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ABSTRACT

The use of engineering cases as tools for learning engineering is stated to be about 10 years old. A brief account of the origin for years before 1950 is given. A note is made of an initial meeting held in 1962 when the potential of the case approach in teaching engineering was discussed. By 1964, case programs were in operation at three schools. Each are described briefly. Note is made of the formation of the American Society for Engineering Education (ASEE) Engineering Case Program Committee in 1971. The present members, 1976, are listed. The Engineering Case Library (ECL) which publishes and distributes case pamphlets is described. The Korea Advanced Institute of Science is cited as a good example of where this curriculum procedure has been successful. References are cited. (EB)

Event 2645
USING ENGINEERING CASES
Part I

History and Use of Engineering Cases

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Engineering cases are tools used to learn engineering. General use of this tool is about 10 years old. Many of us believe that it holds great promise for bringing engineering practice and engineering education closer together. Let us take a brief look at the origins and the current state of engineering cases.

Before 1950

Ever since engineering has been taught there have been teachers who illustrated their lectures by telling anecdotes from engineering practice. One might call these tales oral engineering cases. The use of cases written specially for classroom use started at the Harvard Business School. M. T. Copeland (1) reports that around 1922 ". . . the Dean held luncheon conferences . . . At these conferences the problems of collecting and using cases were discussed. Some members of the Faculty welcomed enthusiastically the innovation which the Dean was sponsoring. The attitudes of other members of the Faculty ranged all the way from lukewarmness to covert hostility."

The Harvard Business School soon was converted to use only the case approach. Some of their cases in Production Management and in Technological Innovation are excellent tools for engineering courses and have been used in Industrial Engineering classes and in Design classes.

In engineering schools the term "case studies" was applied to written descriptions of complex problem situations, some from actual practice and others from imagination. At MIT, T. K. Sherwood used such "case studies" in his classes in Process Engineering and J. E. Arnold used them in his Creative Engineering Laboratory. Professor Arnold's case studies seem to be designed to present students with a realistic complex situation which demands or invites departure from established practices. (2)

1962
The initial meeting

At present the ASEE-Stanford Case Program is the chief source of engineering cases. It gradually evolved from a meeting in Los Angeles in September 1962. A number of people met for dinner to discuss the potential of the case approach in teaching engineering. Those present were (according to the author's memory), J. L. Adams, then senior engineer at JPL, now director of the Design Division of the ME Department at Stanford; J. E. Arnold, then director of the Design Division at Stanford, died in 1963; William Bollay, then visiting professor at MIT, now engineering consultant in Santa Barbara; H. O. Fuchs, then senior lecturer at UCLA, now emeritus professor at Stanford; N. A. Hall, then director of the Commission on Engineering Education, now consultant in Connecticut; William Pickering, then and now director of JPL; W. J. Schimandle, then section chief at JPL, now consultant in Sacramento; R. F. Steidel, Jr., then and now professor at U. C. Berkeley; K. H. Vesper, then case writer at the Harvard Business School, now professor at the University of Washington; T. T. Woodson, then senior lecturer at UCLA, now professor at Harvey Mudd and director of their clinical engineering program.

Those present agreed that a call for proposals on engineering cases should be sponsored by the Commission on Engineering Education and that examples of engineering cases should be prepared. In response to this decision, an engineering case history (on the design and development of a refrigerator car heater) was written and published in February 1963 by UCLA. (3) The call for proposals was issued in March 1963 by a committee with W. Bollay as chairman. (4) Proposals were submitted. Professor Arnold hired K. H. Vesper to direct the development of engineering cases, and left on sabbatical leave. He died in Spain in September 1963. Dr. Bollay repladed him as principal investigator of the case project at Stanford, which was funded by a grant from the National Science Foundation.

1964
Three programs

By 1964 case programs were in operation at three engineering schools: At Stanford, the emphasis was on cases which described problem situations. The early Stanford cases were written mostly by graduate students employed half time for the purpose. Funds came from the NSF grant.

At UCLA, the emphasis was on case histories, accounts of the way problems were perceived and solved in the world outside of schools. The UCLA cases were written either by professors or by writers employed full time. Money came from the Educational Development Program which was funded by the Ford Foundation.

At the University of California in Berkeley, Professor Steidel taught a case course in which teams of students interviewed engineers and wrote case histories in partial fulfillment of the requirements for the Master's Degree. They were not paid for this work. A Ford Foundation grant permitted Professor Steidel to bring visiting faculty to Berkeley for two semesters each to study his use of cases. It also covered expenses.

The case work at UCLA ended in summer 1964 when Fuchs was appointed professor at Stanford, where he eventually took charge of the case program.

Between 1964 and 1968, Stanford had two summer workshops on case methods in engineering and a three-day conference on the use of case material in teaching engineering. Berkeley had visiting professors participating in Professor Steidel's case course. The use of cases and of the case approach were thus brought to the attention of many teachers. Some of them adopted it enthusiastically, among them John Bristor of Florida, Geza Kardos of Canada, Charles O. Smith of Detroit, and Paul Youngdahl of Michigan, who have served on the ASEE Case Committee and Jerry Henderson of Davis whose students have won the engineering case contest sponsored by Region IX of the ASME.

1971 The ASEE Case Program Committee

The ASEE Engineering Case Program Committee was formed in 1971.* It brings together people from the schools which are actively developing the case approach and people from industry who support it.

*At present this committee consists of H. O. Fuchs, Stanford University, Chairman; J. R. M. Alger, General Electric Company: E. Brown, Union Carbide Co.: E. G. Chilton, Stanford University; M. H. Jacoby, Olin Corporation; G. Kardos, Carleton University; B. J. Pelan, Rutgers University; C. O. Smith, University of Detroit; J. Stahl, IBM; R. F. Steidel, U,C.-Berkeley, C. W. Theobold, du Pont; P. F. Youngdahl, Consulting Engineer.

The committee supervises the conduct of the Engineering Case Library.

A definition

The Engineering Case Library (ECL) publishes and distributes case pamphlets. It defines an engineering case as an account of a job or problem as an engineer or engineers actually encountered it, told with some of the background complexities, and published for use in engineering courses. By saying "actually encountered" we mean to exclude educational encounters such as student projects. Manuscripts are contributed by teachers and other people who have written engineering cases. The new cases published each year are reviewed by an editorial committee. If accepted they are bound into annual volumes which are sold to many libraries as material for research in engineering practice. ECL is located in an attic at Stanford. Mrs. L. Rendall manages it as Administrative Editor.

Funds for its operation come in part from the sale of cases and annual volumes. This covers the cost of reproduction. The cost of "tooling up" and overhead are now covered by contributions from sponsors in industry to the ASEE-Stanford Case Program.

Current status

The ECL has published over 200 case pamphlets and 11 bound volumes of cases. The pamphlets have been used for instruction in more than 200 schools here and abroad. Over 60 libraries have placed standing orders for the bound volumes.

The increasing acceptance of the case approach is shown by commercial publication of case collections. Longman published "10 Cases in engineering design" by Fuchs and Steidel in 1973; Houghton/Mifflin published "Engineers at Work: A Casebook" by Vesper in 1975. The cases in both are true, taken from actual practice. Most of them have previously appeared as ECL pamphlets. Several authors of engineering texts are now including cases in their books, frequently taking them from the ECL collection.

What good does it do?

A great deal of work by many people has gone into the development of the case approach in engineering; frustration was present along most of the way; academic recognition of engineering case work is still

rare. Has it been worth our while? De we have real results other than publications to show for our efforts? I think so. As the interest in the practice of engineering is re-appearing, after its eclipse behind the shining disc of engineering sciences, engineering cases become more and more useful as true examples of practice. The existence of published cases and of casebooks provides a welcome beacon for those who seek to orient their teaching to the practice of engineering. An example from a new engineering school may illustrate this:

An example from Korea

The Korea Advanced Institute of Science was founded in 1971 as a national graduate school to provide "a steady supply of engineers and applied scientists who combine high ability with advanced training towards the technological needs of Korean industry." (5). The majority of the faculty consider specialized research and scientific publication as their main objectives just as we did ten years ago. There are a few professors who want to educate engineers so that the graduates can see what the technological needs of the country are and find solutions to satisfy those needs - in other words they want to teach design.

It was my good fortune to be associated in teaching with Dr. Soonhoon Bae who is such a professor. The printed book of cases which we used in class helped to introduce outside reality into our classroom and to reinforce observations from plant visits, talks by engineers, and project work. Without the book all the idiosyncracies, shortcomings, and difficulties would have seemed like accidental exceptions which ought to be overlooked. When observed together with the study of printed cases, the apparent exceptions are seen to be manifestations of over-riding principles, such as Murphy's law.

With the printed cases Dr. Bae's desire to orient his students towards practical problems became more respectable and more easy to fulfill. He and I wrote a case from which I learned more about Korean industry than from all the reports I could read. When I left he planned to have case histories written by some of his graduate students to advance their understanding of industry and to produce material for use in future classes.

Conclusion

Korea seemed to me an image of our own situation, seen in a different perspective and through a different filter. What was true there is probably true here too: We will not convert anybody by showing him engineering cases, but with engineering cases we can encourage those who tend to look at the practice of engineering, and we can make it easier for them to help students learn to become engineers.

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