

## Hands-On Ethics: Experiences with Cases in the Classroom

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This paper describes classroom experiences using two ethics cases (A.C. Rich and DesignTex) developed by Michael German and his team.<sup>1</sup> Edmund Russell describes why he uses case studies in general and how he has used these two cases in particular.<sup>2</sup> Julie Stocker describes the way she and others evaluated the cases and the results they obtained.

### Why use cases? (Russell)

Why do I use cases? Because students like and learn from them. The core curriculum for fourth-year engineering students at the University of Virginia includes study of engineering ethics.<sup>3</sup> The first time I taught that subject, students read a standard textbook.<sup>4</sup> Like many textbooks, it stressed ethical theory and presented short case studies to illustrate key ideas. I liked the textbook, perhaps because it presented material in a way that suits my style of learning: it was deductive, theoretical, and organized. For variety and depth, I had students analyze several longer cases, too. They included studies of the Challenger disaster, plant siting, and water pollution.

For the last case, I had students play roles. They pretended they represented various interest groups and debated what should be done. Students took the task very seriously. (A couple students argued so strenuously for their assigned points of view that they came up to me after class to say that they were not really so hard-hearted as they sounded.) It was gratifying to learn that students enjoyed taking a variety of points of view, including ones they did not agree with. They seemed to like “trying out” ideas without feeling that they had to defend them as their own. In particular, students who had little patience for managers (“they just care about money, not good engineering” summed up a common attitude) seemed to develop a greater appreciation for the multiple demands facing management.

After completing the ethics part of the course, I asked the Teaching Resource Center of the University of Virginia to help me assess its success. The associate director of the center (a member of the drama department faculty) talked to my class while I was out of the room.<sup>5</sup> She asked what was working well, what was getting in the way of learning, and what suggestions they had. The students discussed these questions in small groups, and then as an entire class. The assessor recorded, and relayed to me, points on which the class reached consensus.

I gained three insights from that assessment. First, students loved playing roles. This result was mildly surprising. I had thought they liked the experience, but I had not known that they liked it quite so much. The second and third insights were related: students disliked the textbook, and they loved the in-depth cases. Again, I was mildly surprised. I had not thought they were thrilled with the textbook, but it had seemed adequate. And they had seemed to like the in-depth cases, but I had not known they liked them quite so much. What was going on?

Findings from psychologists helped me interpret the results.<sup>6</sup> Faculty members tend to like intriguing ideas (whether or not they are “practical”), theory, and deductive reasoning. Most people, however, like and learn best by approaching problems from another angle. They like to deal with real-world issues, learn ideas that will help them solve concrete problems, and reason from their own experience (i.e., inductively). Neither approach is “better.” A balance between the two probably contributes to the most successful endeavors. Organizations that



balance both creativity and practicality probably succeed more often than those with vision but no follow-through, or action but no vision.

These findings, coupled with comments from my students, helped me understand why students and educators have called for reorientation of professional education. Like medical schools, engineering schools have long stressed theory in the first couple years of school and application in the last two.<sup>7</sup> The learning style of individuals attracted to faculty positions probably contributes to that approach. (I, for one, like learning that way.) Recently, however, some medical and engineering schools have stressed real cases and problem-solving skills beginning in the first year. Students find, or faculty members introduce, ideas and theory as needed to help solve problems in the cases. This approach builds on the learning style of most students, including those in engineering. They like concrete problems and data.

### **Piloting the A.C. Rich Case (Russell)**

The next time I taught the course (TCC 401), I emphasized in-depth cases and piloted the A.C. Rich case developed by Michael German and his team. Despite my growing appreciation for inductive reasoning, I introduced some theory before students read the case. Students attended a talk by William McDonough (dean of the University of Virginia School of Architecture and one of the actors in the then-unwritten DesignTex case). McDonough stressed principles of environmental design. Students also read two pieces: an essay on environmental ethics written by project consultant Patricia Werhane, and selections on ethical theories (especially those of Mill and Kant) from the ethics textbook.

In class discussion, it became clear that students disagreed with some of the theories presented. Almost all agreed that McDonough sounded impractical. "How much would his ideas cost?" they wanted to know. The essay on environmental ethics split the class. Many agreed that human beings should be concerned with the fate of other species; one thought the essay was a parody of socialist thought and was surprised to learn that it was serious. They dutifully recounted the main ideas of Mill and Kant.

Then students read the A.C. Rich case. After we discussed the key features of the case in class, I gave students the following assignment:

- Form groups of three.
- Pick one alternate technology to compare with Rich's.
- Discuss group choices so that the class as a whole would research a range of alternatives.
- Do research. (I told them I expected each person to put in 4-6 hours on research. Students had five days before they had to make presentations.)
- Come prepared to present results to the rest of the class. Pretend that the class is a group of venture capitalists trying to decide whether or not to invest in American Solar Network (Rich's company).
- After the presentations, write a memo stating your recommendation on whether to invest in American Solar Network (Rich's company). State reasons and mention comparisons with other technologies.

The students presented their findings in class and prepared memos about their recommendations. The following class, ethicist Patricia Werhane led a class discussion about the students' positions. At the end, students filled out evaluations of the case and its use.

### **Evaluating the A.C. Rich Pilot (Stocker)**

I was not at the University of Virginia for the piloting of the A.C. Rich case, so these comments paraphrase a note entitled "A.C. Rich Case - Evaluation of the First Iteration," by Michael E. German and Gautam Jagannathan.

Sixteen men and four women completed a questionnaire after the class finished the case. Students rated the difficulty of the case as average to slightly below average (Figure 1). The scores on the overall value of the case



and library research indicate a respect for the case's value and even the research it required, although some students requested less emphasis on this aspect. Finally, the students appeared satisfied with the class lectures and the discussion, although they seemed to prefer the latter. As one student said, "The discussion in class seemed more beneficial than the presentations." Perhaps the greatest surprise was the variation in the amount of time students spent on research--the effort ranged from four to twenty hours.<sup>8</sup>

Questions	Mean	Standard Deviation
Overall GPA	2.89	0.42
Hours spent on case and research	6.97	4.79
How difficult was the case study including research and supporting documents? (scale of 1-5, easy to hard)	2.75	0.91
How valuable did you find (scale of 1-4 very helpful to not helpful)		
Note on ethics?	3.00	1.06
Note on sustainability?	2.65	1.11
A.C. Rich case?	1.65	0.67
Library research?	1.58	0.69
Relevant class lectures?	2.16	0.83

Figure 1: Results of survey of students who used the pilot of the A.C. Rich case, summer term 1995.

### Pairing the A.C. Rich and DesignTex Cases (Russell)

The following semester, I used a revised version of the A.C. Rich case and piloted the DesignTex case. This time, I introduced two theories with readings before beginning the cases, (For better or worse, I find it impossible to rely on the inductive approach alone.) The first theory was ethics. Students read selections from the textbook on Kant and Mill. The second theory was actor-networks. Students read John Law's essay on heterogeneous engineering.<sup>9</sup> We reviewed both of these theories in class, and then students read the A.C. Rich case as homework.

The next class, students discussed Rich's network in small groups and then sketched their views of his network on the board (Figure 2). Next to each element of the network, students wrote + or - to indicate whether that element was working for Rich or not. Most groups agreed on major elements of Rich's network (Rich, governments, technology, and markets).

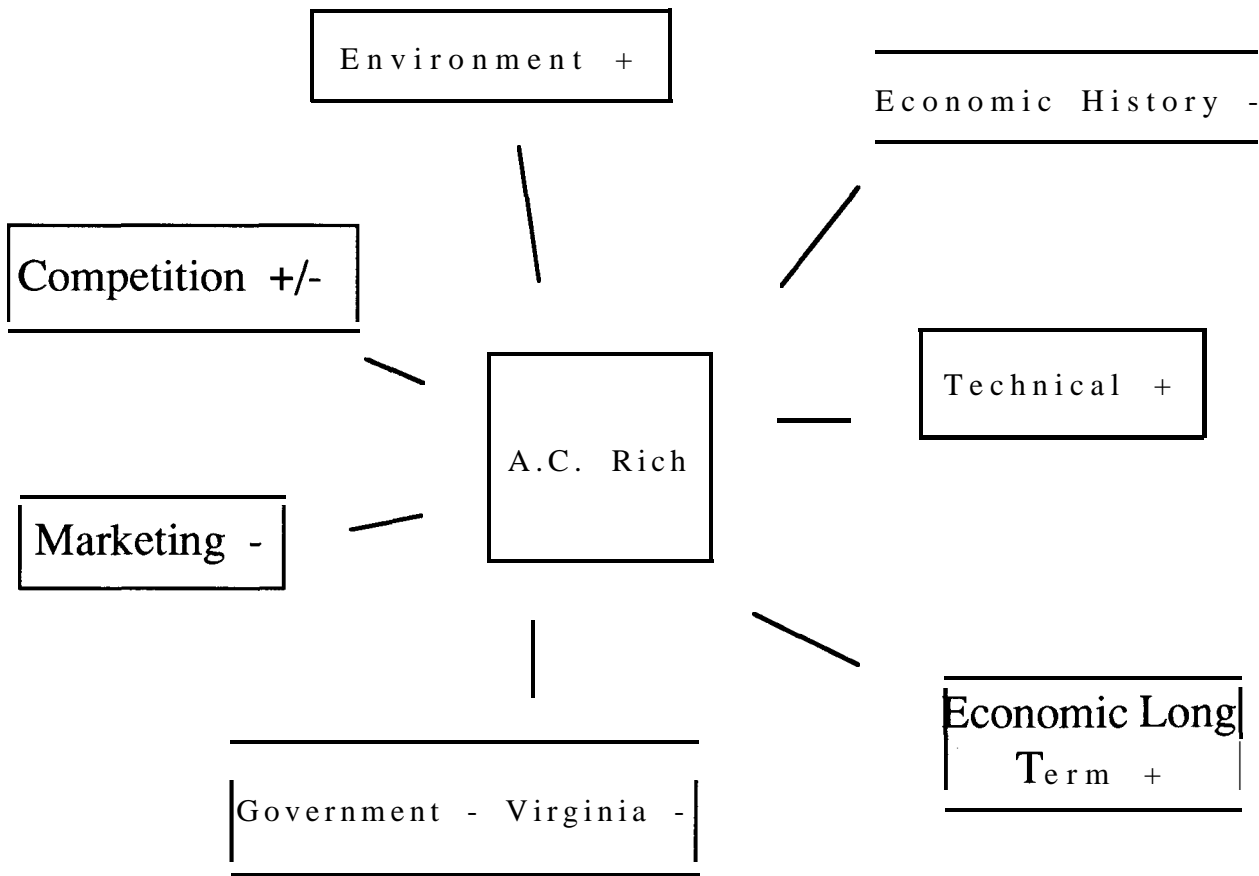


Figure 2: Example of an actor network for the A.C. Rich case.

Then I had students read the B section of the case in class. Section B described Rich's decision to move to California to take advantage of tax breaks. There, one of his salesmen embroiled the company in an ethical controversy. (While acting as a government contractor, the salesman recommended that a homeowner replace a working solar heater with Rich's model.) This imbroglio made it clear that Rich faced not just economic and technical problems, but ethical ones as well. No groups had put ethics in their first network diagrams. We discussed the impact of ethics on Rich's network. Rich's reputation influenced his position in the market, so it was almost impossible to argue that ethics and economics were separate concerns. Students agreed that Rich needed to act to correct the problem.

Before the next class, students read the DesignTex case. In class, they mapped Susan Lyons' network, discussed the goals of each element of the network, and identified bottlenecks in meeting those goals. Students then broke into groups to discuss what to do from the perspective of various actors in the case: Lyons, McDonough and Braungart, Kaelin, architects (customers), Saltzman (owner of DesignTex), and suppliers other than Kaelin. The class then played the roles of each individual in a whole-class discussion. On economic and ethical grounds, the class agreed to pursue the "intermediately green" fabric while continuing to develop the "purely green" fabric.

Then the class broke into small groups (five members each) to do research. Like the previous semester's class, they pretended that the class as a whole was a group of venture capitalists trying to decide where to put its money. The group had decided to explore the green market, and Rich and Lyons had asked the group for money. Should the company invest? I gave the students the option of making one of three recommendations to the company: (1) invest money in Rich or Lyons or both, or (2) buy patent rights from Rich and/or Lyons and get

another company to make the product, or (3) invest in another company or technology altogether. Once in small groups, students selected individual topics for research.

After five days of research, the groups presented their findings orally. In general, students thought that A.C. Rich was a poor manager unworthy of the company's investment. His technology, on the other hand, appeared attractive to several groups. They recommended buying the patent rights and having someone else make the product. Students had a more positive view of managers responsible for the development of DesignTex. Several groups recommended investing in that company and product. Others recommended investing in other "green" products altogether (e.g., a company that made clothing fibers from recycled plastic soda bottles).

After the presentations, Teaching Assistant Matthew Mehalik told the class what had happened with the real DesignTex. The company had decided to go ahead with the more stringent standards, rather than the "intermediately green" approach, and succeeded. The fabric had recently won a "best of show" award. Mehalik passed around samples of the fabric. Students were moved; they examined the fabric closely and asked a number of questions. One commented, "This is scary. We've been talking about these ideas, and now it seems real."

### Evaluating the Two Cases (Stocker)

Matthew Mehalik and I observed classes in which the DesignTex and A.C. Rich cases were used. This discussion reports Mehalik's and my observations and the results of a quantitative survey.

#### Observations

Mehalik and I concluded that discussions about both cases allowed the students to see how ethics can play a major role in engineering and the marketplace. After students discussed the AC Rich case in small groups and reported their conclusions to the class, Russell noted the following common perceptions among students:

1. Rich's marketplace was largely driven by reputation. Hence, the company's ethics become a major concern in the acquisition of funding to survive.
2. On the question of the loan, a variety of reasons existed for a positive or negative response, revealing the difficulty of evaluating someone's ethical reputation and agenda.

Many students questioned Rich's integrity because of his salesman's mistake in recommending that an existing solar heater be replaced by one of Rich's designs, even though the original was not broken. They used the same incident to question Rich's business skills (for example, his ability to hire competent people). Finally, an interesting feature of the student's networks was that in at least one of the classes, all the groups gave the technical node on Rich's tree a positive mark, while his business know-how and ethics received mixed reviews. In the end, most groups of students recommended that the class, acting as venture capitalists, not invest in the solar water heating industry.

When discussing the DesignTex case, students revealed a keen awareness of the tension between modern business/engineering design and the extent to which one infuses ethical considerations into these areas. Although they were role-playing, most students appeared to agree with the moderate approach of introducing DesignTex's Climatex fabric in two stages, in two stages: first the intermediate version with the older dyes, then a version with more "environmentally-intelligent" (McDonough's phrase) dyes, i.e., a "new and improved Climatex Lifecycle." Most students highlighted this scenario's compromise as its strength--it balanced business with environmental considerations, since the earlier version would catalyze profits, while the later version would be environmentally safer. The students were visibly surprised when Russell revealed that DesignTex chose the more stringent road, i.e., not producing the fabric until sure the dyes were safe.

In general, the students appeared to like the DesignTex case better than the A.C. Rich. However, both the A.C. Rich and DesignTex cases revealed important ethical considerations that engineering students will encounter in the "real world." For example:



1. How far should one go with the integration of ethical considerations into design, production, and marketing decisions?
2. How does one weigh ethical considerations against those of aesthetic design or economical production?

Also, these cases forced the students to steep themselves in that quagmire called ethics, an area not often emphasized in engineering classes, but a very real consideration of practicing engineers. Both cases successfully required the students to consider ethical, practical, and economic components of a product in making decisions about its design and production. Rather than bore these students with moral platitudes and pre-packaged lectures, these cases required the students to actively consider the factors at play in integrating ethics into the engineering profession and the business world. It not only introduced them to a real-world concept, but fostered in them a greater empathy for the role of managers as decision makers (a role which most engineers usually acquire as their careers progress). Gone were the cut-and-dry engineering problems of a text, replaced with the intricate problems of A.C. Rich and DesignTex. Students appeared to enjoy this change and acknowledged the need for such considerations now and in the future.

## Quantitative Evaluations

About fifty students from Russell's two sections of TCC 401 responded to the surveys on the A.C. Rich and DesignTex cases. (Students filled out the surveys on different days, and the number of students attending each day varied slightly.) Figures 3 and 4 summarize the results.

Students found the A.C. Rich case easier to analyze than the DesignTex case. Students thought the Rich case raised more engineering and engineering design issues than ethical ones, revealing the traditional compartmentalization of ethics apart from engineering (Figure 3). As seen in the Challenger incident, such compartmentalization can lead to tragedy, suggesting once again the need to include ethics in engineers' education. In general, students found the subject matter of the A.C. Rich case more interesting than that of DesignTex, but less immediately linked to environmental concerns. However, both cases accomplished the goal of spurring the students to think not just about the performance of designs, but also to consider the ethical and environmental impacts such designs would have.

Students found DesignTex slightly more difficult than A.C. Rich, but still within their reach. Students appeared to find more ethical issues within DesignTex, but fewer engineering issues. (This might be because of differences in subject matter, i.e., fabric versus water heaters.) As in the A.C. Rich case, this pattern demonstrates the need to infuse engineering considerations with ethical ones, especially at the educational level. Overall, the statistics in Figures 3 and 4 reveal that the students found the DesignTex case and the class structure around it interesting and relevant to their engineering education. While this is an encouraging observation for the future of engineering, it needs continual reemphasis in the classroom through cases similar to DesignTex and A.C. Rich.



<b>Questions</b>	<b>Mean</b>	<b>Standard Deviation</b>
How many hours did you spend reading, studying, and researching for the case? (0 . . . 10+)	1.329	0.580
How difficult was the case study (1=Very Difficult . . . 5=Easy)?	3.760	0.870
In the following, students rated their level of agreement on a scale from 1 (Strongly Agree) to 5 (Strongly Disagree):		
5. This case . . .		
a. Raised important ethical issues.	2.608	0.940
b. Raised important engineering issues.	2.784	0.879
c. Raised important engineering design issues.	3.137	0.980
d. Raised important environmental issues.	2.608	1.021
e. Contained interesting subject matter.	2.549	0.945
f. Provoked interesting class discussions.	2.431	1.063
In the following, students responded on the following scale: 1 (Very Helpful) . . . 5 (Completely Unhelpful)		
How valuable did you find. . .		
a. The World Wide Web for accessing the case?	1.660	1.069
b. The World Wide Web for the presentation and organization of the case?	1.717	0.958
c. The case exhibits?	2.612	0.909
d. Relevant class lectures?	2.533	0.968
e. Relevant class readings?	2.705	0.954
f. Class discussion of the case?	2.333	1.143

Figure 3: Quantitative evaluation of the revised version of the A.C. Rich case, fall term 1995.



Questions	Mean	Standard Deviation
How many hours did you spend reading, studying, and researching for the case?	1.381	0.566
How difficult was the case study (1=Very Difficult. . . 5=Easy)?	3.510	0,784
In the following, students rated their level of agreement in a scale from (1 Strongly Agree). . . (5 Strongly Disagree).		
This case . . .		
a. Raised important ethical issues.	3.120	1.023
b. Raised important engineering issues.	2.725	1.002
c. Raised important engineering design issues.	2.353	1.074
d. Raised important environmental issues.	1.941	0.968
e. Contained interesting subject matter.	2.725	1.060
f. Provoked interesting class discussions.	2.255	1.017
In the following, students responded on the following scale: 1 (Very Helpful) . . .5 (Completely Unhelpful))		
How valuable did you find. . .		
a. The World Wide Web for accessing the case?	1.531	0.739
b. The World Wide Web for the presentation and organization of the case?	1.918	0.886
c. The case exhibits?	2.739	0.999
d. Relevant class lectures?	2.413	1.002
e. Relevant class readings?	2.921	1.050
f. Class discussion of the case?	2.176	0.994

Figure 4: Quantitative evaluation of the DesignTex case, fall term 1995.

## **Conclusion**

We believe these two cases offer valuable additions to engineering curricula. They offer students concrete examples of the importance of ethics in engineering. Students enjoy the chance to learn such lessons through “hands-on” experience. These cases encourage engineering students to consider ethics as a component of design, rather than as an afterthought.

## **Acknowledgments**

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## **References**

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