ADDITIONAL CASES

Case 16.2 Smart Steering Support

On a sunny May morning, Marc Binton, CEO of Bay Area Automobile Gadgets (BAAG), enters the conference room on the 40th floor of the Gates building in San Francisco, where BAAG's offices are located. The other executive officers of the company have already gathered. The meeting has only one item on its agenda: planning a research and development project to develop a new driver support system (DSS). Brian Huang, Manager of Research and Development, is walking around nervously. He has to inform the group about the R&D strategy he has developed for the DSS. Marc has identified DSS as the strategic new product for the company. Julie Aker,Vice President of Marketing, will speak after Brian. She will give detailed information about the target segment, expected sales, and marketing costs associated with the introduction of the DSS.

BAAG builds electronic nonaudio equipment for luxury cars. Founded by a group of Stanford graduates, the company sold its first product—a car routing system relying on a technology called global positioning satellites (GPS)—a few years ago. Such routing systems help drivers to find directions to their desired destinations using satellites to determine the exact position of the car. To keep up with technology and to meet the wishes of their customers, the company has added a number of new features to its router during the last few years. The DSS will be a completely new product, incorporating recent developments in GPS as well as voice recognition and display technologies. Marc strongly supports this product, as it will give BAAG a competitive advantage over its Asian and European competitors.

Driver support systems have been a field of intense research for more than a decade. These systems provide the driver with a wide range of information, such as directions, road conditions, traffic updates, etc. The information exchange can take place verbally or via projection of text onto the windscreen. Other features help the driver avoid obstacles that have been identified by cars ahead on the road (these cars transmit the information to the following vehicles). Marc wants to incorporate all these features and other technologies into one support system that would then be sold to BAAG's customers in the automobile industry.

After all the attendees have taken their seats, Brian starts his presentation: "Marc asked me to inform you about our efforts with the driver support system, particularly the road scanning device. We have reached a stage where we basically have to make a go or no-go decision concerning the research for this device, which, as you all know by now, is a key feature in the DSS. We have already integrated the other devices, such as the PGS-based positioning and direction system. The question we have to deal with is whether to fund basic research into the road scanning device. If this research were successful, we then would have to decide if we want to develop a product based on these results—or if we just want to sell the technology without developing a product. If we do decide to develop the product ourselves, there is a chance that the product development process might not be successful. In that case, we could still sell the technology. In the case of successful product development, we would have to decide whether to market the product. If we decide not to market the developed product, we could at least sell the product concept that was the result of our successful research and development efforts. Doing so would earn more than just selling the technology prematurely. If, on the other hand, we decide to market the driver support system, then we are faced with the uncertainty of how the product will be received by our customers."

"You completely lost me." snipes Marc.

Max, Julie's assistant, just shakes his head and murmurs, "those techno-nerds. . . ."

Brian starts to explain: "Sorry for the confusion. Let's just go through it again, step by step."

"Good idea—and perhaps make smaller steps!" Julie obviously dislikes Brian's style of presentation.

"OK, the first decision we are facing is whether to invest in research for the road scanning device."

"How much would that cost us?" asks Marc.

"Our estimated budget for this is $300,000. Once we invest that money, the outcome of the research effort is somewhat uncertain. Our engineers assess the probability of successful research at 80 percent."

"That's a pretty optimistic success rate, don't you think?" Julie remarks sarcastically. She still remembers the disaster with Brian's last project, the fingerprint-based car security system. After spending half a million dollars, the development engineers concluded that it would be impossible to produce the security system at an attractive price.

Brian senses Julie's hostility and shoots back: "In engineering we are quite accustomed to these success rates— something we can't say about marketing. . . ."

"What would be the next step?" intervenes Marc.

"Hm, sorry. If the research is not successful, then we can only sell the DSS in its current form."

"The profit estimate for that scenario is $2 million," Julie throws in.

"If, however, the research effort is successful, then we will have to make another decision, namely, whether to go on to the development stage."

"If we wouldn't want to develop a product at that point, would that mean that we would have to sell the DSS as it is now?" asks Max.

"Yes, Max. Except that additionally we would earn some $200,000 from selling our research results to GM. Their research division is very interested in our work and they have offered me that money for our findings."

"Ah, now that's good news," remarks Julie.

Brian continues, "If, however, after successfully completing the research stage, we decide to develop a new product then we'll have to spend another $800,000 for that task, at a chance of 35 percent of not being successful."

"So you are telling us we'll have to spend $800,000 for a ticket in a lottery where we have a 35 percent chance of not winning anything?" asks Julie.

"Julie, don't focus on the losses, but on the potential gains! The chance of winning in this lottery, as you call it, is 65 percent. I believe that that's much more than with a normal lottery ticket," says Marc.

"Thanks, Marc," says Brian. "Once we invest that money in development, we have two possible outcomes: either we will be successful in developing the road scanning device or we won't. If we fail, then once again we'll sell the DSS in its current form and cash in the $200,000 from GM for the research results. If the development process is successful, then we have to decide whether to market the new product."

"Why wouldn't we want to market it after successfully developing it?" asks Marc.

"That's a good question. Basically what I mean is that we could decide not to sell the product ourselves but instead give the right to sell it to somebody else, to GM, for example. They would pay us $1 million for it."

"I like those numbers!" remarks Julie.

"Once we decide to build the product and market it, we will face the market uncertainties and I'm sure that Julie has those numbers ready for us. Thanks."

At this point, Brian sits down and Julie comes forward to give her presentation. Immediately some colorful slides are projected on the wall behind her as Max operates the computer.

"Thanks, Brian. Well, here's the data we have been able to gather from some marketing research. The acceptance of our new product in the market can be high, medium, or low," Julie is pointing to some figures projected on the wall behind her. "Our estimates indicate that high acceptance would result in profits of $8.0 million, and that medium acceptance would give us $4.0 million. In the unfortunate case of a poor reception by our customers, we still expect $2.2 million in profit. I should mention that these profits do not include the additional costs of marketing or R&D expenses."

"So, you are saying that in the worst case we'll make barely more money than with the current product?" asks Brian.

"Yes, that's what I am saying."

"What budget would you need for the marketing of our DSS with the road scanner?" asks Marc.

"For that we would need an additional $200,000 on top of what has already been included in the profit estimates," Julie replies.

"What are the chances of ending up with a high, medium, or low acceptance of the new DSS?" asks Brian.

"We can see those numbers at the bottom of the slide," says Julie, while she is turning toward the projection behind her. There is a 30 percent chance of high market acceptance and a 20 percent chance of low market acceptance.

At this point, Marc moves in his seat and asks: "Given all these numbers and bits of information, what are you suggesting that we do?"

(a) Organize the available data on cost and profit estimates in a table.
(b) Formulate the problem in a decision tree. Clearly distinguish between decision and event nodes.
(c) Calculate the expected payoffs for each node in the decision tree.
(d) What is BAAG's optimal policy according to Bayes'decision rule?
(e) What would be the expected value of perfect information on the outcome of the research effort?
(f) What would be the expected value of perfect information on the outcome of the development effort?
(g) Marc is a risk-averse decision maker. In a number of interviews, his utility function for money was assessed to be

$$u(M) = \frac{1 - e^{-M/12}}{1 - e^{-1/12}},$$

where M is the company's net profit in units of hundreds of thousands of dollars (e.g., $M = 8$ would imply a net profit of $800,000). Using Marc's utility function, calculate the utility for each terminal branch of the decision tree.
(h) Determine the expected utilities for all nodes in the decision tree.
(i) Based on Marc's utility function, what is BAAG's optimal policy?
(j) Based on Marc's utility function, what would be the expected value of perfect information on the outcome of the research effort?
(k) Based on Marc's utility function, what would be the expected value of perfect information on the outcome of the development effort?

Case 16.3 Who Wants to be a Millionaire?

You are a contestant on "Who Wants to be a Millionaire?" You already have answered the $250,000 question correctly and now must decide if you would like to answer the $500,000 question. You can choose to walk away at this point with $250,000 in winnings or you may decide to answer the $500,000 question. If you answer the $500,000 question correctly, you can then choose to walk away with $500,000 in winnings or go on and try to answer the $1,000,000 question. If you answer the $1,000,000 question correctly, the game is over and you win $1,000,000. If you answer either the $500,000 or the $1,000,000 question incorrectly, the game is over immediately and you take home "only" $32,000.

A feature of the game "Who Wants to be a Millionaire?" is that you have three "lifelines"—namely "50-50," "ask the audience," and "phone a friend." At this point (after answering the $250,000 question), you already have used two of these lifelines, but you have the "phone a friend" lifeline remaining. With this option, you may phone a friend to obtain advice on the correct answer to a question before giving your answer. You may use this option only once (i.e., you can use it on either the $500,000 question or the $1,000,000 question, but not both). Since some of your friends are smarter than you are, "phone a friend" significantly improves your odds for answering a question correctly. Without "phone a friend," if you choose to answer the $500,000 question you have a 65% chance of answering correctly, and if you choose to answer the $1,000,000 question you have a 50% chance of answering correctly (the questions get progressively more difficult). With "phone a friend,"

you have an 80% chance of answering the $500,000 question correctly and a 65% chance of answering the $1,000,000 question correctly.

(a) Use ASPE to construct and solve a decision tree to decide what to do. What is the best course of action, assuming your goal is to maximize your *expected* winnings?
(b) Use the equivalent lottery method to determine your personal utility function (in particular, your utility values for all of the possible payoffs in the game).
(c) Re-solve the decision tree, replacing the payoffs with your utility values, to maximize your expected utility. Does the best course of action change?

Case 16.4 University Toys and the Engineering Professor Action Figures

University Toys has developed a brand new product line—a series of Engineering Professor Action Figures (EPAFs) featuring likenesses of popular professors at the local engineering school. Management needs to decide how to market the dolls.

One option is to immediately ramp up production and simultaneously launch an ad campaign in the university newspaper. This option would cost $1,000. Based on past experience, new action figures either take off and do well or fail miserably. Hence, the prediction is for one of two possible outcomes— total sales of 2,500 units or total sales of only 250 units. University Toys receives revenue of $2 per unit sold. Management currently thinks that there is about a 50% chance that the product will do well (sell 2,500 units) and a 50% chance that it will do poorly (sell 250 units).

Another option is to test market the product. The company could build a few units, put up a display in the campus bookstore, and see how they sell without any further advertising. This would require less capital for the production run and no money for advertising. Again, the prediction is for one of two possible outcomes for this test market, namely, the product will either do well (sell 200 units) or do poorly (sell 20 units). The cost for this option is estimated to be $100. University Toys receives revenue of $2 per unit sold for the test market as well. The company has often test marketed toys in this manner. Products that sell well when fully marketed have also sold well in the test market 80% of the time. Products that sell poorly when fully marketed also sell poorly in the test market 60% of the time.

There is a complication with the test market option, however. A rival toy manufacturer is rumored to be considering the development of Law School Professor Action Figures (LSPAFs). After doing the test marketing, if University Toys decides to go ahead and ramp up production and fully market the EPAFs, the cost of doing so would still be $1,000. However, the sales prospects depend upon whether LSPAFs have been introduced into the market or not. If LSPAFs have not entered the market, then the sales prospects will be the same as described above (i.e., 2,500 units if EPAFs do well, or 250 units if EPAFs do poorly, on top of any units sold in the test market). However, if LSPAFs have been introduced, the increased competition will diminish sales of EPAFs. In particular, management expects in this case to sell 1,000 units if EPAFs do well or 100 units if they do poorly (on top of any units sold in the test market). Note that the probability of EPAFs doing well or doing poorly is not affected by LSPAFs, just the final sales totals of each possibility. The probability that LSPAFs will enter the market *before the end* of the test market is 20%. On the other hand, if University Toys markets EPAFs immediately, they are guaranteed to beat the LSPAFs to market (thus making LSPAFs a nonfactor).

(a) Suppose that the test marketing is done. Use the Posterior Probabilities template to determine the likelihood that the EPAFs would sell well if fully marketed, given that they sell well in the test market and then given that they sell poorly in the test market.
(b) Use ASPE to develop and solve a decision tree to help University Toys decide the best course of action and the expected payoff.
(c) Now suppose that University Toys is uncertain of the probability that the LSPAFs will enter the market before the test marketing would be completed (if it were done). How would you expect the expected payoff to vary as the probability that the LSPAFs will enter the market changes?

(d) Use ASPE to generate a parameter analysis report that shows how the expected payoff and the test marketing decision changes as the probability that the LSPAFs will enter the market varies from 0% to 100% (at 10% increments).

(e) At what probability does the test marketing decision change?