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Chapter 1

General Introduction: The Engineering-Business Nexus: Nature, History, Contexts, Tensions



Steen Hyldgaard Christensen, Bernard Delahousse, Christelle Didier, Martin Meganck, and Mike Murphy

The vested rights of absentee ownership are still embedded in the sentiments of the underlying population, and still continue to be the Palladium of the Republic; and the assertion is still quite safe that anything like a Soviet of technicians is not a present menace to the vested interests in America. (Veblen 1921, p. 128)

The engineer is both a scientist and a business man. (Layton 1971, p. 1)

While the systematic monopolization of scientific knowledge by the professionals increased the autonomy of scientists, however, it had the opposite effect upon engineers, tying them to the large corporation. (Noble 1977, p. 43)

Questions about the nature, history and context of the engineering-business nexus related to specific times and countries are not new, as evidenced by the quotations given above from three American classics: Thorstein Veblen's *The Engineers and*

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the Price System (1921), Edwin Layton's *The Revolt of Engineers* (1971), and David Noble's *America by Design* (1977). What these classics have in common is that they all set out to examine the consequences related to a decisive moment in the history of business and engineering in the United States, namely the emergence of the multidivisional business corporation – a new institutional entity constituting a main feature of corporate capitalism or what Harry Braverman (1974) calls monopoly capital. Each in its own way has shown how the professional ideals and aspirations embraced by many American engineers during the Progressive Era, from the 1890s to the 1920s, were in marked tension with business imperatives and bureaucratic loyalties. Nevertheless the work of both Edwin Layton and David Noble helped to contextualize the professionalization of American engineers. They also showed how prevailing engineering values and attitudes were frequently interchangeable with a business ethos inculcated through dominant pathways in engineering education and career trajectories. At a more general level the conflicting values and commitments of professionals and managers have been substantiated in Joseph A. Realin's 1985 book *The Clash of Cultures: Managers and Professionals* in which he proposes how professionals should be managed to avoid a clash of cultures.

The engineering-business nexus has also been a persistent subtheme in engineering ethics. In their 2000 book *Introduction to Engineering Ethics* Mike W. Martin and Roland Schinzinger write:

From its inception as a profession, as distinct from a craft, much engineering has been embedded in corporations. That is due to the nature of engineering, both in its goal of producing economical and safe products for the marketplace and in its usual complexity of large projects that requires that many individuals work together. (Martin and Schinzinger 2000, p. 19)

Though some engineers also work within government entities, or for non-profits, such as humanitarian organizations, the bulk of engineering activity occurs in the service of business and industry. In highly technological businesses, it is not uncommon for engineers to take on business management functions and often rise into the executive ranks. So, while engineering and business are generally studied as distinct entities, they are deeply symbiotic. Further, engineering and business are both quite diverse. Engineering has a wide array of disciplines, and a wide array of job functions within each discipline. And the companies that engineers work for provide a panoply of products and services, range in scale from small consultancies to giant multinationals, and vary across a spectrum of political and cultural environments. Thus there is a complex business-engineering ecology that defies any simple characterization of the engineering-business relationship. The engineering-business relationship is also complicated by tension between the two – most often a tension between the demands of the marketplace and the ideals of the profession.

Examination of the social context in which the large corporation arose, and how this new entity was regarded by society, shows that the birth of the business corporation represented more than a simple development and implementation of new technologies and adaptation to new market conditions. In itself the multidivi-

sional business corporation was an important innovation, because it professionalized the big company and set its dominant structure. In this way the business corporation became the template for “managerialism”. John Micklethwait and Adrian Wooldridge in their 2003 book *The Company: A Short History of a Revolutionary Idea* put it this way: “If the archetypical figure of the Gilded Age was the robber baron, his successor was the professional manager – a more tedious character, perhaps, but one who turned out to be surprisingly controversial” (ibid., p. 103). Ultimately, as Joel Bakan unveils in his 2004 book *The Corporation. The Pathological Pursuit of Profit and Power*, the large business corporation was also linked to emerging social, intellectual and cultural conditions, or more precisely to the disruption of an entire social order. As noted by Braverman (1974, p. 260) prior to 1850 very few American firms needed the services of a full-time administrator. Neither did they require a clearly defined administrative structure as industrial enterprises were very small. Administration in such small businesses was usually a family affair. Its basic economic, administrative, operational, and entrepreneurial activities could normally be handled by two or three men responsible for the destiny of the enterprise.

As the business corporation came to replace the small traditional family firm Alfred D. Chandler in his 1977 classic *The Visible Hand: The Managerial Revolution in American Business* noted that in many sectors of the economy,

The visible hand of management replaced what Adam Smith referred to as the invisible hand of market forces. The market remained the generator of demands for goods and services, but modern business enterprise took over the functions of coordinating flows of goods through existing processes of production and distribution, and of allocating funds and personnel for future production and distribution. As modern business enterprise acquired functions hitherto carried out by the market, it became the most powerful institution in the American economy and its managers the most influential decision makers. (Chandler 1977, p. 1)

Chandler extends and deepens insights that can be found as well in a 1932 analysis by Adolf A. Berle and Gardiner C. Means, *The Modern Corporation and Private Property*, which picked up on the significance of the divorce of ownership from the control of the business corporation, as did Veblen’s 1923 *Absentee Ownership and Business Enterprise in Recent Times: The Case of America*.

From the second half of the nineteenth century, however, it was not clear whether graduates from engineering schools or graduates from emerging business schools would provide leadership in society, industry, and emergent large business corporations, and whether they should pursue higher aims of service beyond material rewards and profit. With respect to the emergence of the American business school the taken-for-granted assumption that an enormous cadre of salaried managers should manage the business corporation on behalf of absentee owners was a historical contingency. The business school was established for a growing occupation in search of legitimacy. In Rakesh Khurana’s account (Khurana 2007) the emergence of the American business school in 1881 was founded on the promise of turning management into a profession for higher aims.

Consequently, at the beginning, the rhetoric of both engineers and managers implied aspirations of providing professional leadership for higher aims. However, these groups emerged as a response to social needs related to their occupational practice, and the discussion about higher aims came along later. Although at the level of early practice the question of doing good – and giving oneself some rules – was always an issue for some people, the formalization of education and the emergence of new groups – the “professionals”, or the “graduates” – was the result of a whole process. First came the needs from the practice of their trade, secondly came the need for formal education, and finally the collective discussion about the other goals such as higher aims. Today, however, and perhaps more than ever before, business leaders and practicing engineers face a complex interdependence. This interdependence arguably affects all participants in the global economy, and in our increasingly interconnected world it is becoming ever more obvious that actions providing immediate advantage to some cannot be counted on to benefit all. A glaring example of such actions that provide advantage to a single group to the detriment of other stakeholders is the way business managers are incentivized:

The tactic of “incentivizing” managers with stock options, for example, followed from a market logic – inculcated in directors and managers alike by business schools beginning in the 1970s – that assumes that managers are both purely self-interested and motivated only by the prospects of lavish material rewards. By demoting managers from professional stewards of the corporations resources to hired hands bound only by contractual requirements and relationships, business schools thus helped create the conditions and standards of behavior through which the market-based mechanism of stock options was turned into instrument of defrauding investors, jeopardizing the livelihoods of employees, and undermining public trust in managers and corporations. (Khurana 2007, p. 375)

These new times raise questions about business and engineering practices, the meaning of leadership and expertise, and, ultimately, the very purpose of business and engineering. For engineers this is all the more relevant as we live in a progressively engineered world, which raises troubling questions regarding the meaning of life and the goals of societies in this kind of world.

In light of this background, the purpose of this book is to explore the engineering business ecology in order to increase our understanding of its nuances. This includes understanding the common ground between business and engineering, as well as differences between them. Our aim is to explore perceived benefits and challenges, compatibilities and tensions, and agreements and misunderstandings within the engineering/business relationship, and consequent implications for society. In the process, we also want to highlight the importance of the engineering/business relationship in the education of engineers.

The present volume therefore interrogates multilayered relationships between engineering and business on a broad international canvas with an eye to the social transformation of business schools and the unfulfilled promise of management as a profession (Khurana 2007). Key overlapping questions that inform the volume are:

- What kinds of conflict arise for engineers in their attempt to straddle both professional and organizational commitments?

- How should professionals be managed to avoid a clash of managerial and professional cultures?
- How do engineers create value in firms and corporations?
- What kinds of tension exist between higher education and industry?
- What kinds of tension does the neoliberal entrepreneurial university pose for management, faculty, students, society, and industry?
- Should engineering graduates be ready for work, and can they possibly be?
- What kinds of business issues are reflected in engineering education curricula, and for what purpose?
- Is there a limit to the degree of business hybridization in engineering degree programs, and if so, what would be the criterion for its definition?
- Is there a place in engineering education curricula for reflective critique of assumptions related to business and economic thinking?

As regards the last bullet question, concerns have been voiced over the narrowness of business curricula and the lack of reflective critique resulting in the failure of business educators to challenge students to question assumptions, to think creatively, and to understand the place of business in larger institutional contexts. Prominent examples of scholarly work that point to the need to address this situation are Rakesh Khurana's 2007 book *From Higher Aims to Hired Hands: The Social Transformation of American Business Schools and the Unfulfilled Promise of Managements as a Profession*, Anne Colby, Thomas Ehrlich, William M. Sullivan and Jonathan R. Dolle's 2011 book *Rethinking Undergraduate Business Education: Liberal Learning for the Profession*, and Robert R. Locke and J.-C. Spender's 2011 book *Confronting Managerialism: How the Business Elite and their Schools Threw our Lives out of Balance*. In spite of dispersed initiatives the situation seems to be quite similar in engineering education curricula. All the more so is this the case since STEM fields play a crucial role in the neoliberal entrepreneurial university and managerialism and administrative bloat have been flourishing in this new corporatized entity.

In addressing the above-mentioned questions the present volume collects 21 original contributions grouped into four parts. Part I concerns engineering and business value systems, and Part II engineering and business ideologies past and present. Part III has its focus on the practices of business and engineering. Finally the focus of Part IV is on engineering and business education.

1.1 Part I: Engineering and Business Value Systems

The five chapters in the first part of the present volume examine the relationship between business and engineering through the values and ideologies as conveyed by scholars of these two occupations in various geographical areas in North America and Europe respectively and who normally speak different native languages. For the sake of precision: American English is the native language of two American

scholars, British English the native language of an Irish scholar, and French the native language of a Quebecois and a Frenchwoman. This part of the volume thus evokes the values of two occupations morally characterized in various ways according to the cultural moorings and industrial histories of each of the universes traversed in this first part. The various perspectives also depend on the chosen theoretical disciplines and frameworks, whether it is philosophy, ethics, or social science.

Through contrasting North America with Europe, the first part of the book highlights the influence of political and social contexts on the production of ideas and categories of analysis. In particular the boundaries between two occupational worlds, namely that of business people and that of engineers, are highlighted. Readers of Chaps. 2 and 3 will find that the demarcation approach that comes into view in these chapters is echoed in the Canadian Iron Ring ceremony as presented in Chap. 8. Moreover the critical perspective proposed in Chap. 6 which traces the construction of several professional models to the Middle Ages, will find some resonance, though less distant than the Middle Ages, in some of the chapters in Part II, especially in Chap. 7. In addition, Chap. 5 shares with Chap. 16 an approach focused on actors at work and with Chap. 13 a diachronic approach to careers, but above all a more interactionist perspective on professions and a more fluid understanding of occupational boundaries. Readers will find that the captivity argument advanced in Chap. 4 is reflected in Chap. 9 with respect to the captivity of Chinese entrepreneurs and engineers under the socialist planned economy. Furthermore readers of Chap. 4 may delve deeper into the discussion on the need to develop the critical thinking skills of engineers by considering Chaps. 17 and 18 which both address the broader outcomes of engineering education. In the following we present each chapter in Part I in its own right.

U.S. philosopher of the professions, Michael Davis in Chap. 2 analyzes the evolution of the relationship between engineering and business, two human activities he clearly distinguishes by means of the nature and moral obligations that flow from them. According to the functionalist framework he adopts – matching that of sociologist Rakesh Khurana – business management should not be considered as a profession in contrast to engineering which should be. Consistent with the author's definition of a profession as “a number of individuals in the same occupation voluntarily organized to earn a living by openly serving a moral ideal in a morally permissible way beyond what law, market, morality and public openness would otherwise require” (Davis 2009, p. 217), business management does not qualify as a profession whereas engineering clearly fulfills the criteria of being a full blown profession. Davis proposes that MBA students should study the professions in terms of their culture, values, and standards. He also defends the idea that business schools should not so much prepare their students to become “leaders” who should “manage professionals”. Rather they should prepare students to know how to “manage with professionals” like engineers and other professionals. The author's view might be more meaningful for readers for whom “profession” is a stabilized legal and/or social institution and status. Still, however, an evident need for business managers and engineers – trained in different types of institution in most countries – to be

socialized to understand each other's occupation comes into view as an issue that goes beyond any cultural and geographical specificity.

In Chap. 3, Quebec ethics philosopher Luc Bégin and his colleagues analyze the tensions encountered by engineers between the ideals of their profession and the expectations of their employers. The founder in 2004, and active director of the Laval University Applied Ethics Institute (IDEA, *Institut D'Ethique Appliquée*), Bégin has regularly served as an ethics expert for the Quebec Government and for several professional orders, such as the *Ordre des ingénieurs du Québec*. The research question posed in this chapter relates to the same geographical context as Davis, North America. Although they do not belong to the same culture, Canadians – even in French-speaking Québec – share many values with Americans. If contrasted with other continents' approaches, there are also similarities in the ways Canadian and American scholars deal with occupational ethics. But there are also differences, especially for engineers. In Quebec the title of engineer is socially considered as a “privilege”, and engineers are organized – as in the rest of Canada – as a “regulated profession”. Moreover, and importantly the first and foremost legal obligation of the Order which controls them is to protect the public. In the context of the time and these entitlements, Bégin and his colleagues have observed an erosion of the professional ideals, which led them to focus their present study on the tension encountered by the engineers who work for very large public and private organizations. In order to counteract this erosion, they propose (a) that the state imposes an obligation on companies that they should guarantee a right for engineers to respect and fulfill their professional moral duties, (b) to develop a better mutual understanding of the respective values of the engineers and their employers, as well as (c) to ensure a better legal protection for whistleblowers. Although their contexts differ, Davis and Bégin share the view that engineers and business managers (Davis) or their employers (Bégin et al.) need a better understanding of each other's value framework.

Irish scholar Edward Conlon, in Chap. 4, takes a Marxist approach to engineering ethics. Despite the fact that in this theoretical approach and geographical context there are occupational groups socially defined as “professions” – and sometimes legally defined as regulated/chartered professions – the notion does not match Davis' definition. Moreover in the Irish social context the engineering title is not regarded as a privilege. In point of fact the notion of profession does not need to be defined here because Conlon does not base his research on the nature or status of engineering as a group whether its denomination is occupation or profession. He studies the concrete engineers' decisions and actions in their work context using the sociological distinction between structure and agency. Rather than discussing the relationships between engineers and their managers seen as interdependent equals or the engineers' dual obligations toward their employers and their order, the author puts forward the concept of the captivity of engineering by the capitalist machine to develop his points regarding critical issues in engineering ethics. From this perspective, the efforts of engineers to address the critical issues of safety and sustainability are seen as prevented or hindered by structural constraints that weigh heavily on their professional practice. By mobilizing Margaret Archer's theory of critical realism which is neither determinist nor relativist, the author proposes to develop an

ethical training strategy capable of contributing to the emancipation of engineers by strengthening their capacity to analyze the context in terms of the structure of their practice as a way to develop new means of action.

Glen Miller, U.S. philosopher, analyzes in Chap. 5 the ethics of engineering from an individual and Western perspective which is both realistic and sensitive to the weight of contingencies. By way of addressing the business-engineering nexus more implicitly, the approach differs considerably from the previous ones. In a micro-subjective approach the author focuses on the way individual engineers might “navigate” the engineering-business space in terms of how they deal with the ethical issues within their actual work and how they make career choices. He also questions the relationship between professional ethics and ethics taken in a broader sense. According to the author, the ethics codes produced by engineering organizations “in some countries” or by program accreditation bodies like ABET in the U.S. and EUR-ACE in Europe are good resources for an ethical career at the beginning of a professional trajectory, thereby enabling engineers to become rule-following employees. However, he also notes that they are insufficient beyond that. Miller proposes to go beyond the preventive/prohibitive approach of the codes by founding his approach on W. D. Ross’ ethics of obligations, which he considers compatible with the moral stipulations of ABET and EUR-ACE. According to Miller, the development of individual dispositions to virtue can accompany, better than codes, the ability of engineers to navigate the engineering-business space over a life-long career path.

Finally in Chap. 6, French sociologist Christelle Didier proposes to stage the debates on professional values differently, by enlarging the perspective to a broader historical context without taking *the higher aims* of the profession for granted in the way of scholars such as Davis and Khurana associated with the North American tradition. She revisits the medieval European context, with its Catholic bodies and Saxon brotherhoods, as well as the Puritan conceptions of vocations which served as a framework for many academic studies of the professions and their ethics. Many of these studies have been carried out by British scholars but in the main by scholars from North America. In fact the concept of “profession” – without the adjective “regulated” – as distinct from the notion of “occupation”, whatever its definition, developed in the English-speaking world, does not have an exact equivalent in the majority of other languages, such as the author’s native French language as well as in Japanese to mention two recognizable examples, because it belongs to a certain type of social stratification. The author proposes to clear up a few misunderstandings in this respect as well as misunderstandings related to cultural, linguistic and theoretical aspects that accompany most university discussions on the ethics of engineering and business, and the role the concept of profession plays in these endeavors. The author emphasizes the need to question some of the basic assumptions, if the aim is intercultural exchanges, to maintain a fruitful debate.

1.2 Part II: Engineering and Business Ideologies Past and Present

The six chapters in the second part offer historical reflections on engineering and business ideologies past and present as well as reflections on reform efforts in higher education that have been informed by the dominant economic discourse of neoliberalism originating in the 1970s and the associated discourses of “new public management” from the 1980s. Geographically the chapters span past and present developments in the United States, Canada, the United Kingdom, Ireland, and China. However as Chap. 10 is focused on how the key composite engineering competence “acting as an engineer in an organization” can best be learned, it could just as well have been located in Part IV as a complement to Chap. 22 as both these chapters relate to bullet 6 under the key overlapping questions mentioned earlier. Yet the Chaps. 10, 11, and 12 may be read as a triptych as their common theme, in spite of considerable variation in subthemes, is the expansion of higher education systems in the United Kingdom, the United States, and Ireland from the post-WWII period to the present. Readers of Chaps. 7 and 8 should also consider Chap. 2 in which Veblen’s 1921 book *The Engineers and the Price System* is given a lengthy treatment from a historical perspective. Here the author points out that Veblen’s use of the notion of engineer, industrialist, and technologist is somewhat arbitrary but that he did identify important issues of a perennial nature between engineers and business management. These chapters have Veblen either wholly or partially in common, but they differ considerably in approach; yet some common conclusions can be taken from them. Finally using the story of McDonald’s as a case in point and without making explicit reference to Veblen, the Foreword nevertheless provides an exemplification of his engineering-business dichotomy.

Drawing on Veblen’s early, mid-career, and later work on “technicians”, in the opening Chap. 7 the Danish and French academics Steen Hyldgaard Christensen and Bernard Delahousse respectively set out to reinterpret Veblen’s 1921 book *The Engineers and the Price System* as regards the theoretical status of his projected *Soviet of Technicians*. Their reinterpretation is undertaken in light of his deconstruction of the engineering-business nexus which reflects Veblen’s epistemological, ontological, and axiological commitments. Moreover their reinterpretation is founded on two methodical premises reflected in the structure of the chapter: (1) it should be based on a close-reading of the text, and (2) it should locate the text both within the theoretical context of Veblen’s theory of corporate capitalism and in his Darwin-informed evolutionary theory. They advance from the recognition that Veblen explored the cultural contradictions of capitalism in terms of a contradiction between industry and business, whereby he enabled an understanding of why factories rarely worked at full capacity and in addition pointed to the business corporation as a key development in finance capitalism. They show that from an anthropological perspective Veblen traced this contradiction to the residual habits of primitive societies in terms of two clusters of instincts – group-regarding versus self-regarding instincts – and thereby identified the persistent presence of residual habits of primitive societies in modern American life. By juxtaposing engineers to

the “pecuniary class” Veblen, as part of his research program on social movements, aimed to explore a possible candidate movement such as the one led by progressive engineers with the potential to delegitimize the prevailing business ideology for a final socialist overturn. They emphasize that during the course of their study they have observed a tendency among engineering education researchers and historiographers of engineering to reduce the complexity of Veblen’s thought to a number of his provocative statements. This means that the theoretical system behind such statements has been neglected, with the result that a more balanced assessment of the critical potential of Veblen’s theoretical system, and his key insights regarding the inherent contradictions of capitalism, have been lacking. They conclude by establishing a trial balance of strengths and weaknesses in Veblen’s work on technicians.

In Chap. 8 Canadian historiographer of science and technology, Janis Langins, picks up on the historiography of engineering and the conflicting ideologies of engineering and business in the United States during the Progressive Era and their reflection in a later industrializing Canada. He notes that in both countries the influence of modern business as well as academic engineering education became increasingly important and central to the ethos of engineers. His narrative is focused on the Canadian “Iron Ring” ceremony instituted by Herbert E. T. Haultain (1869–1961), a Toronto professor of mining engineering. He clarifies form and content of the ceremonial ritual created by Rudyard Kipling to initiate engineering graduates into their profession. The ritual commemorates an age of masculine engineering heroism, self-denial, and sense of duty in which great engineering works were not yet so common as to be taken for granted by the general populace. Kipling’s poem *The Sons of Martha* served as the core of the ceremony. The author makes it clear that Kipling employed the analogy between Martha and engineers in the biblical allegory of Mary and Martha (Luke 10:38–42) and that he portrays engineers as the people who make it possible for the rest of society to “choose the better Part”. In contextualizing the poem and the response it elicited in 1919 in the form of a new poem titled *The Sons of Mary* advocating the values of a distinctly pro-business ideology, he clarifies the changing relationship between engineering and business ideologies and traces the way engineering developed in the United States and Canada. In so doing he relates the two poems to themes in Veblen’s work and seeks to identify the contradictions in both of these conflicting ideologies. He concludes that both these ideologies contributed to forming the uneasy nexus between business and engineering that continued to evolve during the twentieth century.

The entrepreneur as a social character as well as a class of people smacks too much of unfettered private initiative and business not to constitute a precariat when this character emerges in a socialist plan economy. The narrative of Chap. 9 by the Chinese philosophers of engineering and technology, Wang Nan and Li Bocong, addresses this situation in China during the period of “opening up” from 1978 to 1992 under the leadership of Deng Xiaoping. By first exploring various meanings of the notion of entrepreneur they go on to discuss historical periodization. As the “opening up” period constitutes a whole in itself following European antecedents in historical periodization, they argue that it would be meaningful to term it “the

Long 1980s". They articulate that the outcome of Deng's leadership was a nation that underwent huge social transformations, but remained subject to the rule of the communist party, even though it lost its strong ideological moorings. Having defined the engineering community they explore the consequences for the engineering community of Mao Zedong's (1893–1976) harsh leadership from the 1950s to the 1970s, whereby an anomaly in the engineering community was created as entrepreneurs were lacking and engineers like other intellectuals were restricted. If entrepreneurs had disappeared under Mao they reemerged under Deng, and engineers who had been restricted in their work evolved into a special kind of engineers, Sunday Engineers. They finally explore a number of cases in which the extra money Sunday Engineers were able to earn by working on Sundays, helping factories in the countryside to become more effective, became a subject of ideological controversy and law suit for bribery before official ideological acclaim was in place.

The English engineering educator and researcher John Heywood, resorting to the history of higher technical education in the United Kingdom, starts in Chap. 10 from the general observation that there is a perennial conflict between education and industry in terms of the different perceptions educators and industrialists have regarding the purposes of higher education. He makes it clear that presently there is a pressure on the higher education sector that it should prepare new graduates immediately for work in industry. He sets off from the recognition that educating and training graduates to act confidently as engineers or technologists in an organization solely through academic study is impossible. In support he points to a growing body of literature providing evidence to the fact that the key engineering competence "acting as an engineer in an organization" can only be learned on site. He then goes on to examine an exemplary case regarding the education and training of engineers and technologists in England and Wales in the 1950s and 1960s, and thereby provides an understanding of how the new post-WWII system of higher technological education in the United Kingdom came about and how its expansion was projected to respond to the need for technical manpower obeying the *gold standard* of academic degrees in technical diploma (dip. tech). During this period of time the combination of academic study and industrial work – the sandwich principle – came close to forming an ideal national curriculum for higher technological education and training, but in the end it did not become as successful as it could have been due to the fact that the responsibility of industry and academia was not appropriately shared.

Taking a job creation perspective, the Irish and North American academics, Mike Murphy and Michael Dyrenfurth respectively, in Chap. 11 examine the role of neo-liberal entrepreneurial universities as job creators and as engines of economic growth in the increasingly knowledge-led global economy. They first look into how the role of the university has expanded from traditional first and second mission activities, in terms of teaching and research, to encompass third mission activities that include industry engagement and how this engagement supports job creation and economic development. Next they examine how new jobs are created within a geographic region or country, and the role the university can play in support of this. Finally, they examine the role of government and policy related to sustainable job

creation. They start from the premise that if the regional or national goal is job growth, then the focus should be on how largest job growth occurs. They argue that maximum job creation is best achieved through the attraction of large companies, support for growth of small and medium-sized companies, and the nurturing of start-up companies. In Ireland, the government has taken the approach of consistently attracting foreign direct investment, investing heavily in higher education, and providing a favourable business environment, including making the tax system purposefully pro-business and fine-tuned to ensure it is internationally competitive. Enumerating third mission activities, they provide the following grouping of activities: (a) Technology Transfer & Innovation activities; (b) Continuing Education activities, and (c) Social Engagement activities. They explore how the activities within the grouping of Technology Transfer & Innovation are those most directly associated with economic development.

Completing this part in Chap. 12 with a focus on the restructuring of higher education in the United States, Steen Hyldgaard Christensen examines how the corporatized public research university came about, its distinctive features, and considers the costs and benefits to the public good of commercializing teaching, research, and service. He explores how the dominant economic discourse of neoliberalism originating in the 1970s and the associated discourses of “new public management” from the 1980s have created a tension between two dominant institutional logics of higher education in university restructuring, namely those of the university as a social institution and the university as an industry. He identifies how the relationship between the two institutional logics or models of higher education can be conceptualized in terms of a *social charter* between higher education and society. *The communitarian philosophy of the public good* is reflected in a social and public charter associated with the traditional model of higher education. *The neoliberal philosophy of the public good* promotes an individual and economic charter, resulting in the industrial model of higher education. Finally *the utilitarian model of the public good* advocates a changing and contested charter that is a blending of both the traditional and the industrial models of higher education. He concludes that a precondition for the alternative utilitarian charter to succeed is that students and faculty will have to develop ideas with respect to the funding of the envisioned alternative and to build broad public support for this vision, as simply expecting the state to supply more money is unrealistic.

1.3 Part III: The Practices of Business and Engineering

Approaching the engineering business relationship empirically the four chapters of Part III interrogate a number of practices related to business and engineering respectively. Even though these occupations are often inseparable, yet questions may be raised as to whether they are distinguishable, how engineers and business managers are perceived by outsiders, and how they perceive themselves. In a paradoxical way, the omnipresence of engineering makes it almost invisible to the public. If

engineering and business have a lot of commonality within industry, the main issue remains whether they are dealing with the same questions. For instance what responses do they offer to important, yet often neglected issues like the value aspect of work in industry. The practices of business and engineering and the interplay between them can also be studied by exploring their boundaries, particularly the issues of gender equality in the workplace and the predicament of newly hired engineers beginning new jobs. Exploring these issues constitutes the red thread of contributions to this part. Before presenting the four chapters of Part III in their own rights, it is to be noted that a number of issues raised under this section are unsurprisingly echoed in other parts of the book. Readers of Chap. 13, for instance, should consider Chap. 5 in which the relationship between business/engineering practices and society is treated from an ethical standpoint. Likewise readers of Chap. 14 will find some resonance on the need to broaden the scope of entrepreneurial education across different chapters, particularly in Chaps. 17 and 18. From a different perspective, Chap. 15 which deals with the ideals of social justice and human rights through the theme of gender inequality should be related to the broader concept of social charter developed in Chap. 12. And readers of Chap. 16 on the problematic of newly hired engineers beginning new jobs will find further interest in the conclusions of Chap. 22 regarding the employability of engineering graduates.

In the opening Chap. 13 the Australian academic and philosopher of engineering Erik W. Aslaksen sets out to investigate the questions of how engineering and business practices appear to the public and to analyze their complex association in relation to the economy and society at large. His point of departure is that the relationship between these two activities is characterized by two features, namely the need for business to provide the conditions for generating a return on investment, and the fact that engineering, while applying technology to meet expressed needs, generates new technology, thus providing business with new opportunities. After defining a number of significant concepts, Aslaksen explores the relationship between four functional entities: engineering, industry, business, market, and he argues that what appears to society as being *technology* is largely determined by business. He also highlights the difference between science and engineering in the way they are perceived by the public: while science ranks high, engineers are paradoxically almost “invisible”. Then he focuses on how engineering and business are interlocked in a strong economic relationship in which technology is the interface, and he observes that the twentieth century tendency to isolate business from engineering not only proved to be inefficient, but also ignored many non-economic issues. He then goes on to introduce the concept of *engineering paradigm* relating to the external conditions under which engineering is practiced, particularly in the interaction with the business process. Due to increasing legal, technological and statutory constraints, he notes that the engineering paradigm is currently undergoing crucial and rapid changes. Finally he concludes that these transformations to the engineering paradigm call for changes to the engineering profession namely through *hybridization*, whereby technology mediates our relationship to our environment. Acknowledging

that this raises a number of major questions, the author calls for a restructuring of the engineering profession and its place in the workforce.

The investigation presented in Chap. 14 by the Australian and Irish academics and engineering educators James Trevelyan and Bill Williams respectively, originates in their observation that the engineers seldom perceive the *value creation* of their work even though their contributions create value for their enterprises and their clients. This has led them to review the scarce literature addressing value creation by engineering and business enterprises. First they explore various definitions of value creation from the perspectives of business research, wealth creation, engineering design and engineering education, focusing on the role of technological innovation for the creation of value, and referring to the concept of *creative destruction* put forward by Schumpeter in the early twentieth century. They note that value creation is perceived in an abstract way and is marginal to the engineering discourse. Then, drawing on empirical studies on engineering practice they set out to identify how engineers create and protect value regarding the reduction of investment risk, due commitment and maintenance work. They argue that engineering activities also aim at value protection, avoiding economic value destruction and showing how destruction can occur. Their research reveals that very few engineers are involved in technological innovation and that most of them perform more “ordinary” tasks. The authors stress the need for human interpretation of documents as well as the necessity for engineering and business people to appropriate information in order to make decisions. Finally, from the qualitative analysis of interviews and field observations, they examine areas of research into engineering practice that could lead to considerable financial savings in major enterprises. In so doing they put forward a model of value creation and protection within an engineering enterprise. They conclude that in the absence of awareness on engineering practice there is an urgent need for engineering faculties to broaden the scope of entrepreneurship education to help their students understand how they can create and protect value in different settings.

After noting the shortage of engineers in most countries, the two Irish academics Jane Grimson and William Grimson – both former presidents of Engineers Ireland – open Chap. 15 by asking if there is sufficient diversity in the engineering community to ensure efficient and sustainable solutions to meet the needs of everyone in society. The diversity they have in focus here is gender: they outline that not only women are significantly under-represented in senior positions in organizations but also that the pay gap with men is still a reality today, despite the fact that a number of major sectors like industry, commerce, engineering and academia, have made or are making real efforts to eliminate gender inequality. They also examine why it is essential to address the gender issue and distinguish three reasons for this: the first is based on the principle that social justice and human rights are or should be guaranteed by the work environment, the principle that all careers should be equally open to both men and women being a prerequisite. The second is a matter of parsimony whereby talent should not be wasted by the failure to attract and retain women in the engineering profession especially in a period of shortage of engineers. The third reason is precisely relating to the diversity argument whereby the wide range of different skills, perspectives and experiences can better respond to whatever challenge is to be faced.

Then they set out to identify a number of measures which organizations are taking to tackle the complex task of promoting gender equality. In so doing they consider four key themes: committed, determined and sustained leadership from the top of the organization, working arrangements to ensure better work-life balance, facilitating initiatives to develop future women leaders, and tackling unconscious bias. After analyzing two characteristic case studies they conclude that gender balance will not be attained automatically without such positive interventions as it is rooted in our culture, and that the engineering profession has to take sustained action now in order to be able to meet the needs of society today and tomorrow.

Closing this part with Chap. 16, the American academic Russel Korte explores the relationship between engineering and business from the viewpoint of newly hired engineers beginning new jobs in a business organization, as this complex transition experienced by graduates illuminates the differences they encounter between engineering as they learned it in school and as they practice it in an organization. The author's perspective is that business and engineering are both occupational communities embedded in an organizational context where engineers have to go through a socialization process with business people to learn how to practice and where, as a result, boundaries are more or less blurred while they work together. The chapter reports the findings of a qualitative, inductive case study carried out by the author on a sample of newly hired engineers and Human Resources managers. One of the first results that Korte relates here is that new engineers are more discomforted by the socio-cultural aspects of organizational work than by the technical aspects of "real" engineering work. He then points out to the complexity and ambiguity of engineering practice which depends on the quality of social interactions within the enterprise: social interaction goes beyond pure communication, and is essentially about building relationships and making sense of things, which form the major part of the new engineers' work. Analyzing Korte's surveys a distinction emerges between three types of communities, engineering, business and organizational communities, each of which depends on and comprises the interactions of the other two. He also stresses that, with the rise of innovation and entrepreneurship, traditional forms of organizations have been evolving to more dynamic models based on communities and collaborative networks. He then concludes that the distinctions between business and engineering communities are mainly disconnected abstractions and tend to disappear in the intricacy of organizational work.

1.4 Part IV: Engineering and Business Education

The six chapters in this section explore, analyze, and provide insights and recommendations on the education of the engineer, not simply from a narrow technical disciplinary perspective, but from the more complex perspective of its purposes within a wider business context. Like the other sections in this volume, the thirteen authors who have contributed to these six chapters come from four countries on two continents. Four are Danes, four are Irish, three are Americans and two are

Canadians. Each chapter has focused on engineering education issues evident within their national footprint. Yet each chapter throws up some common messages or findings: that the nature of societal challenges requires a more reflective engineer, that the education of such engineers requires a systemic approach, and that the employability of engineers demands more complex approaches to their education.

Before presenting the six chapters of Part IV individually, there are links worth noting between the chapters in Part IV and those in the earlier sections. Chapter 2, in its discussion of engineering and business management, provides interesting contrasts to Chaps. 17 and 18 regarding the mechanisms by which engineering curricula are broadened with business subjects. Chapters 18 and 19 examine ethics and sustainable development in engineering and technological education; while Readers might also look at Chap. 3 for an alternative perspective in that it argues that the economic imperative for profitable production is a cause of work place accidents. Chapter 22 which examines employability and whether engineering graduates are ready for work can usefully be read in conjunction with Chap. 5 which notes that engineering graduates are largely left to their own devices after graduation with the competences described through ABET and EUR-ACE criteria. For Readers of the evolution of engineering education, and the current trend towards introducing entrepreneurial subjects, Chap. 9 provides an interesting historical Chinese counterpoint to the western examples provided in Chap. 18, and both are worth reading. In examining the arguments set out for broadening the engineering curriculum in Chap. 17, there is value in a review of Chap. 10 in which John Heywood provides an excellent UK historical example of when industry and education shared responsibility for the development of engineering graduates. Erik Aslaksen in Chap. 13 argues that engineering, as a profession, has not responded adequately to changes over the last 50 years, and the Reader might find echoes of this in the pace of change in engineering curricula described in Chaps. 17 and 18. Readers interested in how engineering graduates assimilate in their early careers should compare a Danish study described in Chap. 22 with an American study described in Chap. 16.

In Chap. 17, three Irish academics – Mike Murphy and Pat O'Donnell from engineering education and John Jameson from business education – examine the evidence of whether and how undergraduate engineering students in Irish universities and institutes of technology are exposed to a broadening curriculum from subjects in liberal arts or social sciences. They do this in response to the assertion set out by philosopher Carl Mitcham that the greatest engineering challenge is to cultivate “deeper and more critical thinking ... about the ways engineering is transforming how and why we live”. In line with Mitcham's critique, the authors construct a hierarchy called the “Mitcham Classification of Engineering Program Enlightenment” and then use this instrument to examine every undergraduate engineering program in Ireland to determine what evidence there is of a systemic approach to broadening through the inclusion of liberal arts or social science courses, including business courses. The evidence would indicate that the academic engineering community in Ireland generally attaches a low priority to the development of a broader context and perspective within engineering students, beyond technical and disciplinary content, and that there is no systemic attention to a broadening

agenda. Often the same few courses within a program are used as evidence across a number of accreditation criteria. Business school leaders also point to a low level of collaboration between engineering and business schools, and the underlying rationale appears to be the “engineer identity” that pushes back against inclusion of non-engineering content. The authors note that an argument might now be made that the narrow technical focus of engineering programs may contribute to the general diminution in the role of the engineer from “an expert astride the wheel to a cog on it”. There are resonances here with the conclusions set out strongly by Kolmos and Holgaard in Chap. 22 with regard to employability of engineering graduates.

While written independently by Michael Dyrenfurth and the American academic Gary Bertoline respectively, Chap. 18 takes a similar approach to Murphy, O’Donnell and Jameson by examining the educational curricula of BE&T (business, engineering and technology) students within U.S. universities. Dyrenfurth and Bertoline use the terms “pragmatic capabilities” for employer-demanded skills, and “larger outcomes” for the needs of society, to describe the overall set of competences that BE&T students should acquire. The authors first conduct a review of undergraduate programs in the United States in order to confirm that “significant proportions of university undergraduate enrolment are directed towards pragmatic purposes such as engineering, business and technology”; and they subsequently examine the implications of that focus. They next set out to examine the extent to which ethics, corporate social responsibility and “conscientious capitalism” are reflected in plans of study of a selected number of high profile public and private universities. This is comparable in intent to the examination carried out by Murphy, O’Donnell and Jameson in Chap. 17 to determine broadening content within Irish programs of study, including holding interviews with selected deans and leaders. The results found by Dyrenfurth and Bertoline indicate that ethics is covered widely, but there is less evidence found for corporate social responsibility (CSR) and conscientious capitalism. Interestingly, within the U.S. it would appear that programs are more responsive to accreditation-driven requirements than the Irish authors found. Chapter 18 describes in considerable detail two exemplars of systemic change. These are Olin College, which perhaps provides a unique example of designing a university including its curricula from a student-oriented set of requirements, and the Purdue Polytechnic Institute, which provides an example of transformative change within an established college of technology. The authors conclude by noting that ‘bolt-on’ approaches to broadening the curriculum will not work and systemic transformation is required.

In Chap. 19, Canadian scholars Lovasoa Ramboarisata and Corinne Gendron also address ethics education, CSR and sustainable development (SD) education at the taught postgraduate level in Canada. They examine business schools and their role in educating engineer-managers via MBA and MS programs. This again can be seen as extending the examination undertaken by the authors in Chaps. 17 and 18. Here in Chap. 19 the authors provide a review of the development of ethics education and the growing debate about its sufficiency arising in recent years from incidents such as bridge and building collapses, water contamination, and chemical leaks. Despite professional codes of ethics and the acceptance that engineers should

put the public interest above self-interest, business interest and professional interest, the authors point out that ethical training provided to engineers still stresses their duties to their profession. The authors explore whether education has made the necessary change of direction, or turn, to accommodate the demanding concepts of CSR and SD. What they report finding, however, is that this critical turn has not yet been made to go beyond instrumental ethics, loyalty to businesses, and moral righteousness towards the profession. Ramboarisata and Gendron report that the “business-case” approach remains dominant and broadening teaching beyond this approach is largely still absent. They further report data that show integration of these topics into curricula as non-significant, and that stand-alone courses cannot meet the “ensemble of objectives identified”. The authors provide an exemplar course that they designed and teach for an MBA and Technology Management program in Montreal. Through the authors’ pedagogical choices, their students have become reflective practitioners.

Chapter 20 focuses on experiences with changes in both the conception and the curriculum of engineering education: the “Design & Innovation Program” implemented at the Technical University of Denmark (DTU) in 2002. The Danish academics Joakim Juhl and Anders Buch draw a historical framing: how, after World War II, public investment in fundamental research first was seen as necessary to protect the special status and independence of research, but gradually the emphasis shifted seeing science as a political instrument, with economic growth as a key performance indicator. Almost simultaneously, views on the internal functioning of science were changing too: instead of focusing on the demarcation of a proper ethos of science (in the line of e.g. Robert Merton and Karl Popper), science came to be seen as a more socially embedded activity: trans-disciplinary, context-aware, and more reflexive (“Mode 2-science”). A final impulse for the development of the Design & Innovation Program was constituted by legislative measures in Denmark. Although officially framed as an “opening up” of universities “outwards to society”, and an improvement of universities’ “decision-making competence”, the changes seemed to have financial self-sustainability of universities as their leading idea. The Design & Innovation Program was developed as a response to that. It combines creative, synthesis-oriented competences, innovative, socio-technical competences and reflective technological engineering competences. The unique and rather atypical profile of this program was attractive to incoming students, and at first the program appeared very successful. In the long run however, it was difficult to maintain the program at its original pace. Juhl and Buch end their chapter by drawing some lessons concerning the entanglement of engineering and business, the normative shifts that occur when marketability is introduced as a quality criterion both for engineering and for academia, and the contingencies and situated nature of how innovations are implemented and evaluated.

In Chap. 21, the American engineering educationalist and philosopher of engineering Alan Cheville and English academic John Heywood take a more analytic and contemplative stance on reforms of engineering education. First, they challenge the traditional view of engineers as “problem solvers”. The term “problem” is far too static and one-dimensional to describe the situations engineers have to deal

with. They prefer talking about “tensions”: this is a better rendering of the multidimensional, dynamic and dialectic nature of engineering work. In an organization, tensions often arise as the result of differences in “credo” of the members, a credo being a set of beliefs, attitudes and values that may or may not be directly in line with the official policy of the organization. Engineers, like many other collaborators, have to operate within the tension of these different credos. But they are seldom well prepared for this ill-defined situation that seems to require continuous negotiation. The authors argue in favour of an engineering education combining the traditional, linear problem-solving competences with the more subtle, context- and communication-aware competences that would prepare young engineers for their work in real organizations. They use the metaphor of the “real” and “imaginary” components of complex numbers, well known to engineers; both components are necessary to allow the possibilities of complex mathematics to be fully deployed. The hitherto “hidden curriculum” of engineering education should therefore at the same time be adapted and be made more transparent, in order to incorporate and combine both components. And even in the very act of reforming their curricula, educators and their leaders should combine the pragmatic straightforward problem solving approach, with the awareness of the never completely solved set of tensions within which they operate. In this way, the proper professional value of engineering can be protected against the mono-dimensional finance-driven approach that is present in many policy issues, in education as well as in the rest of society.

With the search for employment, young engineers are immediately in the very middle of the engineering-business nexus. In the final chapter of this book, the Danish academics and engineering educators Anette Kolmos and Jette Egelund Holgaard report on the results of an extensive survey (taken in Denmark between 2010 and 2015) on how young graduates perceive the way their education prepared them for the labor market. First of all, the authors are well aware of the conceptual discussions about the components and the idea of “employability”, especially when terms like “generic skills”, “transferable skills”, “core skills”, “soft skills”, etc. are used. Equally, they are aware of methodological issues in the set-up of surveys, and of the difficulty of interpretation of the answers, often also depending on how the questions were framed or formulated. Finally, it also appears that what students or young graduates expect to be important for their first employment, may very well differ from what employers (and educators, and other stakeholders) expect. Kolmos and Holgaard comment *inter alia* on how the students’ self-perception of their competences and their future employability changes when they move through their study career, and on the role of prolonged internships.

References

- Bakan, J. (2005/2004). *The corporation: The pathological pursuit of profit and power*. London: Constable an imprint of Constable & Robinson.

- Berle, A. A., & Means, G. C. (2009/1932). *The modern corporation and private property*. New Brunswick: Transaction Publishers.
- Braverman, H. (1974). *Labor and monopoly capital: The degradation of work in the twentieth century*. New York: Monthly Review Press.
- Chandler, A. D. (1977). *The visible hand: The managerial revolution in American business*. Cambridge, MA: The Belknap Press of Harvard University Press.
- Colby, A., Ehrlich, T., Sullivan, W. M., & Dolle, J. R. (2011). *Rethinking undergraduate business education: Liberal learning for the profession*. San Francisco: Jossey-Bass A Wiley Imprint.
- Davis, M. (2009). Is engineering a profession everywhere. *Philosophia*, 37, 211–225.
- Khurana, R. (2007). *From higher aims to hired hands: The social transformation of American business schools and the unfulfilled promise of management as a profession*. Princeton: Princeton University Press.
- Layton, E. T. (1971). *The revolt of the engineers: Social responsibility and the American engineering profession*. Cleveland: The Press of Case Western Reserve University.
- Locke, R. R., & Spender, J. C. (2011). *Confronting managerialism: How the business elite and their schools threw our lives out of balance*. London: Zed Books.
- Martin, M. W., & Schinzinger, R. (2000). *Introduction to engineering ethics* (2nd ed.). Boston: McGraw-Hill Publishing Company.
- Micklethwait, J., & Wooldridge, A. (2003). *The company: A short history of a revolutionary idea*. London: Weidenfeld and Nicolson.
- Noble, D. F. (1977). *America by design: Science, technology, and the rise of corporate capitalism*. New York: Alfred A. Knopf.
- Realin, J. A. (1985). *The clash of cultures: Managers and professional*. Boston: Harvard Business School Press.
- Veblen, T. (2007/1923). *Absentee ownership: Business enterprise in recent times: The case of America*. New Brunswick: Transaction Publishers.
- Veblen, T. (2009/1921). *The engineers and the price system*. Introduction by Daniel Bell. New Brunswick: Transaction Publishers.

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