Teaching Business History to Engineers

August W. Giebelhaus
Georgia Institute of Technology

This paper first addresses the relevance of courses in business history for engineering students. It then describes my experiences teaching such a course at Georgia Tech during the fall of 1978, and reports on the evaluation of that course by the students who took it. This course grew out of both my own feeling that Tech students would benefit from examining the role of business in American society, and a wider ongoing discussion in the Department of Social Sciences about the overall role of the social sciences and humanities in engineering education.

BUSINESS AND THE ENGINEER

In his provocative and important study, *America by Design: Science, Technology, and the Rise of Corporate Capitalism* [10], David Noble raises questions of particular concern to humanists and social scientists teaching in the engineering colleges of our universities or, like myself, in institutes of technology. Noble views engineering historically as the connective link between two forces that have largely shaped modern America -- scientific technology and corporate capitalism. He argues that in the first phase of this process in the late 19th century, the rise of science-based industry, the development of technical education, and the emergence of professional engineers served, in Marx's terms, to press science into the service of capital. In the second stage during the 20th century, the professional engineers, Noble maintains, sought to design an America around this perception through industrial and scientific standardization, patent reform, the organization of industrial and university research, and the transformation of higher education [10, pp. xiv-xv]. It is this latter point -- Noble's view of engineering education -- that is relevant here.

Noble concludes that engineering curricula developed to meet corporate needs, sponsored research on the campus meshed with the particular demands of industry, and scientific management was heralded as the key to rationalizing conflict between capital and labor. He writes "Because they embodied the union of business

with science, engineers naturally sought, in their technical work, to resolve the tension between the dictates of the capitalist system and the social potentials implicit in technological development" [10, p. xiii].

Whether one accepts the fundamental premises of his neo-Marxist argument or not, Noble's research clearly sheds light on aspects of both business and technological history. More important for this discussion, his documentation of the increasing role of the engineering mind-set in business management, the growing emergence of engineers themselves as managers, and the tailoring of engineering education to meet the demands of large science-based industry, paint a picture of technical education that is both narrow in conception and limited in its objectives.

Although there have been periodic proposals from within the engineering establishment to increase the level of humanities and social science education that engineers receive, Noble suggests that this was largely done to prepare the engineer better for the "handling of men" rather than to broaden his intellectual horizons [10, p. 311]. Indeed, the chief recommendations emerging from the Wickenden Commission Report, a massive six-year study of engineering education conducted in 1923-29, call for closer cooperation between industry and education and the inclusion of social science training to prepare the engineer better for future managerial responsibility [11; and 10, pp. 241-42].

ENGINEERING EDUCATION SINCE WORLD WAR II

Although the pattern Noble describes was certainly evident prior to the war, those concerned with engineering curricula have developed a broader view of their mission since 1945. The influential Hammond Report, "Engineering Education After the War," explicitly stated the need for discrimination between humanistic studies and business training [6, p. 595]. The American Society for Engineering Education (ASEE) reiterated this view in 1956 when it argued that "business training must not be confused with humane and social studies that serve quite different educational purposes" [5, p. 10].

From these early postwar studies developed the concept of two main "stems" of technical education: the "scientific-technical" and the "humanistic-social." First identified in a 1940 report on "Aims and Scope of Engineering Curricula," this two-track program was largely suspended due to the wartime demand for technical training [6, pp. 589-90]. Although the notion of these two bodies of knowledge as separate, nonintegrated entities helps explain why there remained dissatisfaction with both the quality and quantity of "liberal" or "general" education given the engineers, the stem idea at least demonstrated a growing concern to deal with the need for educating as well as training our technical experts.

An awareness of the spotty record of implementing the ideals of the 1944 and 1956 reports, and the growing criticism of technology in the 1960s prompted the ASEE to sponsor another study, "Liberal Learning for the Engineers," in 1967 [9]. The published results of this inquiry led to what has been widely dubbed the "contextual approach," a problem-oriented response aimed at demonstrating how science and technology operate within the context of Western civilization. The most tangible outgrowth of these recommendations has been the development of technology, society, and values programs at Stanford, Northwestern, Washington University, and a host of other colleges of engineering.

Another conclusion of the 1968 study interestingly parallels part of David Noble's analysis. The ASEE report argued that engineering was about to enter a new period of development in the 1970s, the last stage of a three-stage process. In the first stage, up to 100 years ago (and before the emergence of giant enterprise in America), the engineer was largely an independent practitioner. In the second stage, however, he became the relatively dependent employee of a rapidly expanding industrial system. The new, third and last stage would be one whereby the engineer will return to his earlier professionalism. The ASEE study defined this new status in terms of three principles seen operating in the new environment:

(1) The companies that engineers work for are far more socially responsible and public-spirited than their predecessors.

(2) As the division between the private and public sectors increasingly becomes blurred, engineers are becoming involved in problems of transportation, housing, urbanization, pollution, and defense.

(3) The engineer is more and more becoming involved in administrative decision-making and policy-making positions (exactly 50 percent of those replying to a 1967 survey indicated that their functions were at least half administrative) [9, pp. 7-8].

More recently, Henry Knepler of the Illinois Institute of Technology, has argued in *Change* magazine that "the New Engineers" are more aware than ever before of the ecological, social, cultural, psychological, and political influences of their work. With technology under far more scrutiny today than at any other time in the past, the humanities and social sciences are today being called on to do far more than simply provide the 18 to 24 course hours of "second stem" education for the engineer [7, p. 35].

EDUCATION AT THE GEORGIA INSTITUTE OF TECHNOLOGY

Georgia Tech was founded in 1885 as the unit in the University of Georgia system charged with providing technical education for its citizens during an era when the South as a region was consciously attempting to industrialize using the North as a model

[1, pp. 176-82]. In establishing an engineering institute able to meet the needs postulated by the "New South Creed" of industrialization, Georgia looked to two ongoing patterns of technical education in the 1880s -- those of the shop culture and the school culture [1, pp. 176-77; and 2, p. 62]. It was significant for Tech's later development that the model chosen was that of the shop -- with its emphasis on practical vocational training rather than engineering analysis or original research. Although Georgia Tech has adapted well to the needs of modern science-based engineering, the school's commitment to the "practical" training of the shop culture has persisted well into this century [1, pp. 191-92].

Georgia Tech today awards graduate and undergraduate degrees in engineering, industrial management, psychology, architecture, and the physical and life sciences. Unlike other technical institutes that have over the years developed their own degree programs in the social sciences, Tech has not departed from its main mission of technical education. The psychology degree program is recent as well as focused on experimental rather than clinical study, and economics degrees are awarded in the College of Industrial Management. General education is offered through the College of Sciences and Liberal Studies by the Department of Social Sciences (a multidisciplinary department consisting of history, political science, sociology, and philosophy), the English Department, a Department of Modern Languages, and through a variety of courses taken for social sciences or humanities credit at other units on the campus.

The average SAT scores of this year's freshman class was a combined 1141, and Tech ranks first nationally per capita in the number of National Merit Scholars and National Achievement Scholars (a program for black students only). Out of a total undergraduate enrollment of 9,025 students, Tech has 371 National Merit and 113 National Achievement Scholars.

Tech students have traditionally done well in the job market, and despite current economic uncertainty nationally, corporations are recruiting engineers in record numbers. A recent study by the College Placement Council reported that engineering graduates are getting 47 percent of all job offers although only 5 percent of all bachelor's degrees are in engineering [7, p. 30]. Generalizations are always very shaky in these matters, but Georgia Tech students do tend to conform to a model that one might expect. They are bright, career-motivated, generally politically conservative, and more attuned to scientific, technical, and quantitative subjects than they are to history. Yet my experience has shown that this image is not entirely accurate. For example, there are consistently high enrollments in our upper-division history courses and a recently adopted minors certificate program in history has become very popular.

Based on this proven track record of interest in history at Tech and my own concerns that many of my students were taking jobs

with major corporations without possessing any knowledge about the role of those institutions as major forces in our society, I decided to offer an elective course in business history in the fall quarter of 1978.

BUSINESS HISTORY AT TECH

Despite the fact that History 4926, "Business in American Life," was a special topics course and thus not listed in the preregistration catalog, I was pleased that 31 students showed up for the first day of class and 27 remained for the duration. Of this group, 12 students were engineers, 12 were from industrial management, and 3 majored in either architecture or the hard sciences.

The organization of the course was limited by the constraints of Georgia Tech's somewhat unusual credit system. The school is on a 10-week quarter calendar, but all nonlaboratory courses meet only three hours a week for three credits. Thus the entire course had to be structured around only 30 class meetings over the course of one quarter. History 4926 focused on what proved to be a somewhat overly ambitious outline of 11 major topics:

1. The Historical Setting: American Values and the Business Revolution;
2. Early Business Institutions;
3. The Revolution in Transportation and Communication;
4. The Evolution of Banking and Finance;
5. The Growth of Big Business;
6. The Progressive Response to Industrialism;
7. Strategy and Structure: Phase I;
8. Strategy and Structure: Phase II;
9. The Emergence of Modern Business Forms;
10. Business and Government in the 20th Century; and
11. The Changing Role of the Corporation.

The overall theme of the course was the examination of changing business institutions over the past 200 years, and the relationship of those institutions with society. I conceived the course as a compromise between what Herman Kroos has described as the two general categories of business history courses -- traditional business history and "business and society" approaches [8, pp. 44-45]. By this I mean that the course did not focus solely on the role of businessmen in their economic environment, but was concerned with the broader political, social, and economic context of business development. However, unlike those business and society courses that Kroos criticized for being too presentist, mine clearly emphasized historical analysis and was not an examination of businessmen's responsibilities in today's world. By the same token, I did not design the course around the role of the engineer in American business development. These issues arose in our discussions of

business in the Progressive Era, Taylorism and scientific management, and many of the themes stressed when we got to the 20th century.

In attempting to strike a balance between the obvious need of Tech students to read and write more than they generally do in their engineering courses, and the fact that they all carry very heavy course loads, I assigned just two books: Thomas Cochran's *200 Years of American Business* [4], and Alfred Chandler's *Strategy and Structure* [3]. These were supplemented by a reading list of appropriate articles from *Business History Review*.

There were two hour-long essay tests during the course of the quarter, a final exam, and two short term papers. The first writing assignment required the student to analyze the issues in one of the assigned *Business History Review* articles. He or she was responsible for writing a précis of the article, offering a critique of it, and constructing an essay presenting his or her own analysis of the issues based on individual research. The second paper (which proved to be more popular) was a case study of a particular firm chosen from the *Fortune* 500 list that had undergone a major change or encountered a significant problem in the recent past since 1945. For this assignment research was done primarily in business periodicals.

COURSE EVALUATION

At the end of the quarter I used two instruments to assess the quality and value of the course as perceived by the students. The first was an institute-wide questionnaire, "Student Reactions to Instructors and Courses," consisting of 46 diagnostic questions. These results provided comparative data with other courses within the Department of Social Sciences, the College of Sciences and Liberal Studies, and the institute as a whole. The other tool was a simple attitude survey consisting of six opinion questions.

The composite figure for overall course value compiled from 25 responses was a mean score of 4.2 on a scale of 1-5 (5 = outstanding; 1 = poor). This translated into a 90 percentile rating within the department, a 95 percentile for the college, and a 93 percentile for the institute (see Table 1). Of the total institute, approximately 14 percent of the classes have an average rating of 3.0 (good) on overall course value, and 17 percent have an average rating of 4.0 (very good) or better. On the question of "Would you take similar courses?" the mean score was 4.5. There was also a high correlation of scores on factual knowledge learned in the course (4.5), and principles, theories, and generalizations learned (4.3). On other subheadings under the category of "What students got from course," however, the results were modest; they ranged from a score of 3.0 for "implication for conduct," to 3.6 for "professional attitude" (see Table 2).

Table 1

OVERALL RATING OF HISTORY 4926

	Responses	Mean	Percent below		
			Dept.	Col.	Inst.
Overall course value[a]	25	4.2	90	95	93
Take similar courses[b]	25	4.5	90	94	94

Source: Georgia Institute of Technology teacher effectiveness evaluation form, November 1978.

[a]5 = outstanding; 4 = very good; 3 = good; 2 = adequate; 1 = poor.

[b]5 = strongly agree; 4 = agree; 3 = undecided; 2 = disagree; 1 = strongly disagree.

Table 2

WHAT STUDENT GOT FROM COURSE

	Responses	Mean[a]	Percent below		
			Dept.	Col.	Inst.
Factual knowledge	25	4.5	94	96	93
Principles	25	4.3	91	95	90
Applications	25	3.4	91	59	39
Self understanding	25	3.4	74	85	84
Professional Attitude	25	3.6	91	91	82
Communication skill	25	3.0	65	60	59
Implication for conduct	25	3.0	53	71	68
Cultural understanding	25	3.3	12	70	80
Learning habit	25	3.1	59	74	70

Source: Georgia Institute of Technology teacher effectiveness evaluation form, November 1978.

[a]5 = great deal; 4 = lot; 3 = moderate; 2 = some; 1 = little.

Table 3

HISTORY 4926 ATTITUDE SURVEY

	Responses	A	B	C	D	E	Mean[a]
Question 1	25	16	8	1	0	0	4.6
Question 2	24	8	12	4	0	0	4.0
Question 3	25	5	12	7	1	0	3.8
Question 4	25	0	4	12	6	3	2.7
Question 5	25	8	14	2	1	0	4.2
Question 6	25	2	18	4	0	1	3.8

1. How much have you learned about the role of business in American history from this course?
   A. A great deal; B. A lot; C. A moderate amount; D. Some; E. Little or nothing.

2. How valuable is a course like this to someone entering a career in the business world (either as a manager or an engineer)?
   A. A great deal; B. A lot; C. A moderate amount; D. Some; E. Little or no value.

3. How would you rate your general attitude toward business in America today?
   A. Highly favorable; B. Favorable; C. Neutral; D. Somewhat unfavorable; E. Very critical.

4. How has your attitude toward business changed as a result of your study in this course?
   A. A great deal; B. A lot; C. A moderate amount; D. Some; E. Hardly at all.

5. To what extent does government interfere with the affairs of private businessmen?
   A. Too much; B. Some; C. Only a little; D. Not enough; E. Hardly at all.

6. To what degree has free competition been sacrificed for efficiency by the growth of "big business"?
   A. Too much; B. Some; C. Only a little; D. Not enough; E. Hardly at all.

[a]A = 5; B = 4; C = 3; D = 2; E = 1.

The attitude survey showed high mean scores on question 1 ("How much have you learned about the role of business in American history?") and question 2 ("How valuable is a course like this to someone entering a career in business as an engineer or a manager?"). The results of attitude questions 3-6 indicate, not surprisingly, that the students entered the course with probusiness views that remained essentially intact (see Table 3). One student wrote, however, that his basically cynical attitude toward business had been changed by the course, while another stated that he had developed a more critical view of American business as a result of the course and the instructor.

CONCLUSION

The results of the institude-wide diagnostic evaluation and the attitude survey indicate that the engineering and management students at Georgia Tech who elected business history found the course to be relevant to their studies, and indicated that they would take similar courses if offered. At the present time the College of Industrial Management does not offer a business history course, and I have discussed the possibility of cross-listing the course as part of that college's management offerings. By advertising the course in the Industrial Management College I am confident that a large constituency for business history would develop. On the other hand, I was pleased that over half of the students in the class were engineers or science majors and I would hope that this would continue to be the case in the future when business history is again offered.

Based upon many hours of conversation with undergraduate engineers at Georgia Tech, I have concluded that they are very concerned with the changing role of the engineer in today's society. They are also well aware that the normal career pattern for most engineers today is to move into management positions within a relatively short period. This awareness, I must admit, resulted in some unexpected student comments. One mechanical engineer, for example, wrote that "This course is particularly important in job searching because it gives the opportunity to study particular companies in depth, and thus learn their strategies and how you might fit into them" -- a utility of *Strategy and Structure* that I doubt Professor Chandler ever anticipated. Many other written comments were more pleasing. Numerous students felt that they had learned much about business development and structure and that this knowledge gave them good background for a career in the business world. More encouraging were the number of comments that the course had succeeded in demonstrating the interrelationship of businessmen and business institutions with society as a whole during the past 200 years. I am convinced that there is a market for the

study of business history at Tech and plan to propose its adoption as a regular course offering in the Department of Social Sciences.

The primary value of such a course, although there are obvious "contextual" relevances with engineering, is not its practical value, but its contribution to a broader understanding of American society and culture. Engineering education must go beyond the "first stem" of technical training and the "second stem" of humanities-social science education. The curriculum must provide opportunities for students to challenge their fundamental assumptions, gain a wider understanding of how we arrived at our present situation, and raise questions about their own role in modern society. Given the close connections between the engineering community and American business in this century, it is particularly important for budding engineers to gain an understanding of the role of corporations as a major institution in America. If engineers graduate into positions of leadership holding only the narrow perceptions that David Noble suggests that they do, then those of us teaching in engineering schools will have failed in our task.

REFERENCES

1. James E. Brittain and Robert C. McMath, Jr., "Engineers and the New South Creed: The Formation and Early Development of Georgia Tech," *Technology and Culture*, Vol. 18 (April 1977), pp. 175-201.

2. Monte A. Calvert, *The Mechanical Engineer in America, 1830-1910* (Baltimore: Johns Hopkins University Press, 1967).

3. Alfred D. Chandler, Jr., *Strategy and Structure: Chapters in the History of Industrial Enterprise* (Cambridge: M.I.T. Press, 1962).

4. Thomas C. Cochran, *200 Years of American Business* (New York: Delta, 1977).

5. *General Education in Engineering*, A Report of the Humanistic-Social Research Project (Urbana: The American Society for Engineering Education, 1956).

6. H. P. Hammond, "Engineering Education After the War," *Journal of Engineering Education*, Vol. 34 (May 1944), pp. 589-613.

7. Henry Knepler, "The New Engineers," *Change* (June 1977), pp. 30-36.

8. Herman E. Kroos, "Recruiting Business History Teachers," *Business History Review*, Vol. 36 (Spring 1962), pp. 44-48.

9. *Liberal Learning for the Engineer*, Report of the ASEE Humanistic-Social Research Project (Washington: American Society for Engineering Education, 1968).

10. David F. Noble, *America By Design: Science, Technology, and the Rise of Corporate Capitalism* (New York: Alfred A. Knopf, 1977).

11. W. E. Wickenden, *Report of the Investigation of Engineering Education, 1923-1929* (Pittsburgh: Society for the Promotion of Engineering Education, Vol. 1, 1930; Vol. 2, 1934).