IE301 Product Design and innovation
Exercise (8) [product development management and ethics]

Prject Economic

1- *Build a quantitative model to analyze the development and sale of a bicycle light. Assume that you could sell 20,000 units per year for five years at a sales price (wholesale) of $20 per unit and a manufacturing cost of $10 per unit. Assume that production ramp-up expenses would be $20,000, ongoing marketing and support costs would be $2,000 per month, and development would take another 12 months. How much development spending could such a project justify?*

2- *Compute the trade-off rules for the case described in Exercise 1.*

3- *Two new design options (A, B) are to be considered for a product having sale forecast of 100,000 units. Select a design type, given the following data:*
   - *The design option (A): at design cost of $1,000,000 has 90% probability to yield 59% of the sale as good product and 10% probability to yield 64% of the sale as good product. It is possible to increase yields of 59% to 64% by additional cost of $250,000.*
   - *The design option (B): at design cost of $1,350,000 has 20% probability to yield 59% of the sale as good product and 80% probability to yield 64% of the sale as good product. It is possible to increase yields of 59% to 64% by additional cost of $250,000.*
   - *The product manufacturing cost is $75, the good product will sell for $150, and the bad product will scraped without salvage value.*

4- *A product design group decided to design a new series of product having a market forecast of 200,000 units. It must decide on one of three design strategies. Select the appropriate strategy if the following estimates of the initial and variable costs for each strategy are given.*
   a. ***Low tech:*** *A low-technology, low-cost process consisting of hiring several new junior engineers. This option has fixed cost of $45,000 and variable-cost probabilities of 0.3 for $0.55 each, 0.4 for $0.50, and 0.3 for $0.45.*
   b. ***Subcontract:*** *A medium-cost approach using a good outside design staff. This option has fixed cost of $65,000 and variable-cost probabilities of 0.7 for $0.45, 0.2 for $0.40, and 0.1 for $0.35.*
   c. ***High tech:*** *A high technology approach using the very best of inside design staff. This option has fixed cost of $75,000 and variable-cost probabilities of 0.9 for $0.40, and 0.1 for $0.35.*

5- *An engineering firm is designing a major design project which is due to in 8 weeks. The penalty of not completing the design on time will cost of $14,000for each wake late. the firm study three alternatives to carry out the design:*
   a. ***Use inside engineering staff:*** *The project is done at cost of $96,000. For this option: the probabilities to finish the project are 0.4 on time, 0.5 one week late, and 0.1 two weeks late.*
   b. ***Use outside engineering firm:*** *The project is done at cost of $92,000. For this option: the probabilities to finish the project are 0.2 on time, 0.4 one week late, 0.3 two weeks late, and 0.1 three weeks late.*
   c. ***Make joint design with outside firm:*** *The project is done at cost of $86,000. For this option: the probabilities to finish the project are 0.1 on time, 0.3 one week late, 0.4 two weeks late, and 0.3 three weeks late.*

   What is the best decision based on expected monetary criterion?

Project plan

6- *The tasks for preparing a dinner (along with the normal completion times) might include:*

- *Wash and cut vegetables for the salad (15 minutes).*
- *Toss the salad (2 minutes).*
- *Set the table (8 minutes).*
- *Start the rice cooking (2 minutes).*
- *Cook rice (25 minutes).*
- *Place the rice in a serving dish (1 minute).*
- *Mix casserole ingredients (10 minutes).*
- *Bake the casserole (25 minutes).*

Prepare a DSM for these tasks.

7- *The activities and times for a production line setup project are given in table (7-1)*

a) *Draw the project network.*
b) *Identify critical path.*
c) *What is the expected project length?*
d) *Draw a Gantt chart for the project.*

Table (7-1)

Activity	*Time , hr*	*Immediate predecessors*
A	*6.0*	*-*
B	*7.2*	*-*
C	*5.0*	*A*
D	*6.0*	*B, C*
E	*4.5*	*B, C*
F	*7.7*	*D*
G	*4.0*	*E, F*

8- *A new car is designed and the manufactured based on the activities given in table (8-1).*

a) *Draw the project network.*
b) *Identify critical path.*
c) *What is the expected project length?*
d) *Draw a Gantt chart for the project.*

Table (8-1)

Activity	*description*	*Normal Time , day*	*Immediate predecessors*
A	*Start*	*0*	*-*
B	*Design*	*8*	*A*
C	*Order special accessories*	*0.1*	*B*
D	*Build frame*	*1*	*B*
E	*Build doors*	*1*	*B*
F	*Attach axles, wheels, gas tank*	*1*	*D*
G	*Build body shell*	*2*	*B*
H	*Build transmission and drivertrain*	*3*	*B*
I	*Fit doors to body shell*	*1*	*G, E*
J	*Build engine*	*4*	*B*
K	*Bench-test engine*	*2*	*J*
L	*Assemble chassis*	*1*	*F, H, K*
M	*Road-test chassis*	*0.5*	*L*
N	*Paint body*	*2*	*I*
O	*Install wiring*	*1*	*N*
P	*Install interior*	*1.5*	*N*
Q	*Accept delivery of special accessories*	*5*	*C*
R	*Mount body and accessories on chassis*	*1*	*M, O, P, Q*
S	*Road test car*	*0.5*	*R*
T	*Attach exterior trim*	*1*	*S*
U	*Finish*	*0*	*T*

9- The activities and times for a production line setup project are given in table (9-1)

a) Draw the project network.
b) Identify critical path.
c) What is the expected project length?
d) Draw a Gantt chart for the project.

Table (9-1)

Activity	*Time , day*	*Immediate predecessors*
A	*5*	*-*
B	*2*	*A*
C	*4*	*A*
D	*5*	*B*
E	*5*	*B*
F	*5*	*C*
G	*2*	*E, F*
H	*3*	*D*
I	*3*	*G, H*

Design Ethics

1.1) John Williams, a professional engineer, agrees to testify as an expert witness for the firm of Jones & Black in a court case. In return, the firm promises to pay Williams $1500 plus expenses for his services. (*a*) Is this a lawful contract? State the reasons for your decision. (*b*) Suppose Williams agrees to accept $2500 if Jones wins, but only expenses if Jones loses. Is this a lawful contract? State your reasons.

1.2) ABC Electric agreed by fax on Monday to buy 100 fractional-horsepower motors for $3000 from Amalgamated Electric. On Wednesday the purchasing agent from ABC calls and says he is canceling the order. Amalgamated says the motors have already been shipped and they want their money. (*a*) What is the legal responsibility of ABC Electric in this transaction? (*b*) Would it have been any different if the motors had not already been shipped?

1.3) A car designer specified steel bolts of the highest quality and strength when designing a connection for the front-end steering rods. The manufacturer of the bolts used an inadequate sampling plan for inspecting the bolts, and several defective bolts caused failure of the steering mechanism. Several deaths resulted and there was a major product recall. Discuss the liability of the designer, the auto company, and the bolt manufacturer.

1.4) Read the story of the failure of the General Electric refrigerator with the revolutionary rotary compressor (*Wall Street Journal,* May 7, 1990, p. A1, A5). What lessons does this teach us about product design? What implications does it have for product liability?

1.5) Aristotle put forth the precept that humanity should follow four virtues: (1) prudence, (2) justice, (3) fortitude, and (4) temperance. Define each virtue broadly and give examples of ethical behavior for each virtue.

1.6) Make a list of business practices that signal whether an organization is an ethical corporation. What role does the CEO of the corporation play in this?

1.7) We are in a period where the desire for steady increase in corporate earnings, driven to a large degree by the stock market, sometimes causes management to require layoffs even when profits are good. Discuss the ethics of this from the viewpoint of both corporate management and the individual engineer.

1.8) Imagine what it would be like if there were no codes of ethics for engineers. What would be the consequences?

1.9) A trend in sports equipment has been to improve the players' performance by introducing new products. Examples are the graphite-composite shaft and titanium head in golf drivers, lighter-weight composite tennis rackets with a larger "sweet" spot, and an aluminum baseball bat with built-in damping. Discuss the ethics of compensating for personal inadequacies in performance with technology in competitive sports.

1.10) Discuss the ethics of the following situation. You are a design engineer for the Ajax Manufacturing Co., a large multiplant producer of plastic parts. As part of your employment, you were required to sign a secrecy agreement that prohibits divulging information that the company considers proprietary.

Ajax has modified a standard piece of equipment that greatly increases the efficiency in cooling viscous plastic slurries. The company decides not to patent the development but instead to keep it as a trade secret. As part of your regular job assignment, you work with this proprietary equipment and become thoroughly familiar with its enhanced capabilities.

Five years later you leave Ajax and go to work for a candy manufacturer as chief of production. Your new employer is not in any way in competition with Ajax. You quickly realize that Ajax's trade secret can be applied with great profit to a completely different machine used for cooling fudge. You order the change to be made. Discuss the ethics.

1.11) Discuss the ethics in the following situation. You have been on the job for nine months as an assistant research engineer working with a world-famous authority on heat transfer. It is an ideal job, because you are learning a great deal under his sympathetic tutelage while you pursue an advanced degree part-time.

You are asked to evaluate two new flame-retardant paints A and B. Because of late delivery of some constituents of paint A, the test has been delayed and your boss has been forced to make a tentative recommendation of paint A to the design group. You are asked to make the after-the-fact tests "for the record." Much to your surprise, the tests show that your boss was wrong and that formulation B shows better flame resistance. However, a large quantity of paint A already has been purchased. Your boss asks you to "fudge the data" in favor of his original decision, and since there is reasonable possibility that your data were in error, you reluctantly change them to favor his decision. Discuss the ethics.