69 (2013).
[117] *Id.* at 9-11, 63-68.
[118] Dent v. W. Va., 129 U.S. 114 (1889).
[119] For example, the case does not get even a mention in one of the leading administrative law texts, Peter L. Strauss, Todd D. Rakoff, Cynthia R. Farina & Gillian E. Metzger, GELLHORN AND BYSE'S ADMINISTRATIVE LAW: CASES AND COMMENTS (11th ed. 2011).
[120] MOHR, *supra* note 116, at 155-58.

The dispute in *Dent* arose when, in 1882, West Virginia authorities indicted 27-year-old Frank Dent on misdemeanor charges of practicing medicine without a license in Newburg, West Virginia.[121] The indictment came just months after West Virginia became the first state to pass a licensing law that restricted the practice of medicine to a defined class.[122] Dent was a fourth-generation physician and had apprenticed for five years under his father, who was a degreed graduate of "a well-recognized Regular school."[123] All four generations of Dents had practiced traditional medicine in Newburg, and Frank Dent had practiced for seven years as a partner with his father and on his own.[124]

West Virginia's new law provided that Dent could obtain a license and continue practicing medicine by establishing that he satisfied one of three requirements: (1) that he had a diploma issued by "a reputable medical college"; (2) that he had practiced medicine for ten years before 1881; or (3) that he passed a two-part written and oral examination administered by the new West Virginia Board of Health.[125] After learning that the board would not give him credit for his five years' apprenticeship under his father, thus depriving him of a claim of ten years of practice before 1881, Dent relocated his practice to Topeka, Kansas, where a license was not required.[126] He quickly returned home to Newburg, however, after deciding that Kansas' climate did not suit him or his lung ailment (likely tuberculosis).[127] On his return to Newburg, he stopped in Cincinnati long enough to complete a couple of "short courses" at the American Medical Eclectic College where, after passing final examinations, he received a medical doctor degree.[128] Having obtained a diploma, he resumed his medical practice in Newburg until a rival physician informed authorities of his unlicensed practice.[129]

When board members investigated, Dent presented his recently-issued diploma.[130] The board rejected the diploma as not having been issued by a reputable medical college.[131] Deciding the new licensing law deprived him of a basic freedom to practice medicine as he saw fit, Dent declined the board's invitation to sit for an examination.[132] He opted instead to challenge the law's

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[121] *Dent*, 129 U.S. at 117; MOHR, *supra* note 116, at 96-97.
[122] *Dent*, 129 U.S. at 117-18.
[123] MOHR, *supra* note 116, at 97-98.
[124] *Id.*
[125] *Dent*, 129 U.S. at 115. The Board of Health granted licenses to Frank Dent's father and grandfather on the basis of their having practiced for ten years before 1881, but his father also was eligible for a license by virtue of his holding a degree granted by "a reputable medical college." MOHR, *supra* note 116, at 98.
[126] MOHR, *supra* note 116 at 99.
[127] *Id.* at 99-100.
[128] *Id.* at 100.
[129] *Id.* at 101-02.
[130] *Id.* at 102.
[131] *Id.*
[132] *Dent*, 129 U.S. 114, 124-25.

constitutionality on the ground that it deprived him of his "vested right" to practice medicine.[133] In a perfunctory trial presented on stipulated facts, a jury returned a guilty verdict after deliberating briefly.[134] The court fined Dent $50, the minimum allowed.[135]

When Dent's appeals reached the United States Supreme Court in 1889, Justice Stephen Field declared for a unanimous court that West Virginia did not unduly interfere with Dent's freedom to choose his occupation or profession.[136] The court acknowledged that choosing an occupation is "a distinguishing feature of our republican institutions,"[137] but offsetting this right was West Virginia's right to restrict the practice of medicine to individuals whom legislators believed had the appropriate education and experience.[138] This, the court explained, was because the practice of medicine is not just an ordinary occupation, but is one that requires "careful preparation," including mastery of "all those subtle and mysterious influences upon which health and life depend . . . ."[139] With that description, Justice Field secured medicine's standing as a profession, which, unlike ordinary occupations, required the state's close scrutiny and regulation.

Nonetheless, Justice Field explained, West Virginia's exercise of police power had to be reasonable to comply with due process.[140] West Virginia's law satisfied this requirement if its demands and constraints were not arbitrary or capricious, a very low standard. To satisfy the standard, the law merely had to treat every physician alike, and the West Virginia statute did:

> It applies to all physicians . . . . It imposes no conditions which cannot be readily met; and it is made enforceable . . . by regular proceedings adapted to the case. It authorizes an examination of the applicant by the board of health as to his qualifications when he has no evidence of them in the diploma of a reputable medical college in the school of medicine to which he belongs, or has not practiced in the state a designated period . . . . If, in the proceedings under the statute, there should be any unfair or unjust action on the part of the board in refusing him a certificate, we doubt not that a remedy would be found in the courts of the state. But no such imputation can be made, for the plaintiff in error did not submit himself to the examination of the board after it had decided that the diploma he presented was insufficient.[141]

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[133] *Id.* at 121.
[134] MOHR, *supra* note 116, at 105-06.
[135] *Id.*
[136] *Dent*, 129 U.S. at 123.
[137] *Id.* at 121.
[138] *Id.* at 121-22.
[139] *Id.* at 122.
[140] *Id.* at 123-24.
[141] *Id.* at 124-25.

Dent all but ended the hope of practitioners of alternative medicine for recognition. Not only did it affirm a state's power to choose among factions in a profession, but it also demonstrated that, of all the factors that can transform an occupation into a recognized profession, none is more powerful than governmental licensing.

Dent demonstrated that politics is as important a factor as merit in achieving passage of licensing legislation. Although the regulars' victory in West Virginia coincided with notable scientific breakthroughs, politics, rather than scientific merit, seems to have been the greater driving force in West Virginia's decision. The record is void of any time when legislators considered the merit of preferring traditional medicine over homeopathy and eclectic treatment.[142] As James Mohr notes, the regulars "never cited a single scientific advance to illustrate why doctors suddenly needed to understand the research sciences. In their defense of scientific education, they never once explained why a laboratory knowledge of chemistry would be necessary to administer future therapies that might emerge from chemical laboratories."[143] That a maturing medical profession in the latter half of the 20th Century would seem to acquit the West Virginia legislators' choice does not make the original decision any less politically motivated.

After *Dent*, the Supreme Court confirmed in later cases involving physician licensing that a state has virtually unfettered policymaking power in regulating a profession. Four years after *Dent*, Justice David Brewer declared for a unanimous Supreme Court, "The power of a state to make reasonable provisions for determining the qualifications of those engaging in the practice of medicine, and punishing those who attempt to engage therein in defiance of such statutory provisions, is not open to question."[144]

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[142] *See* MOHR, *supra* note116, at 156-58.

[143] *Id.* at 158.

[144] Reetz v. Michigan, 188 U.S. 505, 506 (1903). In cases not involving regulation of a profession like medicine, the court was not accepting of occupational licensing at first, but it gradually accepted state power to regulate all occupations. Two years after Reetz, a split court, showed reluctance in Lochner v. New York, 198 U.S. 45, 59 (1905), to accept regulation of a nonprofessional group, bakers. The court struck down a New York law setting maximum hours for bakers, ruling that the law unduly interfered with "the right to labor, and with the right of free contract on the part of the individual, either as employer or employee." *Id.* The court did not explain why it rejected the New York legislature's conclusion that workweeks of more than 100 hours threatened bakers' health. *See* Friedman, *supra* note 98, at 490 (discussing the New York State Bureau of Labor Statistics' investigation of the employment conditions of the state's bakeshops). The court demonstrated its deference to state authority to enact such regulation, however, beginning with West Coast Hotel Co. v. Parrish, 300 U.S. 379 (1937) (upholding Washington state minimum wage law) (dubbed the "switch in time saves nine" case).

D. Push for Engineering Licensure

The clear message of the courts' decisions was that licensing laws were an effective means for securing and shaping a profession, and, caught up in the Progressives' push for regulation,[145] state legislatures rapidly passed laws requiring licenses to practice a number of occupations: plumbing, barbering, hair dressing, funeral directing, electrical work, fitting horses with shoes, and eventually flower arranging in Louisiana.[146] The overall attitude of engineers, however, was opposition to licensure. They preferred to continue policing themselves.

But other regional organizations of engineers saw the opportunity presented by licensure. One of the first such groups to act was a small group of civil engineers in Louisiana, which began lobbying in about 1898 for laws to restrict the practice of civil engineering to license holders.[147] Initially, the legislature rebuffed their proposals when other civil engineers opposed them.[148] The proponents of licensing eventually succeeded in 1908,[149] but, before they did, a notable civil engineer and Wyoming's state engineer, Clarence Johnston, lobbied for[150] and obtained in Wyoming in 1907 what has come to be recognized as the first engineering licensing law in the United States, although the law was very limited in its scope.[151]

In his January 1904 report to the Governor, Johnston, a graduate of the University of Michigan's civil engineering program,[152] lamented that most anyone—even lawyers—could prepare the survey maps that had to be attached to applications for state irrigation permits.[153] The result, Johnston said, was that the maps were of no use to his office or Wyoming landowners.[154] This initiated a

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[145] *See supra* text accompanying note 94.

[146] Friedman, *supra* note 98, at 489; Carpenter, *supra* note 15, at 30. The Louisiana legislature enacted the florists licensing law in 1936. Carpenter, *supra* note 15, at 30.

[147] *History of the Board 1908-1950*, LA. PROF'L ENG'G & LAND SURVEYING BD., at 2, http://www.lapels.com/History_of_the_Board_1908-1950.pdf (last visited Dec. 27, 2014) [hereinafter LA. PROF'L ENG'G & LAND SURVEYING BD.].

[148] *Id.*

[149] *Id.*

[150] *See* WYO. STATE ENG'R'S OFFICE, SEVENTH BIENNIAL REPORT OF THE STATE ENGINEER TO THE GOVERNOR OF WYOMING (1905) (discussing Johnston's legislative recommendations) [hereinafter SEVENTH BIENNIAL REPORT].

[151] *100 Years of Engineering Licensure*, NAT'L SOC'Y OF PROF'L ENG'RS, http://www.nspe.org/resources/media/resources/100-years-engineering-licensure (last vistied Dec. 27, 2014).

[152] *Clarence T. Johnston Papers, 1888-1941*, BENTLEY HISTORICAL LIBRARY, UNIV. OF MICH., *available at* http://quod.lib.umich.edu/b/bhlead/umich-bhl-88344?rgn=main;view=text (last visited Dec. 27, 2014).

[153] *See* SEVENTH BIENNIAL REPORT, *supra* note 150, at 16.

[154] *See id.* at 16-17.

push for legislation that restricted preparation of survey maps to engineers and land surveyors holding a license. In defending his proposal, Johnston described preparation of the survey maps as "one of the most important duties of the engineer in Wyoming" because of its effect on the public.[155] He further argued that federal authorities required mining surveyors to submit to an examination and mining surveys are "no more important than the surveys which should be made prior to the preparation of maps and applications, for permit to use the water of the public."[156]

Wyoming's legislature responded by enacting in 1907 the nation's first licensing law of any kind pertaining to engineering.[157] It said:

> All engineers and surveyors who shall hereafter perform any field work preliminary to the preparation of an application for permit to use the water of the State or who shall make surveys or do engineering work relative to the utilization or use of water, shall satisfy a board to be known as the Board of Examining Engineers . . . that they belong to one or more of [five] classes [of land surveyor (Class One), topographic engineer, (Class Two), hydraulic and hydrographic engineer (Class Three), construction and designing engineer (Class Four), and administrative irrigation engineer (Class Five)].[158]

The law did not otherwise restrict the practice of engineering in Wyoming. Anyone could engage lawfully in any other form of engineering in the state.

In the meantime, as the Louisiana civil engineers pushed for what would truly be the first engineering licensing law, Johnston joined fellow civil engineers, members of the American Society of Civil Engineers, in opposing them.[159] ASCE was strongly committed to self-regulation, and the civil engineers opposing the licensing proposal believed the Louisiana law was much too broad.[160] It sought not only to regulate engineers and engineering through the power of the state, but to regulate all civil engineers, even those who did not reside in Louisiana.[161] Johnston noted that the legislation he had endorsed addressed a specific problem created by a particular group, whereas the Louisiana engineers sought to regulate engineering without being able to articulate any existing problems.[162]

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[155] *Id.* at 65.
[156] *Id.* at 66.
[157] Assistants to the State Engineer, Etc., ch. 86, §§ 28-29, 1907 Wyo. Laws 147-48.
[158] *Id.* at 147.
[159] PFATTEICHER, *supra* note 112, at 122.
[160] *Id.*
[161] *Id.*
[162] *Id.*

The opponents' views prevailed for a few years but failed in the end. After repeated rebuffs, the Louisiana legislature passed in 1908 the first law in the United States that restricted the practice of civil engineering to licensed individuals.[163] In addition to requiring licensure, Louisiana's law established a state agency and granted it power to set standards for the practice of civil engineering in Louisiana.[164]

ASCE was more successful in defeating licensing efforts in other states. Licensing legislation was proposed in Idaho in 1909, and the next year bills were considered in Pennsylvania, Ohio, and New York.[165] In 1911, the Alabama legislature considered a proposed engineering licensing law.[166] In each state, civil engineers, primarily members of ASCE, were able to defeat the measures by arguing that only engineers, not the state, should regulate the practice of engineering.[167]

In 1915, Illinois became the third state to enact an engineering licensing law, but the law applied only to persons engaged in structural engineering.[168] Illinois would wait until 1945 to enact an all-encompassing engineering licensing law.[169]

In 1917, Florida became the first state to enact an engineering licensing law that encompassed all engineering specialties.[170] The legislation came about because of the lobbying efforts of Florida engineers who had organized the Florida Engineering Society just the previous year.[171] As their first order of business, society members began lobbying for a licensing law[172] and quickly persuaded state legislators that restricting the practice of engineering to licensed individuals was the best way to ensure that Florida built a long-lasting infrastructure, which was then much in its infancy.[173]

Although ASCE leaders were fully committed to professionalism, they perceived engineers, not government bureaucrats, best understood what constituted good engineering practices. Proponents of licensing believed that

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[163] LA. PROF'L ENG'G & LAND SURVEYING BD., *supra* note 147, at 2.
[164] *See id.*
[165] PFATTEICHER, *supra* note 112, at 122.
[166] *Id.*
[167] *Id.*
[168] *Report on the National Summit on Separate Licensing of Structural Engineers*, AM. SOC'Y OF CIVIL ENG'RS (Nov. 3, 2000), at 3, *available at* http://www.asce.org/uploadedFiles/sei/Certification/November2000FinalReport.pdf.
[169] Professional Engineering Practice Act of 1989 § 1380.Appendix A: Significant Dates for the Administration of Section 19 of the Act – Endorsement, ILL. GEN. ASSEMB., *available at* http://www.ilga.gov/commission/jcar/admincode/068/06801380ZZ9996aR.html.
[170] Donald W. Ditzenberger, *Approaching Our Centennial: An Historical Overview*, FLA. ENG'G SOC'Y, at 7, http://www.fleng.org/images/aboutFES/FEStory.pdf (last visited Dec. 27, 2014).
[171] *Id.* at 5-6.
[172] *Id.* at 6-7.
[173] *Id.* at 7.

placing engineers on governing boards and putting practicing engineers in charge of formulating regulation should allay these concerns. The boom years before the Great Depression helped squelch interest in licensing. It was never completely forgotten, but with so many engineers prospering along with a flourishing industry, licensing gained little traction among engineers.[174]

Opposition to licensing waned with an end of the good times. Challenges to the ideas of the "old guard" by the numerous young engineers entering the profession had already chipped away some opposition to licensure,[175] but economic bad times was quite effective in quieting opposition. With many engineers out of work during the Great Depression of the 1930s, licensing became appealing, especially to the young engineers. It had the potential of limiting the supply of engineers and protecting jobs and salaries.[176] Edwin Layton describes the situation:

> In the period between 1929 and 1933, the income of engineers declined almost twice as much as the average of all salaries. It was the younger men who were hardest hit by unemployment and low salaries. The consultants in civil engineering felt especially threatened in the 1930s, because so much of the remaining work in their field was undertaken by the federal government. The private consultant appeared to be facing extinction.[177]

Hence, ASCE's opposition waned, and support for licensure picked up momentum—at least momentarily. By 1933, legislatures in twenty-seven of the then forty-eight states had enacted laws requiring a license to practice at least some aspect of engineering working.[178] Hawaii, as a territory, enacted a licensing law in 1923.[179]

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[174] *See* LAYTON, *supra* note 19, at 237-38.

[175] *Id.* at 111. In 1909, a group of young engineers organized a "rump group," known as the Technical League, for the purpose of challenging the conservative ideas, including opposition to licensure, holding sway among ASCE leaders. *Id.* at 111. The league was able to cause introduction of a bill in the New York legislature in 1910 that would restrict the practice of all engineering to graduates of a four-year engineering school. *Id.* at 112. The bill was killed only after much effort exerted by ASCE's leadership and a compromise in which ASCE leaders agreed to formulate a long-forestalled code of ethics. *Id.*

[176] *Id.* at 237.

[177] *Id.*

[178] PAUL H. ROBBINS, BUILDING FOR PROFESSIONAL GROWTH: A HISTORY OF THE NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS 1934-1984, at 299 (1984). States joining the first four in passing licensing laws were Colorado, Idaho, Iowa, Michigan, Nevada, and Oregon in 1919; New York and Virginia in 1920; Arizona, Indiana, Minnesota, New Jersey, North Carolina, Pennsylvania, Tennessee, and West Virginia in 1921; South Carolina in 1922; Arkansas and South Dakota in 1925; Mississippi in 1928; California in 1929; Wisconsin in 1931; and Ohio in 1933. *Id.*

[179] *Id.*

But opposition never went away. Much of it emanated from a realization of leaders of the engineering societies that they would not be able to qualify for licensure. Most of the leaders were executives or managers of industrial firms. Because they had not practiced engineering for some time, they feared that they would be unable to pass a licensing examination.[180] Moreover, many considered the "closed profession" associated with licensure to be tantamount to collectivism or unionization, and the opposition to both was very strong among engineers.[181] Furthermore, many engineering leaders remained quite committed to industry, and industrial leaders mounted much opposition to licensing. They argued that licensing laws would expose their firms to undue governmental intrusion into their internal employee affairs.[182]

A few engineering leaders, however, understood the importance of licensing to engineering's achieving full profession status. They recognized that achieving profession status was unlikely until every state restricted the practice of engineering to individuals meeting minimum standards of knowledge, education, and experience. One of the more notable advocates for licensing was David Steinman, a renowned civil engineer and bridge builder.[183] In 1934, after failing to garner support for his ideas among other engineering leaders, he led in establishment of the National Society of Professional Engineers for the purpose of uniting the profession in gaining the elusive profession status.[184] "Engineers are pioneers, pathfinders, trailblazers in almost everything they do—with one exception," he lamented in a 1932 speech.[185] "They have left it to the other professions to be the pioneers and trailblazers in securing professional recognition in the field of organizational and legislative activities for the advancement of the status of the profession."[186] Steinman acknowledged that engineering licensing laws were "necessary for the safety of the public," but he understood, too, that they were "also necessary for the protection of the good name of the profession."[187]

With twenty-two states yet to enact a licensing law and with industry's opposition growing stronger, Steinman persuaded NSPE members to embark on an all-out campaign to achieve licensing in the remaining states. He also wanted to seek amendment of narrowly-scoped laws that applied to only one specialty,[188]

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[180] LAYTON, *supra* note 19, at 237.
[181] *Id.*
[182] *See* McGuirt, *supra* note 16, at 26-27.
[183] *Id.* at 27.
[184] ROBBINS, *supra* note 178, at 5.
[185] McGuirt, *supra* note 16, at 27.
[186] *Id.*
[187] *Id.*
[188] For example, Louisiana, California, and Wisconsin required licensure only for civil engineering and a license was required in Illinois for only structural engineering. ROBBINS, *supra* note 178, at 235.

and he led NSPE in beginning to push in 1934 for uniform licensing laws among the states.[189]

Steinman and those joining with him traveled to state capitols to lobby legislators. They gave speeches, wrote letters, published numerous editorials, and helped draft legislation.[190] Their campaign was successful. In the campaign's first year alone—in 1935—seven states adopted licensing laws.[191] By 1940, only five states did not have engineering licensing laws,[192] and by 1947 all forty-eight states had enacted some form of engineering licensing law.[193] The territory of Alaska enacted a licensing law in 1939, and the United States Congress made engineering licensing universal by enacting a law in 1950 that applied to the District of Columbia.[194]

Tragedy often is an effective catalyst for remedial legislation and can go a long way in disarming opposition. Indeed, in addition to NSPE's campaign, engineering failures played a significant role in motivating legislators to pass engineering licensing laws. Two disastrous events were particularly significant in the states' enactment of licensing laws.[195]

One of the disasters was the collapse of the poorly-designed St. Francis Dam on the Santa Clara River near Los Angeles in 1928 in which 400 to 600 persons perished.[196] Overseeing every detail of the dam's construction was William Mulholland, Los Angeles' chief engineer who was self-educated and had begun as a ditch digger.[197] Mulholland overlooked obvious indications that he was placing the dam on an unstable fault line.[198] A year later, California legislators enacted laws requiring civil engineers to be licensed.[199]

The other disaster was a natural gas explosion resulting from a poorly-designed gas distribution system at a school in New London, Texas, in 1937.[200]

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[189] *Id.* at 237; McGuirt, *supra* note 16, at 27.

[190] ROBBINS, *supra* note 178, at 235.

[191] *Id.* at 299. These states were Alabama, Connecticut, Maine, New Mexico, Oklahoma, Utah, and Washington. *Id.*

[192] *Id.* States enacting laws after 1935 were Georgia, Nebraska, and Texas in 1937; Kentucky and Rhode Island in 1938; and Maryland and Vermont in 1939. *Id.*

[193] *Id.* There last states to act were Delaware, Massachusetts, and Missouri in 1941, and North Dakota in 1943. *Id.*

[194] *Id.*

[195] McGuirt, *supra* note 16, at 27-28.

[196] Scott Harrison, *St. Francis Dam Collapse*, L.A. TIMES (Mar. 12, 2013), http://framework.latimes.com/2013/03/12/st-francis-dam-collapse/#/0.

[197] Thomas M. McMullen, The St. Francis Dam Collapse and Its Impact on the Construction of the Hoover Dam at 2 (2004) (M.S. thesis, Univ. of Md.) (on file with Digital Repository at the Univ. of Md.).

[198] *Id.* at 3.

[199] ROBBINS, *supra* note 178, at 299.

[200] *Nearly Three Hundred Die in New London School Explosion*, TEX. STATE HISTORICAL ASS'N, http://www.tshaonline.org/day-by-day/30586 (last visited Jan. 5, 2013).

Nearly 300 children and teachers died in the explosion when a spark from a power tool in the school's industrial arts room ignited a pool of natural gas that had collected in the school's crawl space.[201] The gas leak occurred after school maintenance workers improperly rigged connections of the school's heating system to a nearby oil field natural gas line.[202] In response to the public's demand for remedial legislation, Texas legislators enacted an engineering licensing law only months after the explosion.[203]

Although every jurisdiction had enacted engineering licensing laws by 1950, the laws did not close the profession as licensing proponents had expected. The laws typically applied only to engineers in "responsible charge" of engineering, leaving open engineering done under the supervision of an engineer in responsible charge. Thus, the laws were generally irrelevant to the work of the overwhelming mass of engineers who worked in industry and were not in responsible charge of engineering projects. Nevertheless, to make certain that the engineering being done within the confines of industry did not implicate licensing laws, industry mounted its own counter-campaign to gain legislation exempting from licensure engineering done by an employee of a manufacturer or industrial firm.

III. INDUSTRIAL EXEMPTION: INDUSTRY'S COUNTERMAND OF ENGINEERING LICENSURE

Beginning in about 1940, leaders of industrial firms and public utilities mounted a counterattack against the licensing laws that endured for about twenty years.[204] Instead of seeking repeal of the licensing legislation, industry sought exemption of their employees from licensing requirements. Industry asserted that, so long as it was willing to take responsibility for its engineers' work and was liable for their negligence, licensing was unnecessary for protection of the public's interests. Moreover, industry lobbyists asked: who was a better judge of an engineer's competence than the entity that was taking legal responsibility for his or her work?

Industry's campaign for an industrial exemption was successful for the most part. It attained industrial exemptions in three-fourths of the states—in all

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[201] *Id.*

[202] *Id.*

[203] McGuirt, *supra* note 16, at 27.

[204] ROBBINS, *supra* note 178, at 244; Craig Musselman, *The Industrial Exemption: What, If Anything, Should the Profession Do?* NAT'L SOC'Y PROF. ENGINEERS (Oct. 1, 2009), http://www.nspe.org/resources/blogs/pe-licensing-blog/industrial-exemption-what-if-anything-should-profession-do.

but twelve and the District of Columbia.[205] Morton Fine, former executive director of the National Council of Engineering Examiners, suggested that the campaign's success had less to do with the merits of industry's arguments than with industry's overwhelming political influence.[206] The lesson of Frank Dent's case in West Virginia would lend credence to this notion.[207]

A. The Nature of the Industrial Exemption

M. J. Kolhoff was an engineer working in industry who has endeavored to articulate a defense of the industrial exemption as necessary for setting the jurisdictional scope of licensing laws.[208] Such "a delimiter," as he called it, was required by the "all-encompassing" manner in which most states defined engineering.[209] He saw the industrial exemption as a way of paring back broadly-worded licensing statutes to avoid including persons and activities that legislators did not intend to include. He argued that the industrial exemption's jurisdictional function is important for protecting engineers from an overreaching government. This protection is necessary, he asserted, because of the basic freedoms that are at stake: engineers' right to choose where and for whom to employ their skills. As confirmed by the Supreme Court in *Dent*,[210] this freedom is fundamental. A state should be able to override this freedom only when necessary "to protect citizens from possible fraud and other forms of economic or physical harm that might stem from services by unscrupulous or unqualified practitioners. In

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[205] *See* Arthur Schwartz, *Engineering Licensure Law Industrial/Manufacturing Exemptions State-by-State*, Nat'l Soc'y of Prof'l Eng'rs (June 2011), http://www.nspe.org/sites/default/files/resources/pdfs/blog/Industrial-Exemption-Table.pdf. States not having an industrial exemption include Alabama, Arkansas, Hawaii, Minnesota, New Hampshire, Oklahoma, South Carolina, South Dakota, Tennessee, and West Virginia. *Id.* California adopted an industrial exemption, but it applies only to employees of the communication industry. *Id.* Montana enacted an industrial exemption but repealed it. *Id.*

[206] Morton Fine, *Registration Viewed as Bond to Practice of Learned Profession*, *in* ENGINEERING PROFESSIONALISM AND ETHICS 511, 511 (James A. Schaub et al., eds., 1983).

[207] *See supra* notes 114-140 and accompanying text.

[208] Kolhoff's defense has been published as a section in ENGINEERING PROFESSIONALISM AND ETHICS, *supra* note 10, at 526-30. This work originally appeared in PROFESSIONAL ENGINEER (March 1976), at 34, and identified Kolhoff as staff associate for technical resources at General Electric.

[209] Kolhoff, *supra* note 10, at 527. An example of a broadly worded licensing statute is CA. BUS. & PROF. CODE § 6701. This statute defines a "professional engineer" as "a person engaged in the professional practice of rendering service or creative work requiring education, training and experience in engineering sciences and the application of special knowledge of the mathematical, physical and engineering sciences in such professional or creative work as consultation, investigation, evaluation, planning or design of public or private utilities, structures, machines, processes, circuits, buildings, equipment or projects, and supervision of construction for the purpose of securing compliance with specifications and design for any such work." *Id.*

[210] *See supra* notes 136-141 and accompanying text.

particular, this protection has been applied where the public is unable to adequately evaluate the qualifications of the practitioners that they may employ."[211]

Hence, Kolhoff argued, the industrial exemption has a "specific target" to exempt "the internal engineering that is ancillary to the design, manufacture, sale, service, and repair of products of [a] state's industries."[212] A policy of exempting ancillary engineering is sound, he asserted, because it does not threaten the public's safety and welfare. The only party affected is the one who employs the engineer; hence, licensing applicable to ancillary engineering is unnecessary and overreaching. Elimination of the exemption would expose engineers in industry to unwarranted licensing; thus, unduly impinging on the fundamental freedom of engineers working in industry.

In an attempt to establish that the engineering covered by the exemption does not threaten the public, Kolhoff asked two pointed questions. First, "[a]re . . . engineers in industry . . . posing a serious threat of injury to life, health, and property of the state's citizens—a threat for which there is inadequate legal protection?"[213] Second, "[w]ould [elimination of the industrial exemption] appreciably reduce any residual product-related threat to life, health, or property of the citizens of the state wherein the engineering is regulated?"[214] His answer to both was that he did not find "convincing evidence" of either proposition.[215]

Consistent with Kolhoff's point, some state licensing laws do phrase the exemption in terms suggesting that its target is internal ancillary engineering that any industrial firm must do to get a product to market. Connecticut's statute, for example, exempts an employee of a "manufacturing or scientific research and development corporation . . . provided the engineering work performed by such . . . employees shall be *incidental* to the research and development or manufacturing activities of such corporation . . . ."[216] Missouri's statute exempts "[a]ny person engaged in engineering who is a full-time, regular employee of a person engaged in manufacturing operations and which engineering so performed by such person *relates* to the manufacture, sale or installation of the products of such person . . . ."[217] Engineering that is "incidental" to, or "relates" to, the manufacture of a product arguably is ancillary engineering, as Kolhoff asserted.

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[211] Kolhoff, *supra* note 10, at 527.
[212] *Id.* at 526.
[213] *Id.* at 527-28.
[214] *Id.* at 528.
[215] *Id.*
[216] CONN. GEN. STAT. § 20-309(3) (2014) (emphasis added). Other states whose statutes also exclude engineering "incidental" to manufacturing include Arizona, ARIZ. REV. STAT. § 32-144(C) (2013); and Oregon, OR. REV. STAT. § 672.060(6)(a) (2014).
[217] MO. REV. STAT. § 327.191(3) (2014) (emphasis added). Other states whose statutes also exclude engineering "related" to manufacturing include Indiana, IND. CODE § 25-31-1-20(b)(2) (2014);

Such statutes, however, make up only a portion of those states granting an industrial exemption. Each state independently formulates its engineering licensing laws; thus, the laws vary significantly from state to state as each takes its own nuanced approach. The result is a hodgepodge of inconsistent laws.[218] A number of states do not have an industrial exemption at all,[219] and a number of others have exemptions so broad that they allow the unlicensed practice of any kind of engineering—whether it is ancillary or primary—so long as it is done in an industry context.[220]

Furthermore, even if the statutory language were uniform from state to state, it would be subject to the interpretations of each state's licensing authorities and to the inconsistencies of enforcement. Each state has virtually unfettered control of how to prosecute its laws. What constitutes incidental engineering is in the eyes of the enforcer. With statutes full of ambiguities and vague language requiring interpretation and as personalities and local cultures affect attitudes, enforcement varies widely from state to state, as acknowledged by a task force constituted by the National Council of Examiners of Engineering and Surveying: "Jurisdictions are not necessarily enforcing licensure in categories that are not exempt . . . ."[221] Missouri's licensing board candidly acknowledged that, although it believed Missouri statutes required professors of graduate level engineering courses to be licensed, it only "encouraged compliance but does not enforce."[222] As agencies of the administrative state,

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Ohio, OHIO REV. CODE § 4733.18(B)(2) (2014); and Texas, TEX. OCC. CODE § 1001.057(a)(2) (2013).

[218] Supreme Court Justice Louis Brandeis made this much-repeated observation in his dissent in New State Ice Co. v. Liebmann, 285 U.S. 262, 386-87 (1932) (Brandeis, J., dissenting): "It is one of the happy incidents of the federal system that a single courageous state may, if its citizens choose, serve as a laboratory; and try novel social and economic experiments without risk to the rest of the country." *Id.* Engineering societies have discovered the task of drawing general conclusions about the industrial exemption is daunting because of each state's nuanced approach. The National Council of Examiners of Engineering and Surveying decided to "poll" the various state licensing boards rather than attempt to wade through the statutes themselves. *Industrial Exemption Task Force,* IEEE-USE TODAY'S ENG'R 153-54, http://www.todaysengineer.org/2013/Jul/files/Industrial-Exemption-TF-report-2013.pdf (last visited Dec. 27, 2014).

[219] *See* Schwartz, *supra* note 205.

[220] For example, Kansas statutes exempt from licensing "[p]ersons engaged in planning, drafting and designing of products manufactured for resale to the public." KAN. STAT. ANN. § 74-7033(c) (2014). A Vermont statute provides that the state's engineering licensing law "does not prohibit any person from performing acts constituting the practice of . . . engineering of a manufactured product . . . ." VT. STAT. ANN. tit. 26, § 1163(c)(1) (2014).

[221] *Industrial Exemption Task Force, supra* note 218, at 153.

[222] *Missouri Board Profile,* NAT'L COUNCIL OF EXAM'RS OF ENG'G & SURVEYING (JULY 2, 2012), http://boards.ncees.org/view/index/board-1034-missouri/6/.

licensing boards typically have much discretion to allow full measure of the board's expertise.[223]

Contrary to Kolhoff's view, unlicensed engineers daily engage in primary *and* ancillary engineering in this country. They do so either because they work in a state whose exemption is so broadly worded that it applies the exemption to primary engineering work, or because the board in the state declines to expend limited enforcement resources pursuing actions based on the often fine-haired distinctions between primary and ancillary engineering. Consider, for example, the exemption in force in Colorado, which exempts "[p]artnerships, professional associations, joint stock companies, limited liability companies, or corporations, or the *employees of any such organizations*, who perform engineering services for themselves or their affiliates . . . ."[224] This statute does not exempt only ancillary engineering. It does not restrain the nature of engineering practiced at all, other than to require that the engineering be done for the partnership, professional association, joint stock company, limited liability company, or corporation. It does not even require the organization that employs the person be an industrial firm or manufacturer. The door to unlicensed practice of engineering could not be open much wider.[225] Surely, such a situation poses significant threats to the public. For example, the engineering of the faulty switches besetting General Motors in recent days were engineered for GM by Delphi Mechatronics before GM engineers brought the matter in-house and assumed responsibility for the switches.[226] Whether the work was ancillary or primary to GM's manufacturing of automobiles is open to interpretation. Either way, the work reportedly has resulted in the deaths of at least twelve persons in automobile crashes.[227] Even if designing the switches

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[223] *See generally* Charles H. Koch, Jr., *Issues in Administrative Law: Judicial Review of Administrative Discretion*, 54 GEO. WASH. L. REV. 469 (1986) (discussing the broad scope of administrative agencies' enforcement discretion).

[224] COLO. REV. STAT. § 12-25-103(1)(c) (2014) (emphasis added).

[225] Colorado's statute is not an aberration. In addition to the examples set out *supra* note 220, consider Delaware's statute, which exempts "engineering services performed by an employee of a firm or corporation that does not offer professional engineering services to the general public." DEL. CODE ANN. tit. 24, § 2803(25) (2014); and Mississippi's statute exempting "[t]he performance of engineering services by any regular full-time employee of a manufacturing, research and development, railroad, or other industrial corporation . . . ." MISS. CODE ANN. § 73-13-41(1)(d) (2014).

[226] Mike Colias & Nick Bunkley, *'Cardinal Sin': Former GM Engineers Say Quiet '06 Redesign of Faulty Ignition Switch was a Major Violation of Protocol*, AUTOMOTIVE NEWS (Mar. 24, 2014), http://www.autonews.com/article/20140324/OEM11/303249959/cardinal-sin:-former-gm-engineers-say-quiet-06-redesign-of-faulty.

[227] *Id.*

were deemed primary engineering, unlicensed persons could do the work lawfully under Michigan's exemption.[228]

Kolhoff, however, added a qualifier to his contention. He asserted that the work of engineers working in industry did not pose "a threat for which there is inadequate legal protection[.]"[229] The protections he mentioned were "product safety legislation" and "legal precedents of the manufacturer's responsibility for the quality and safety . . . ."[230]

Kolhoff failed to note that these "protections" all kick in after a product has killed or maimed. Tort liability can make a tortfeasor pay a widow for her husband's wrongful death, but surely most widows would opt for protection that attempts to avoid their husbands' being killed by a product in the first place. Product safety legislation can require industry to take remedial action to correct its dangerous wares, but they typically apply after a product has already done its killing or maiming. Such laws are not nearly as effective in preventing mishaps as a reasonably prudent engineer would be in designing safety into a product at the outset.

Moreover, Kolhoff's reliance on product safety legislation was misplaced. His argument was published in 1983. Since then, with the protections of the laws noted by Kolhoff in place, the mayhem caused by consumer products has worsened. During 2010, more than 38.5 million Americans sought medical attention for injuries related to consumer products, up from the more than 28 million who received medical treatment for such injuries in 1985.[231] Consumer advocate Ralph Nader predicted that threats posed by "the products and processes of technology"[232] would significantly tarnish engineers' reputations "as the realization spreads of what the engineer *can* do in contrast to what he *does* do to diminish the hazards to life and limb . . . ."[233]

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[228] MICH. COMP. LAWS § 339.2012(b) (2014) exempts "[a] designer of a manufactured product, if the manufacturer of the product assumes responsibility for the quality of the product."

[229] Kolhoff, *supra* note 10, at 528.

[230] *Id.* at 526-27.

[231] TOM SCHROEDER, U.S. CONSUMER PROD. SAFETY COMM'N, CONSUMER PRODUCT-RELATED INJURIES AND DEATHS IN THE UNITED STATES: ESTIMATED INJURIES OCCURRING IN 2010 AND ESTIMATED DEATHS OCCURRING IN 2008 (Feb. 2012), at 6, *available at* https://www.cpsc.gov/PageFiles/134720/2010injury.pdf.

[232] Nader, *supra* note 103, at 276.

[233] *Id.* at 278. One of the latest incidences of a faulty engineered product is General Motors' manufacture of millions of automobiles with faulty ignition switches that caused crashes resulting in at least a dozen deaths. Jeff Bennett & Joann S. Lublin, *GM Raises Recall Costs to $1.3 Billion*, WALL ST. J. (Apr. 10, 2014), http://www.wsj.com/news/articles/SB10001424052702303873604579493263271543676. GM has taken job actions against engineers involved in developing one of several compact cars equipped with the switch after determining that the engineers knew as early as 2001 that the switch was prone to failure but still used it. *Id.*
?mod=djemCFO_h.

Although unlicensed engineers working in industry undoubtedly strive to apply the same engineering principles as licensed engineers do, Nader suggested that the industrial context creates a major handicap for those engineers working under an exemption. It deprives them of independence. He noted that they are often co-opted by "corporate culture."[234] Engineers working in this context, he said, struggle to "live professional lives of their own in technical societies and public forums apart from their employee status and without fear of overt or covert retaliation whether in the form of dismissal, demotion, or the freezing of promotion."[235]

B. Real Life for Engineers Working in Industry: The *Challenger* Saga

Supporting Nader's point is the remarkable story of the losing battle Morton-Thiokol engineers waged in an attempt to avert the space shuttle *Challenger* tragedy in 1986. Six astronauts and a school teacher perished in the disaster, and it nearly killed America's space program.

Thiokol's rocket motor engineers put their jobs on the line in trying to stand up against NASA and Thiokol's management. On the eve of the *Challenger*'s launch, Thiokol's vice president of engineering Bob Lund, acting on the data and conclusions prepared by the company's engineers, recommended that the *Challenger*'s launch be delayed because of the frigid temperatures forecasted and the debilitating effect the extreme cold would have on the solid rocket motor seals.[236]

Two of the engineers, Roger Boisjoly and Arnie Thompson, had sounded an alarm when they learned that forecasts called for overnight temperatures as low as eighteen degrees Fahrenheit at Cape Canaveral, and launch-time temperatures were expected to be below thirty degrees.[237] The lowest temperature in which NASA had launched a shuttle was fifty-three degrees, and Thiokol engineers had discovered evidence that during that flight the O-rings sealing the rocket motors had allowed hot gases to escape the motors' casings.[238] Previous testing had confirmed that low temperatures negatively affected the O-rings' function. Boisjoly had written memos the previous year warning that O-ring failure could allow gas flumes to escape and set off an explosion in the shuttle's external tank.[239]

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[234] *See* Nader, *supra* note 103, at 278.
[235] *Id.* at 280.
[236] ALAN J. MCDONALD & JAMES R. HANSEN, TRUTH, LIES, AND O-RINGS: INSIDE THE SPACE SHUTTLE *CHALLENGER* DISASTER 91-106 (2009).
[237] *Id.* at 1, 96.
[238] *Id.* at 1-2, 99-101.
[239] Kimberly A. Pace, *The Legal Profession as a Standard for Improving Engineering Ethics: Should Engineers Behave Like Lawyers?*, 9 HIGH TECH. L. J. 93, 97 (1994).

A week before the Thiokol engineers' recommendation, NASA had stunned Thiokol management with an announcement that it was proceeding with serious consideration of transferring the job of disassembling the shuttle's solid rocket boosters after each flight to one of Thiokol's competitors.[240] Thiokol management became quite apprehensive that such a move might be followed by Thiokol's losing its contract to assemble the booster segments before each flight in the vehicle assembly building at Cape Canaveral.[241] And to add to Thiokol's pressures, NASA had been making noise that, because of future plans to increase shuttle launches to two a month, it was considering terminating its contract with Thiokol as the sole source for the shuttle's rocket motors.[242] Alan McDonald, Thiokol's senior management liaison for solid rocket boosters, described the pressure on Thiokol managers: "It was not the perfect situation for levelheaded engineering thinking to trump vital business concerns inside Morton Thiokol management, not with billions of dollars at stake."[243] He added that, had "Thiokol management not feared that [solid rocket booster] activities might be second-sourced to our competitors, a key domino leading to the *Challenger* disaster of January 28, 1986, might never have fallen."[244]

The domino fell the night before the *Challenger*'s launch. During a three-way teleconference among Thiokol engineers in Brigham City, Utah, with NASA shuttle flight engineers and managers at Kennedy Space Center in Cape Canaveral, Florida, and Marshall Space Flight Center in Huntsville, Alabama, Thiokol engineers stunned NASA officials with its recommendation not to launch the *Challenger* the next morning.[245] This was not welcomed news for NASA, which earlier that day had scrubbed the *Challenger*'s scheduled launch for the sixth time in more than a month.[246]

Earlier on the afternoon of January 27, 1986, Thiokol engineers in Utah began working with Bob Lund, Thiokol's vice president in charge of engineering, after getting confirmation of weather conditions at Cape Canaveral.[247] The Thiokol engineers participated in a preliminary teleconference with NASA managers during the early evening. They expressed their concerns and declared that they believed that the launch should be delayed.[248] When

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[240] MCDONALD & HANSEN, *supra* note 236, at 81-83.
[241] *Id.*
[242] *Id.* at 10.
[243] *Id.* at 83.
[244] *Id.*
[245] *Id.* at 96.
[246] *Id.* at 92-93. NASA put the flight off on January 27 because of high winds, which moved in during a long delay caused by technicians' being unable to remove a bolt preventing the closing of the crew compartment's hatch. *Id.* at 95-96.
[247] *Id.* at 93-97.
[248] *Id.* at 97-106. Judson Lovingood, NASA's deputy manager of the Shuttle Projects Office at Marshall Space Flight Center understood the Thiokol engineers to be making a definitive

Thiokol's engineers teleconferenced later that night with a full contingency of NASA managers and engineers, Lund unequivocally recommended against launching if the temperature was below fifty-three degrees Fahrenheit.[249] Thiokol's engineers unanimously supported the recommendation, and no one at Thiokol made any comment favoring launch.[250]

NASA's reaction surprised Thiokol. Lawrence Mulloy, head of NASA's rocket booster program at Marshall, declared that he could not accept the rationale for the recommendation—that he needed more quantitative data—and George Hardy, deputy director of science and engineering at Marshall, said he was "appalled" by it.[251] Mulloy asked pointedly, "Thiokol, when do you want me to launch, next April?"[252] After NASA's Stanley Reinartz[253] expressed confusion concerning specifications that seemed to suggest that the O-rings were qualified to function as low as forty degrees Fahrenheit, Mulloy criticized Thiokol's data as "inconclusive."[254]

Thiokol engineers understood NASA to be asking them to prove quantitatively that the O-rings were likely to fail.[255] They did not believe that they could do that. Joe Kilminster, Thiokol's vice president of space booster programs, then tipped the domino that would seal the fate of the *Challenger* crew. He asked for five minutes for Thiokol engineers to caucus for purposes of re-evaluating the data.[256]

The account of the remarkable half-hour standoff between engineering and management occurring after Kilminster hit the mute button in Brigham City validates Nader's warning to engineers working in industry: that they should expect times when management, for business reasons, will be dismissive of their sound engineering judgment.[257] Such incidents seem inevitable.

In the room were about ten Thiokol engineers and management executives, Jerry Mason, senior vice president of Thiokol's Wasatch Operations, and Cal Wiggins, vice president and general manager of Thiokol's space division.[258] The story of the intense debate is best told by an engineer who was

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recommending at that point that the launch be delayed. PRESIDENTIAL COMMISSION ON THE SPACE SHUTTLE CHALLENGER ACCIDENT, REPORT TO THE PRESIDENT, Vol. I, at 87 (1986) [hereinafter REPORT TO THE PRESIDENT]. Stanley Reinartz, chief of Marshall's Shuttle Projects Office, understood the engineers to be merely expressing concerns that could lead to a delay in the launch. *Id.*

[249] MCDONALD & HANSEN, *supra* note 236, at 103-04.

[250] REPORT TO THE PRESIDENT, *supra* note 248, at 90.

[251] MCDONALD & HANSEN, *supra* note 236, at 104

[252] *Id.*

[253] *See supra* text accompanying note 248.

[254] MCDONALD & HANSEN, *supra* note 236, at 104.

[255] *Id.* at 106.

[256] REPORT TO THE PRESIDENT, *supra* note 248, at 90.

[257] Nader, *supra* note 103, at 280-81.

[258] MCDONALD & HANSEN, *supra* note 236, at 111.

there and who lived the agony of having management refuse to listen to his warnings of dire consequences. In his testimony before the President's Commission investigating the *Challenger* disaster, Roger Boisjoly recalled:

> [T]he caucus started by Mr. Mason stating a management decision was necessary. Those of us who opposed the launch continued to speak out, and I am specifically speaking of Mr. Thompson and myself because in my recollection he and I were the only ones that vigorously continued to oppose the launch. And we were attempting to go back and rereview and try to make clear what we were trying to get across, and we couldn't understand why it was going to be reversed. So we spoke out and tried to explain once again the effects of low temperature. Arnie actually got up from his position which was down the table, and walked up the table and put a quarter pad down in front of the table, in front of the management folks, and tried to sketch out once again what his concern was with the joint [sealed by the O-rings], and when he realized he wasn't getting through, he just stopped.
>
> I tried one more time with the photos. I grabbed the photos, and I went up and discussed the photos once again and tried to make the point that it was my opinion from actual observations that temperature was indeed a discriminator and we should not ignore the physical evidence that we had observed.
>
> And again, I brought up the point that [an earlier shuttle flight in January 1985] had a 110 degree arc of black grease while [a flight in October 1985] had a relatively different amount, which was less and wasn't quite as black. I also stopped when it was apparent that I couldn't get anybody to listen.[259]

Boisjoly then responded to a question from the commission as to whether any Thiokol engineers spoke up in favor of launching:

> No, sir. No one said anything, in my recollection, nobody said a word. It was then being discussed amongst the management folks. After Arnie and I had our last say, Mr. Mason said we have to make a management decision . . . . From this point on, management formulated the points to base their decision on. There was never one comment in favor, as I have said, of launching by any engineer or other nonmanagement person in the room before or after the caucus. I was not even asked to participate in giving any input to the final decision charts [being prepared to support a recommendation to launch].
>
> I went back on the [teleconference network] with the final charts or final chart, which was the rationale for launching, and that was presented by Mr. Kilminster. It was hand written on a notepad . . . . I did not agree with some of the statements that were being made to

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[259] REPORT TO THE PRESIDENT, *supra* note 248, at 92.

> support the decision. I was never asked nor polled, and it was clearly a management decision from that point.[260]

Boisjoly also told the commissioners that what occurred that night was not the first time he had endured such a confrontation with management. He said that he experienced it before while working for other companies.[261]

After Thompson and Boisjoly finished making their arguments, Mason polled the room, "Am I the only one who wants to fly?"[262] The engineers did not respond.[263] Wiggins and Kilminster indicated that they were ready to reverse Thiokol's recommendation.[264] He then turned to Lund, the company's vice president of engineering, who had not responded.[265] Lund's support would be important to NASA because he had made the original recommendation on the basis of engineering. Mason pressed him: "'We're just going over and over the same information, . . . and it's time for a decision.' When Lund still [did not respond], Mason said, 'It's time for you, Bob, to take off your engineering hat and put on your management hat.'"[266] With that, Lund relented.[267]

When the teleconference resumed, Kilminster announced that Thiokol, after reconsidering the data, was recommending that the launch proceed.[268] NASA asked Kilminster to put his recommendation in writing.[269] He agreed to do so.[270] The next morning, on January 28, at 11:38, while the temperature was thirty-six degrees Fahrenheit, NASA launched.[271] The *Challenger* rose to about 50,000 feet and exploded a mere seventy-three seconds into its flight.[272]

Experts later determined that, just as Boisjoly had warned,[273] superhot gasses had blown by an O-ring stiffed by frigid temperatures.[274] Escaping from a rocket motor, a plume of hot gases ignited an explosion in the *Challenger*'s large

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[260] *Id.* at 92-93.
[261] *Id.* at 93.
[262] MCDONALD & HANSEN, *supra* note 236, at 111-12.
[263] *Id.* at 112.
[264] *Id.*
[265] *Id.*
[266] *Id.*
[267] *Id.*
[268] REPORT TO THE PRESIDENT, *supra* note 248, at 96.
[269] *Id.*
[270] *Id.*
[271] MCDONALD & HANSEN, *supra* note 236, at 116-19.
[272] *See id.* at 121-22.
[273] Actually, Boisjoly expected the O-rings to fail on the launch pad. *Roger Boisjoly*, THE TELEGRAPH (London), Feb. 7, 2012, http://www.telegraph.co.uk/news/obituaries/science-obituaries/9067491/Roger-Boisjoly.html. Fear kept him from watching television broadcasts of the launch, but when the "*Challenger* cleared the launch tower, a [friend] whispered to him, 'We just dodged a bullet.'" *Id.* Their relief was crushed seconds later by the explosion. *Id.*
[274] MCDONALD & HANSEN, *supra* note 236, at 2.

external tank tied to the orbiter's belly.[275] The tank was filled with 1.6 million pounds of liquid hydrogen and oxygen.[276]

Roger Boisjoly did all anyone could reasonably expect him to do to prevent the disaster. Although he was not licensed at the time,[277] he did everything that the public would expect of a professional engineer. He put the public's interests ahead of his own. He did what men facing such situations rarely do: He laid his job and self-interest on the line and stood up for the seven individuals whose space craft would be propelled by his company's rocket motors the next day.

C. What Difference Would a License Have Made?

During such times as Roger Boisjoly faced, about the most significant effect a professional license can have is to serve as an outside influence—a reminder to the professional that his or her duties extend far beyond his or her employer's interests to include the public's interest.[278] It serves as a sort of brooding omnipresence[279] to prick the professional's conscience during such

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[275] *Id.*

[276] *Id.* at 121.

[277] Boisjoly was granted three professional engineering licenses after the *Challenger* incident: in Florida (1989), Arizona (1990), and Utah (1994). *See Licensee Search*," FLA. DEP'T OF BUS. & PROF'L REGULATION, http://www.fbpe.org/licensure/licensee-search (follow "licensee search" hyperlink; then select "Search by Name" and click "Search" button; then search "Roger Boisjoly"; then click on "Boisjoly, Roger M." hyperlink) (last visited Dec. 28, 2014); *Search for Professional Registrants*, ARIZ. STATE BD. OF TECHNICAL REGISTRATION, http://directorybtr.az.gov/listings/professional_registrant2.asp (search "Boisjoly" then click "Find") (last visited Dec. 28, 2014); *License Lookup & Verification System*, Utah Div. Occupational & Prof'l Licensing, https://secure.utah.gov/llv/search/index.html (search "Roger Boisjoly"; then select License # 176639-2202) (last visited Dec. 28, 2014); *Roger Boisjoly Curriculum Vitae*, ONLINE ETHICS CTR. FOR ENG'G. & SCI., http://www.onlineethics.org/cms/12717.aspx (last visited Dec. 28, 2014).

[278] UTAH CODE ANN. § 58-1-401(2) (West 2014) sets out the grounds for disciplining an engineer's license in Utah: "(a) the applicant or licensee has engaged in unprofessional conduct, as defined by statute or rule under this title; (b) the applicant or licensee has engaged in unlawful conduct as defined by statute under this title; (c) the applicant or licensee has been determined to be mentally incompetent by a court of competent jurisdiction; or (d) the applicant or licensee is unable to practice the occupation or profession with reasonable skill and safety because of illness, drunkenness, excessive use of drugs, narcotics, chemicals, or other type of material, or as a result of a mental or physical condition, when the condition demonstrates a threat or potential threat to the public health, safety, or welfare." The Utah licensing board has promulgated a regulation that defines "unprofessional conduct" by listing twenty-six acts that constitute unprofessional conduct. UTAH ADMIN. CODE. r. 156-22-502 (2014).

[279] This is a phrase crafted by Oliver Wendell Holmes in Southern Pac. Co. v. Jensen, 244 U.S. 205, 222 (1917) (Holmes, J., dissenting) ("The common law is not a brooding omnipresence in the sky, but the articulate voice of some sovereign or quasi sovereign that can be identified; although some decisions with which I have disagreed seem to me to have forgotten the fact.").

ethical dilemmas such as Boisjoly and the other Thiokol engineers faced. It is what Martin Goland had in mind when he admonished that, for an engineer to "use his professional talents in a cause he believes to be unworthy is a violation of a sacred social trust."[280]

A license surely would not have made Boisjoly more zealous and passionate that night in Brigham City. Even without a license, he seemed to be spurred by an brooding omnipresence from another source. Indeed, in an account of his life, a British newspaper told of an encounter he had experienced about a dozen years before the *Challenger* ordeal:

> In 1974 [Boisjoly] was working with the Rockwell Corporation on stress analysis for the Shuttle crew compartment when he noticed that a fellow worker was increasingly distressed. It turned out that the colleague had previously worked on the design of the DC-10 cargo door, and had argued for changes to improve it. The man had not insisted, however, and in March 1974 a DC-10 cargo hatch failed near Paris, resulting in the deaths of 346 people.[281]

The Supreme Court of Illinois recognized in *Balla v. Gambro, Inc.*,[282] that professional licenses certainly can have the effect of a brooding omnipresence. Like the *Challenger* incident, the *Balla* case involved a showdown between a professional, an attorney named Roger Balla, and management, Gambro's president.[283] Balla had learned that Gambro was planning to sell equipment in violation of federal regulations.[284] Balla told Gambro's president that he would do all he could to block the sale.[285] The company fired him a month later, and he sued the company for retaliatory discharge.[286]

But the *Balla* court refused to extend the tort's protection to Balla.[287] The court reasoned that the tort's purpose was to provide a remedy for an employee who been wronged after standing up to protect the public, such as a

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[280] Martin Goland, *Can Professionalism Be Attained with in the Corporate Structure?*, ENGINEERING PROFESSIONALISM AND ETHICS 285, 285 (James H. Schaub et al. eds., 1983).

[281] *Roger Boisjoly: Rocket Engineer Whose Warnings of Catastrophe on the Eve of the Challenger Disaster Went Unheeded*, DAILY TELEGRAPH (London), Feb. 8, 2012, at 29, *available at* 2012 WLNR 2705744.

[282] Balla v. Gambro, Inc., 584 N.E.2d 104 (Ill. 1991).

[283] *Id.* at 105.

[284] *Id.* at 106.

[285] *Id.*

[286] *Id.*

[287] *Id.* at 107.

whistleblower might do.[288] Although that certainly described Balla, the court concluded that Balla, as a lawyer, already had a duty to protect the public by reporting his employer's illegal acts.[289] Even if it meant losing his job, Balla's law license and the rules of professional conduct it imposed on him obligated him to be a whistleblower.[290] Because of his duty as a lawyer, the court reasoned, "the public policy . . . of protecting the lives and property of citizens, is adequately safeguarded without extending the tort . . . ."[291]

Regardless of the correctness of the *Balla* court's legal reasoning, the court made an important point about what it means to be a professional. As a professional, Balla had a duty to exert control over matters of law at Gambro. In his dispute with management over selling the illegal equipment, Balla, as the lawyer, could not defer the decision to management. He could not take off his lawyer hat to put on a management hat. A nonprofessional employee at Gambro—say a secretary or clerk—had no such obligation; thus, such an employee needed the tort's special protection should he or she decide to "blow the whistle" on Gambro.

The *Balla* court was speaking of independent judgment and control. Indeed, these are essential indicia of professionalism.[292] The distinctive mark of a professional is the practitioner's exercise of independent judgment and exertion of control over the subject matter within the professional's expertise. Independent judgment and control require discretion, and a professional can expect management to resist such discretion. Management tends to loath discretion by a firm's employees. For a business, employee discretion breeds inefficiency, which is an enemy of profit.[293]

The medical profession illustrates the point. To effectuate cost savings, physicians are being pushed into large business entities, such as health maintenance organizations (HMO). To remain a member of the HMO, a physician must conform to the HMO's constraints. The less discretion a physician exercises, the more "efficient" and profitable his or her services become for the HMO. With such loss of control ever increasing in medicine, the medical profession, once featuring autonomous decision-making, appears to be in a state of decline. Indeed, in a review of Elliott Krause's work on professions,[294] *The Economist* chronicled the decline in medicine's status as a profession:

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[288] *Id.* at 107-08 ("'[T]here is no public policy more important or more fundamental than the one favoring the effective protection of the lives and property of citizens.'" (quoting Palmateer v. Inter'l Harvester Co., 421 N.E.2d 876, 879 (Ill. 1981)).

[289] *Id.* at 108-09.

[290] *Id.* at 108.

[291] *Id.*

[292] *See* ELIOT FRIEDSON, PROFESSIONALISM, THE THIRD LOGIC 17 (2001).

[293] *See Id.* at 3.

[294] KRAUSE, *supra* note 22.

> American doctors['] . . . power in the 1940s and 1950s was almost total. Membership of the American Medical Association rose to nearly 75% of all doctors in the 1960s. Through its state associations, the AMA *controlled* entry into the profession and *dominated* cognate professions like nursing, X-ray technology and occupational therapy. The AMA ensured that the proportion of doctors in the population remained almost static between the early 1930s and the early 1960s. Most doctors remained in their own office practices or operated in hospitals that they *controlled.* All efforts to introduce national health insurance—which posed a threat to doctors' fees as well as their autonomy—were successfully resisted.
>
> Those were the days, now long gone. By 1990 less than half of America's doctors belonged to the AMA. The profession as a whole is increasingly fragmented among specialised associations and between practitioners and academics. Restrictions on entry into the profession collapsed, and the proportion of doctors in the population nearly doubled from 151 per 100,000 in 1970 to nearly 300 by 1990. More than half of all American doctors, far from being free-standing professionals, *are now salaried employees.* Doctors can no longer *control* the previously subordinate medical professions. They can no longer *control* even their own places of work, with more and more decisions—even quasi-medical decisions—being taken by management boards and professional administrators. Worst of all, the AMA a generation ago proved unable to resist the introduction of schemes like Medicare and Medicaid.[295]

Medicine's move away from autonomy—loss of control—and towards the subservience of salaried positions is a clear indicator of a decline in the profession.

In this same vein, engineering's industrial exemption belies professionalism. Its distinctive feature is subservience, not control. Because an engineer is employed by an entity on whom liability will rest, the demands of professionalism such as Roger Balla assumed in his job at Gambro[296] are lifted from his or her shoulders. Moreover, as Edwin Layton observed, engineers' challenge when working in corporate America is to achieve any amount of moral autonomy and social responsibility because "[e]mployers have been unwilling to grant autonomy to their employees, even in principle. They have assumed that the engineer, like any other employee, should take orders."[297]

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[295] *Just Another Way to Make a Living*, ECONOMIST, Mar. 12, 1998, http://www.economist.com/node/370941 (emphasis added). *See* KRAUSE, *supra* note 22, at 38-44.
[296] *Balla*, 584 N.E.2d at 108-10.
[297] LAYTON, *supra* note 19, at 5.

The industrial exemption is a natural outgrowth of a profession, which, from the outset, has been closely allied with the industrial firms it serves. Since the beginning, engineering's primary role has been to answer industry's call for expertise. Industry is, and always has been, engineering's closest associate and ally. Engineers have always depended on industry and its capital[298] as much as industry has depended on engineers' know-how.[299]

This symbiotic partnership has forged a strong alliance in which, as often as not, industry dominates and even controls engineering. Elliott Krause has bluntly concluded that "there never has been much question about the status of American engineering: engineers were and are the middle-level employees of capitalism."[300]

That night in Brigham City, Jerry Mason understood the nature of engineering's relation to corporate management when he told Thiokol's head engineer that it was time for him "to take off [his] engineering hat."[301] Mason knew that management was in charge, not engineering. He knew that he, as the head manager in the room, could insist that his engineers yield their independent engineering judgments and join in making a business decision about an engineering problem.

IV. WHAT TO DO ABOUT THE INDUSTRIAL EXEMPTION?

At the beginning of the 21st Century, engineering stands far from achieving recognition as a true profession. Informed engineers admit it. As Stephen J. Ressler acknowledges, "[e]ngineering is regarded as an inherently weak profession because of the corporate setting in which engineering work is typically performed."[302] And informed engineers have understood their profession's plight for a long time. In 1910, George Swain, professor of civil engineering at Massachusetts Institute of Technology, acknowledged that "many well informed people deny that engineering is a profession at all . . . ."[303] Elliott Krause's assessment is more candid:

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[298] ABBOTT, *supra* note 21, at 156.

[299] LAYTON, *supra* note 19, at 2 ("Where large investments are at stake, the engineer can serve a useful function in eliminating guesswork and minimizing risks. Technically, large works are more likely to involve complexities than are small ones; and the larger the project, the more likely it is that such difficulties will transcend the capabilities of artisans and businessmen.").

[300] KRAUSE, *supra* note 22, at 60.

[301] MCDONALD & HANSEN, *supra* note 236, at 112.

[302] Stephen J. Ressler, *Sociology of Professions: Application to the Civil Engineering "Raise the Bar" Initiative*, J. PROF. ISSUES IN ENGINEERING EDUC. & PRAC., July 2011, at 151, 155 (citation omitted).

[303] George F. Swain, *Engineering as a Profession and Its Relation to the American Association for the Advancement of Science*, 31 SCIENCE 81, 81 (1910).

> [E]ngineering in the United States is a very poorly organized, middle-level employee group, with a series of scientific societies for each specialty, usually run by capitalist engineers-turned-managers. Production and development are controlled by the corporations, with a high proportion of engineers sharing the corporate values, the loose supervision of middle-level employees, and the possibility of promotion at least into technical group management. With practically no action as a group across work settings, engineers are an example of a group that has never had [the power of a profession].[304]

A. The Industrial Exemption is Dangerous to Engineering

The obvious reason states are willing to excuse engineers working in industry from licensure does not appear to be, as Kolhoff believed,[305] that these engineers do only ancillary engineering and thus do not pose much of a threat to the public. The real reason for the industrial exemption is far more likely that the states have perceived that engineers working in industry are not in charge. The law has always preferred to pin responsibility on the person in charge.[306]

The industrial exemption's perversion is that, in lifting responsibility from the engineer's shoulders and putting it on management, it necessarily gives management claim of control over the engineering work. The untenable result is that a person who may or may not understand engineering has control over engineering work—what the work is to be and who is to perform it. Under the exemption, management is free to assign engineering work to any of its employees (even those not trained in engineering), and it is free to accord the title engineer to any employee without consideration of the employee's credentials.[307] An engineer having earned a graduate degree may occupy a cubicle next to a person who, although titled "engineer," has not attained even a bachelor's degree.[308]

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[304] KRAUSE, *supra* note 22, at 67.

[305] *See supra* notes 208-09, 211-215 and accompany text.

[306] *See, e.g.*, Brian A. Melhus, Note, *Control Person Liability: A Repudiation of Culpable Participation*, 37 J. CORP. L. 929 (2012).

[307] Even though a wise manager can be expected to not assign significant work to an employee who does not have the knowledge or skills to do the work, not every manager is wise. Scott Adams' cartoon strip, "Dilbert," amuses its audience daily with its reminder of the incompetent managers nearly every worker has encountered at some point in his or her work experience. Laurence Peter created much stir in 1969 with his theory that every employee tends to rise to his or her level of incompetence. LAURENCE J. PETER & RAYMOND HULL, THE PETER PRINCIPLE (1969).

[308] For example, Richard Masi posted this comment on an internet blog maintained by the National Society of Professional Engineers: "I have a Bachelor's [degree] in Biology and made it through the Navy's Nuke Engineering School (Mechanical) and passed the 6 hour NRRO review board to earn my MM-3385. No degree is awarded for that but you get college credit towards a Bachelor's in Nuke Engineering Technology at many colleges. Nevertheless at my job[,] which I have had for

Engineers working for business firms typically make their decisions as members of a team whose specialized contributions are but one of several disciplines involved in the project. As Martin Goland observed, "Team efforts necessarily tend to subjugate the individual personality to the group median."[309] Licensed engineers bear personal responsibility for their work. Licensure ties work product to the licensee. Unlicensed engineers working in industry under the exemption do not bear such responsibility. Clearly, the public should expect work for which an employee must assume personal responsibility to be done with greater care than work done by one who knows that his or her employer will be assuming responsibility for their work.[310] Business managers can be expected to make decisions based as much on cost, efficiency, and what customers want as on what constitutes good engineering, even if ignoring sound engineering means taking risks at the expense of the public's best interests. Indeed, engineers have "trade[d their] lower-level control of the daily work place for capitalist control of ends, projects of work chosen, and even the decisions to hire and fire," Krause observes.[311] "Engineering is not in control of the market for services, except for a tiny group in consultant status . . . ."[312]

This picture simply does not depict a profession. It portrays instead would-be professionals trapped in the world of business often unable to function adequately as either a professional or business person. Way back in 1910, George Swain captured the engineer's plight: "Many people seem to think that the engineer is neither a scientist nor a professional man, nor yet a business man strictly speaking, but that he is something betwixt and between—some one to be employed for certain technical work."[313]

An engineer is more than a person employed for technical work. Today's engineers, by virtue of their education and esoteric knowledge, should

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10 years, my title is now Regional Applications Engineer. Starting out fresh out of the Navy my boss[,] a degreed engineer (but not a PE; he only passed the EIT exam)[,] only allowed me title of Applications Specialist. A few years into it I threatened to quit unless [my] title was upgraded to ASSOCIATE APPLICATIONS ENGINEER. He begrudgingly obliged. I didn't even want a raise. After all, by then I was designing advanced control systems for combustion and cryogenic systems and thought the title warranted." Richard Masi, *The Industrial Exemption: What, if Anything, Should the Profession Do?*, NAT'L SOC'Y PROF. ENG'RS (March 03, 2010, 10:50 PM), http://www.nspe.org/resources/blogs/pe-licensing-blog/industrial-exemption-what-if-anything-should-profession-do?.

[309] Goland, *supra* note 280, at 286.

[310] This is not to say, of course, that the employee is not aware that faulty work will subject him or her to disciplinary action, including termination. Often, however, this pressure has an effect contrary to protecting the public. As the *Challenger* saga illustrates, the engineering employee feels compelled to accede to management's wishes to "cut corners." *See infra* notes 304-305 and accompanying text.

[311] KRAUSE, *supra* note 22, at 60-61.

[312] *Id.* at 61.

[313] Swain, *supra* note 303, at 82.

be taking their seat among the venerable professionals. Stopping them is engineering's long-standing partnership with industry. Undoubtedly the close association between engineering and business is a fact of life that will not change; both need each other.

But if engineering is ever to achieve profession status, it must find a way to coexist with business without giving up its control of engineering work. Change, if it is going to happen, will be initiated by engineers, not by industry. Management has no incentive to change; it has firm control. Hence, the starting point must be for engineers to find a way to wrest control of engineering from management.

That will require a wholly different engineering culture—a complete paradigm change—and complete paradigm changes are not easily accomplished. They often require nothing short of revolution. In *The Revolt of the Engineer*,[314] Edwin Layton sets out the long, complex battle that conservatives and reformers have been waging since the turn of the 20th Century.[315] Engineers seem to be at a crucial point in a more than a hundred-year-long revolution to pull engineering into the realm of professionalism.

B. The Industrial Exemption is Dangerous to the Public

Of course, no revolution can overcome complacency, and engineers seem to have become quite complacent about their profession's status. One of the more alarming of Elliott Krause's observations about engineers is the effect that their working in the corporation context has had on their engineering values.[316] As should be expected, engineers working in industry must acculturate to a large extent into the business world if they have hope for success. This, of course, requires meshing engineering principles with a company's overarching goal of making a profit. The result, Krause says, is that engineers unavoidably take on business values.[317]

Studies indicate that the vast majority of engineers perceive cost and profit to be as important a factor in their engineering as the physical properties of the components with which they work.[318] But even beyond that, engineers have allowed business values to dissuade them from being whistleblowers. "One thing that engineers almost never do, given their values," Krause says, "is to complain when they work on projects that maximize profits through cutting back on

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[314] LAYTON, *supra* note 19.

[315] Layton acknowledges that that using "revolt" in the title of his book may have been a bit disingenuous. He confesses that he used the term only because his publisher thought his original title "lacked 'pizzazz.'" *Id.* at vii.

[316] Krause, *supra* note 22, at 60-61.

[317] *Id.*

[318] *Id.* at 61.

safety."[319] Engineers understand that their questioning safety aspects of a job can put them in the express lane to unemployment.[320]

As an example of a bad business decision masquerading as an engineering failure, the *Challenger* was not an aberrant occurrence. A list of engineering catastrophes resulting from bad business decisions—often motivated by "corner cutting" after a project falls behind schedule and goes over budget—would be quite lengthy. One of the more recent ones was the 2010 explosion on the BP *Deepwater Horizon* oil rig forty miles off the coast of Louisiana in which 11 workers were killed and millions of gallons of oil spilled into the Gulf of Mexico.[321] A presidential commission investigating the disaster concluded that it resulted from a series of blunders motivated by saving time and money.[322] Every year, hundreds of lawsuits are filed in which plaintiffs establish that manufacturers consciously chose, for reasons of cost savings and market considerations, to sell unsafe consumer products when they knew that safe alternatives having little or no cost were available.[323] One of the most notable examples is Ford's decision to take its Pinto model to market knowing that the car's design made it susceptible to explosions in the car's gasoline tank during rear-end collisions and that the problem could have been fixed for only $11 a car.[324]

Putting employer's interests ahead of the public's is inconsistent with professionalism, especially when doing so has the potential to kill or maim. Simply, engineers who do not have the wherewithal to withstand management pressure to set aside sound engineering in favor of saving time and money are not professionals.

Hence, before changes necessary for advancing engineering can occur, a change of attitude—undoubtedly nothing short of a revolution—must occur among engineers. They must become aware of, and overthrow, the barriers that have debilitated sound engineering. Severely handicapping engineers from effectuating the needed change of attitude is a lack of unity and cohesiveness.

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[319] *Id.* at 65.

[320] *Id.*

[321] John M. Broder, *Blunders Abounded Before Gulf Spill, Panel Says*, N.Y. TIMES, Jan. 5, 2011, http://www.nytimes.com/2011/01/06/science/earth/06spill.html.

[322] *Id.*; NAT'L COMM'N ON THE BP DEEPWATER HORIZON OIL SPILL AND OFFSHORE DRILLING, DEEP WATER: THE GULF OIL DISASTER AND THE FUTURE OF OFFSHORE DRILLING: REPORT TO THE PRESIDENT 223 (2011), *available at* http://www.gpo.gov/fdsys/pkg/GPO-OILCOMMISSION/pdf/GPO-OILCOMMISSION.pdf ("[O]fficials made a series of decisions that saved BP, Halliburton, and Transocean time and money—but without full appreciation of the associated risks."). *See also* Ben Casselman and Russell Gold, *BP Decisions Set Stage for Disaster*, WALL ST. J. (MAY 27, 2010), http://www.wsj.com/articles/SB10001424052748704026204575266560930780190.

[323] *See* Gerald F. Tietz, *Strict Products Liability, Design Defects and Corporate Decision-Making: Greater Deterrence Through Stricter Process*, 38 VILL. L. REV. 1361, 1365 (1993).

[324] *Id.* at 1395-96.

Louis Gattschalk has noted that provocation does not create revolutions. What gives rise to revolutions is solidarity in response to provocation:

> The fact that I am discontent will not lead me to revolution unless I am aware that quite a number of other people are equally discontented and are likely to unite with me in the expression of my discontent. General awareness of resentment against . . . provocations, together with the provocations themselves, creates that kind of demand for change which becomes effective in making revolutions."[325]

Krause agrees, noting that engineers' complacency has prevented development of "oppositional group consciousness."[326] Most engineers do not belong to an engineering society, and, if they do, they do not participate in it much beyond attending a few social events.[327] Without unity, the needed revolution is not likely to endure.

C. Getting Rid of the Dangerous Industrial Exemption

Seemingly, one of the biggest barriers to engineering's achieving recognition as a bona fide profession is the industrial exemption. It necessarily has meant that management, not engineers, is in control of much of the engineering that occurs in the United States. It has significantly affected the attitudes of engineers working in industry by allowing them to avoid responsibility for their engineering and by requiring them to factor business principles into their engineering judgment. The stark reality seems to be that, if engineering is ever going to achieve recognition as a bona fide profession, undoubtedly the catalyst will be a significant paring back, if not elimination, of the industrial exemption.

The bad news, however, is that even if every state with some form of industrial exemption were to amend their statutes to restrict the exemption's application to ancillary engineering, as Kolhoff advocated,[328] it would not be enough. Although Kolhoff is correct that the public should be adequately protected if the work being done under the exemption is work that affects only the firm for whom the engineer works, asking licensing boards to make and enforce such fine-haired distinctions probably is asking for too much. Hence, nothing short of outright elimination of the exemption will be enough.

Eliminating the exemption will not be easy. Industrial management has good reason to want to retain the status quo; it is in control. For example, when

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[325] Louis Gottschalk, *Causes of Revolution*, 50 AM. J. SOC. 1, 5 (1944).
[326] KRAUSE, *supra* note 22, at 62.
[327] *Id.*
[328] *See supra* notes 208-09, 211-215 and accompanying text.

attempts were made in Texas during 2003 to eliminate the exemption, industry was effective in blocking the efforts.[329] According to a NCEES task force, "The industry lobbies, arguing economic development via contracted cheaper foreign engineering services, were able to stop any action . . . ."[330] Industry was able to kill an effort in 1993 to pare back the exemption in Louisiana, even after much effort was made to accommodate industrial interests.[331]

Engineers working in industry have little personal incentive for change. They avoid the hassles of difficult examinations and times of apprenticeship typically associated with licensing, and they enjoy the "safe harbor" of engaging in an interesting job within an organization that assumes responsibility for their work. Vestiges of engineers' ambivalence toward licensing and siding with industry remain. For example, the American Institute of Chemical Engineers defends the exemption as a necessity for chemical businesses that typically conduct interstate and international transactions. "Because of the lack of uniformity in licensing laws and regulations between jurisdictions," the institute's policy statement said, "the need for multiple licensures creates an unnecessary burden on the engineer and company while providing no additional benefit to the general health and welfare of the public."[332] The Public Affairs and Outreach Sector of the American Society of Mechanical Engineers announced similar views.[333]

Between such opposition by industry and engineers sympathetic to industry, there does not appear to be much hope for eliminating the exemption. There has been a bit of action, such as legislation introduced during the 2013-14 legislative session to the Pennsylvania General Assembly to eliminate the exemption in Pennsylvania.[334] Such legislation rarely gains traction, however, and the Pennsylvania bill did not. Montana is the only state to throw out the exemption, and that was more than thirty years ago.[335]

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[329] *Industrial Exemption Task Force*, *supra* note 218, at 155.

[330] *Id.*

[331] *Id.* at 155-56.

[332] Press Release, American Institute of Chemical Engineers, Full Statement: AIChE and the Industrial Exemption, April 2014 (May 7, 2014), http://www.aiche.org/about/press/releases/05-07-2014/full-statement-aiche-and-industrial-exemption-april-2014.

[333] *See Industrial Exemption*, AM. SOC'Y OF MECH. ENG'RS, https://www.asme.org/wwwasmeorg/media/ResourceFiles/AboutASME/Get%20Involved/Advocacy/Policy-Publications/PS14-07-Industrial-Exemption-5-7-2014Statement.pdf (last visited Dec. 28, 2014). *But see* G. J. Kettler, *Against the Industry Exemption . . .*, *in* ENGINEERING PROFESSIONALISM AND ETHICS 531, 533 (James A. Schaub et al. eds., 1983) (In rebuttal to similar arguments, Kettler noted, "The present operations of many of the larger consulting companies cross multiple state lines successfully. Common sense application of the laws and reciprocity provisions should solve most of the problems including the transfer of engineers.").

[334] The measure is H.B. 1447 sponsored by Rep. Marc J. Gergely (D-35th District).

[335] Schwartz, *supra* note 205.

Understanding that eliminating the exemption will require a revolution, opponents of the exemption have called for a multi-faceted campaign. A task force of the National Council of Examiners of Engineering and Surveying has recommended beginning the campaign in the nation's engineering classrooms. The group calls for convincing engineering faculty to place more emphasis on licensure, especially in engineering ethics courses, in hope of making licensure seem like the natural next step for graduates of engineering school.[336] The task force also recommends working for modifications of reciprocity laws to facilitate interstate practices and to heed the concerns expressed by the American Institute of Chemical Engineers and others.[337] The task force understands, too, that it must find a way to "grandfather" the hundreds of thousands of unlicensed engineers working in industry.[338] Finally, the task force recommends an all-out public relations campaign:

> The public will need to understand why the elimination should be undertaken, industry will need to understand why this change would be advantageous to its long-term benefit, the profession will have to agree to some form of initial compromise on some of the legs of licensure, and the licensing boards will have to address comity.[339]

The last recommendation seems to be the most important one. So long as the public fails to perceive the danger posed by the industrial exemption—its facilitation of badly engineered industrial and manufactured products—legislative complacency will surely continue. The public must be made aware that engineering licensing laws rarely apply to the engineering work being done in their states and that the overwhelming majority of engineering is being done by unlicensed engineers. Legislators will be far more responsive to the outcries of a public demanding explanation for why, if the legislatures deemed licensing laws to be necessary for the public's protection, they have seen fit to excuse all but a few engineers from licensure.

V. CONCLUSION

The partnership of engineers and business is, for pragmatic reasons, here to stay. It not only has been a symbiotic partnership—good for both engineers and business—but it has been good for America. It has produced many wonderful products that make life more enjoyable—the likes of smart cars, smart phones, and smart TVs. Business has prospered as engineers have shown it how

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[336] *Industrial Exemption Task Force, supra* note 218, at 158.
[337] *See id.*
[338] *Id.*
[339] *Id.* at 159.

to make its products wonderful and smart, and business has rewarded engineers for the favor.

But it has come at a high cost—for the public and for engineers. Industry has demanded the likes of the industrial exemption and thereby gained control of a majority of the engineering that occurs daily in the United States.

For the public, the price has been the loss of effectiveness of laws intended to protect it from incompetent engineers whose work can kill or destroy. Among the fallouts of the industrial exemption has been disaster—oil spills, unsafe automobiles, and exploding spacecraft.

For engineers, the price may have been higher. It has lost its profession. In exchange for the partnership's rewards, engineers have acceded to business managers' penchant for asking their engineer employees to take off their engineering hats and to fall into step.

The wisest man to have lived posed long ago a question that is apt for engineers today. "What good will it be for someone to gain the whole world," Jesus asked, "yet forfeit their soul?"[340] What good has it been for engineering to have gained the bountiful rewards of business yet to have forfeited its profession?

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[340] *Matthew* 16:26 (NIV).