

## **CASE STUDIES IN ENGINEERING ETHICS**

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### ABSTRACT

The case studies presented in this paper are based on 22 years of experience at two major US companies, four years on active duty in the military, and 11 years of teaching. Cases are presented first as the situation, with the results of action taken in a later section so that they can be used for discussion with students. These occurred over a career that started as a new college hire and progressed to third level management in industry.

### BACKGROUND

During 26 years of industrial and military experience, numerous ethics issues were encountered over the years. I have selected ten cases for this paper and have divided them between technical and personal issues.

### TECHNICAL, ETHICS CASE STUDIES

Case 1 - False Claim of Production Source. A major company was unsuccessful in bidding on a complex gyroscopic control system for a military aircraft. Using strong political connections with the White House, they forced a Pentagon level review of the evaluation. The proposal claimed all portions of the system were produced in company facilities. On a visit to one of the qualified suppliers of Rate Switching Gyros, Air Force personnel had witnessed production of units with name plates of the major supplier. The qualified supplier was a very small company. Is it ethical for a company to subcontract equipment and then claim in a proposal that it is produced in house? Where is the line drawn between a typical purchased subassembly which goes into a larger product?

Case 2 - Unfunded Equipment Development. A working level engineer came up with a very creative approach to improve the UL required High Potential Leakage Tests. He proposed modifying a very complex piece of computer based test equipment to aid final line personnel in discovering causes for failure when the final assembly was tested on a standard High Potential Tester. He convinced his unit manager of the value of his proposal. His manager then convinced his area manager of the high probability of success. Unit had about 15 engineers, the area had 60 engineers and technicians. However, they could not convince the production plant that funded this test equipment to fund this proposal. Funding involved about one man year of programming, about \$10,000 of test equipment, and about four man months of technician time to assembly, debug and try the test equipment. Should the proposal be dropped or should resources be "stolen" from other funded programs?

Case 3 - It's Not Your Responsibility. A Senior Engineer from Advanced Manufacturing Engineering committed to spend two years in a particular job. The first year he would spend in Design Engineering learning the overall system for a very complex piece of office equipment. This product was in the final stage of development with production start-up at the end of the year. His second year would be spent on the manufacturing floor solving performance problems. In the past, manufacturing had experienced great difficulty determining the cause of the final test failures. During his training, a basic performance assumption that was explained to him bothered him. He challenged it, and was told in no uncertain terms that particular challenge was outside the scope of his responsibilities, that he was wrong, and that he should just accept it as a known fact. Should he drop the question?

Case 4 - Technical Production Problems for a Critical Part. A critical part, essential to acceptable performance of a new, state-of-the-art product has very low production yields. If start-up product sales equal marketing forecasts, sufficient parts could not be produced to meet both production and field service requirements. The supplier cannot expand production capability fast enough to meet the proposed production at current and forecasted yields. Should Program Management be informed that they must either delay product introduction or reduce the launch production rates? There is another part with similar problems and the group responsible for the part has informed program management. They are now spending untold hours in status meetings.

Case 5 - Forgotten Commitment. The manager of a test equipment development group decided to take the calculated risk that a foreign division program would be canceled and never started a funded requirement to develop a major piece of equipment. He also failed to inform his successor of this requirement and course of action. This equipment would normally require a year of design and a year of debug. The foreign division asked for a status one year from the delivery date. After finding out what had occurred, should the Manager of the Test Equipment Group confess the real status to the foreign division?

#### PERSONAL RELATED, ETHICS CASE STUDIES

Case 6 - Sharing of Cash Award. A technical design that pushed the state-of-the-art was entered in an annual Aluminum Association Competition. The development involved "early supplier involvement." The supplier suggested the entry. They had been involved with a winning entry the previous year. They warned that determination at who would share the cash award in event of winning should be determined prior to submitting the entry. The subassembly that was to be entered had involved over a year of development by many design and manufacturing personnel. The individual level of involvement varied from a few hours of work to several man months. How is a cash award properly handled in such a situation? Should it be split 50/50 between the lead Design Engineer and the lead Advanced Manufacturing Engineer? Should it be divided to all involved in proportion to hours spent? Only the lead engineers are involved in preparing, submitting, and presenting the entry.

Case 7 - False Trip Report. A Senior Design Engineer and a Senior Fabrication Engineer scheduled a trip to review a very complex tool for an injection molded part at the supplier's plant.

They had been there on previous occasions over a span of many months. This complex long lead part was being developed with early supplier involvement. The Senior Design Engineer was first to turn in his trip report, and his manager noticed that the hotel bill was for a double room. He called the manager of the other engineer to see if he also charged for a room and to see if it was for the same room. Both were known to enjoy their time in bars and the thought was that they might have shared a room and double billed it to work around the daily expense limit on food. When the other expense report came in, it was for a different room number. It was also for a double room. The design manager then called the supplier to ask a technical question about the tool related to the trip report in an attempt to see if the supplier might make some remark that would shed some light on the issue. To his surprise, the supplier stated there had been no review of the tool. He stated that two weeks prior to the trip he asked the two engineers to reschedule the tool inspection since a competitor company was in-plant for a tool tryout. He further stated that the only contact was a brief status meeting in the hotel coffee shop. The design manager then confronted his engineer with the information he had gathered and asked for an explanation. The engineer immediately broke down and stated they had made plans to visit with some women they met on a previous trip and therefore did not change the date of the visit as requested by the supplier. He resigned on the spot. Since he was married, he did not want an investigation. What should the Advanced Manufacturing Engineering organization do about their Senior Manufacturing Engineer? Consider and discuss the ethical actions of the two engineers and management. Consider the ethics associated with the false trip report, and charging the company for the double room. Where should a company draw the line on technical versus personal moral issues versus business issues? As a point of information, the Fabrication Engineer was married. Should this fact be of any concern to the managers?

Case 8 - Acting Area Manager's Rules on Accepting Gifts. Immediately upon being promoted to an acting second level manager position within the same organization in which I had been a first level manager, I published a list of Rules of Conduct with suppliers that was much stricter than company policy. Among these was a rule that stated: "No gifts of any kind could be accepted from suppliers." I was immediately confronted by a young engineer who asked if this included tickets to Buffalo Bills football games. I replied that it did. He stated that it was wrong for me to establish such rules. His peers on other product programs in the company were allowed to accept such tickets and they and the sponsoring supplier could have meaningful technical discussions at the games. At the time, engineers were receiving gifts such as the tickets, all expense paid deep sea fishing trips, ski trips, etc. "Business lunches" were very frequent, always paid for by the supplier. What should the manager do in this situation?

Case 9 - Suggestion Awards. A young engineer, on active duty in the military, tries to eliminate a base that is purchased with every gyroscope. The base allows for quick disconnect/connect. The gyroscope is used in three different aircraft, the base is used in only one of the three. That one aircraft is no longer in production so bases are no longer needed. The other two airframe manufacturers just store them. They can neither dispose of them nor return them to the government. The "system" will not allow the engineer to delete the base from the specification. He then submits a "suggestion" through the formal Suggestion System. The engineer receives a call from a staff member in the office that handles suggestions. Military suggestors cannot receive monetary awards, so the staff member suggests that the officer add a civil service engineer to the suggestion with the arrangement that the civil service engineer split the monetary

award which he is entitled to with the officer. The annual savings for suggestion amounted to \$100,000 per year in 1963 dollars. The top award the officer can receive is dinner for two at the officers club. What should the officer do?

Case 10 - Consulting Fees. A faculty member at a College of Engineering is asked to take part in a project for a local company through a research firm that is associated with the Institute. The policy is for no more than four consulting days per month unless the faculty member "buys out" some of his/her teaching load. The faculty member is currently conducting workshops for colleagues at another institute at the rate of \$1,000 per day. The workshops require two days and he has been conducting at least one, and often two, per month. The research firm pays at the rate of \$40 per hour. The faculty member declines the work based on the pay level, but states that he would change his decision if they raise the pay to \$100 per hour. The representative for the research firm takes the request to the firm and the response to the faculty member is that the fee cannot be raised, but that he can submit two and a half times the actual hours worked on his time card. What should the faculty member do?

## RESULTS OR ACTION TAKEN

For each case I give the action taken. Some were very clear cut, and some the reader probably will not agree with. For some, there are many possible answers so that students may develop several very acceptable decisions that differ from the action taken. They should keep in mind that workload, arbitrary rules of the organization, and management decision may have ruled out their proposal. Personalization and emotional issues are very important considerations in real world ethical decisions.

Case 1: It was ruled that it was not ethical to claim in house manufacture of the Gyro when it was in fact subcontracted as a complete unit. Since this unit had a separate specification and supply number, it could not be considered as a typical subcontracted subassembly. Despite the very strong political connections, the original review stood.

Case 2: The area manager decided to use this as a high priority job to use up any slack in the organization. The effort represented about 2% of the organization resources. He and the unit manager gambled on the continued availability of a surplus test unit and modified it. The understanding was that unit would be converted back to its original configuration if it appeared it might be needed. The project was extremely successful. The final line HiPot test was reduced from an eight hour standard time to just 20 minutes! In addition, the unit tested low voltage circuits that UL did not require to be tested. The quality of the product was significantly improved, and there was a permanent record of failures so that trends could be analyzed and corrective action taken. The engineer received a special merit pay increase of 10%. Many felt that this was a case of the "end justifying the means" and that the managers should be punished for disobeying a higher level decision. No action was taken.

Case 3: He dug into the area to satisfy himself and to determine where he was wrong so that he could fully understand the basic principles of the machine. The more he dug, the more he was convinced he was correct. He established a sounder basis for his second challenge of this very complex issue. This time he created doubts and the proper personnel were assigned to study the issue. He had uncovered a flawed assumption that would have cost the company millions, the exact amount depending on when it was discovered. Major design changes were made at reasonable cost at that point in the design phase. He received a special merit pay increase of 10% and may have saved many jobs, including his own.

Case 4: We did not tell Program Management. We decided they would only be told if the other part achieved a solution and our part became the unique critical path. We did fund an internal program in the Manufacturing Technology organization to develop an alternate production technique for either in-house or out-sourced production. The supplier was informed of this action since there was some evidence that the low yield was being used to justify a very high cost. As the Manufacturing Tech engineers developed a breakthrough approach, the supplier also discovered a solution and the price dropped as yield increased. Although there were a few gray hairs generated, the production and spares requirements were always met, and we did not lose untold hours in special status reviews.

Case 5: Before confessing to the problem, the manager had a carefully selected group of his top people to develop a PERT plan to deliver the equipment on time. Although much higher in risk than the original schedule, there was reasonable chance for success. The key to the plan was conversion of a partially developed piece of equipment from a canceled program. It also required establishment of a team of software engineers who could work effectively together. PERT techniques were used for the first time in the organization to successfully plan, track, and take corrective action. The unit was delivered on time.

Case 6: The same brainstorming technique that was used to develop the entry was used to determine how to distribute the potential cash award. The many possibilities were evaluated and the solution was to donate the money to the local United Way. The entry did win. It became a double winner as corporate management and the company newspaper recognized both the technical merits and the donation. A luncheon was funded by the company for everyone who worked on the project. The check was given to a United Way representative at the luncheon.

Case 7: The Senior Fabrication Engineer was asked to attend a meeting with the first two levels of his management and a Personnel Representative. He was told the facts that were known at that point in time. He was told he could immediately resign or that a complete investigation would be made and that the result would likely be termination for cause. He chose to resign. The plus for him was that the actions he took would not be shared with any future employers since there was no formal investigation. This bothered the two technical managers since they felt badly used by an employee they had trusted with critical responsibilities. Personnel insisted on such a course of action to protect the company from litigation.

As an interesting piece of subsequent history, the employee was not able to find another job! The word was out. He then filed a claim for unemployment benefits based on the claim that he was in essence fired. Personnel took a very strong stand. The technical managers were involved. The State found in favor of the company.

Case 8: The rules held. Most of the employees supported the rules. They found it far easier to never feel indebted and to face the risk of having important technical discussion overheard at lunch. In addition, those with a tendency to drink too much did not face noontime temptation. Funding was provided to hold business lunches in the company cafeteria. This allowed day long meetings to continue through the lunch hour. The company had an excellent cafeteria with provision for table service on short notice and the use of adjacent conference rooms for lunch if scheduled in advance. The first production block of machines were customer acceptable. The first time this occurred in company history. It is extremely important that company personnel have only one loyalty when deciding on the acceptance of tooling and parts.

Case 9: The young officer enjoyed the dinner for two and the ability to look himself in the eye when shaving.

Case 10: The faculty member continued to give workshops. To lie on a time report would be extremely unethical and unprofessional. In addition, it could lead to termination of all involved.

## CONCLUSION

Every student we graduate is going to face ethical issues throughout his/her career. It is critical that they be prepared for these decisions. They must understand the impact their decisions have on the products or tooling they are working on, the customer who buys the product, and their reputation as an engineer and as a person. They need only watch the evening news, open the paper, or read the history of our recent national or world leaders to see the impact of ethical choices on personal careers and the fate of nations. Small transgressions can have vast impact or can lead to a pattern of larger and larger transgressions. We must teach by example as well as by lecture. Engineers through their important work have vast impact on the lives of many people through health and safety issues as well as financial issues. The Canon of Ethics should be stressed from the student's first day as a freshman until graduation day.

## Biographical Information

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