Skillbook
Using Decision Trees

Leadership
Skills
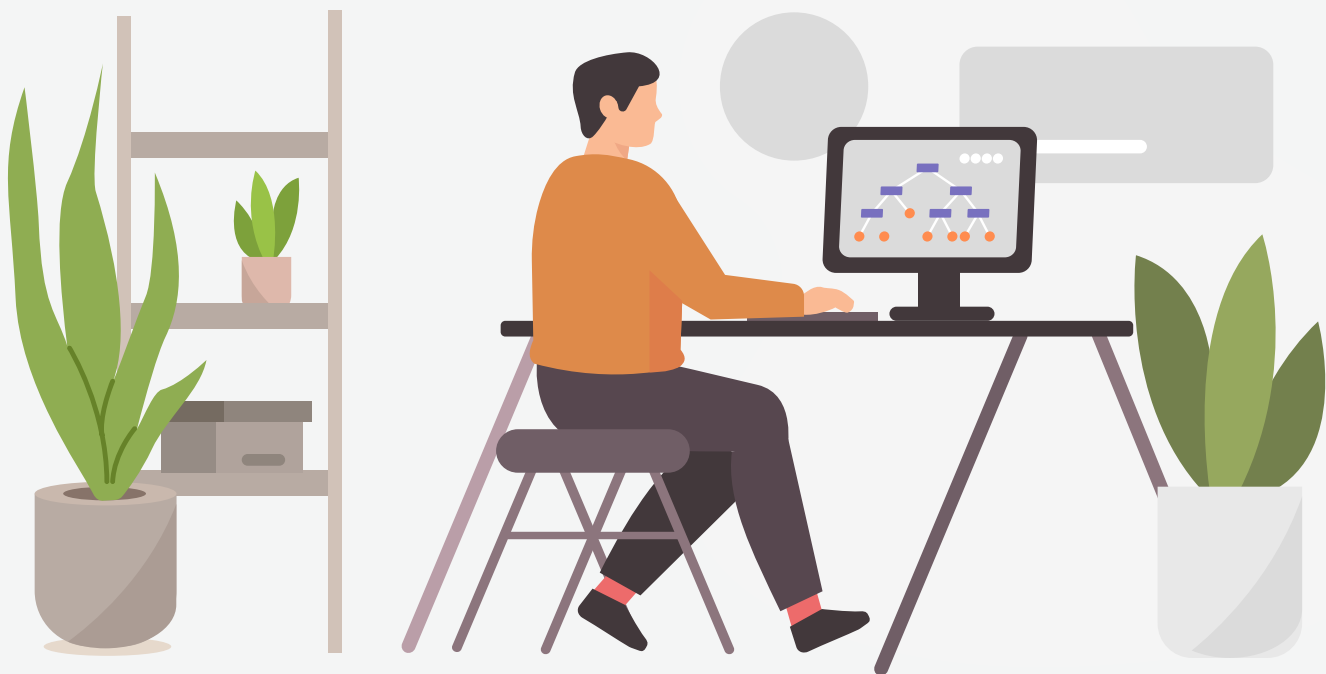
mindtools

Using Decision Trees
Skillbook

Contents

1. Introduction

Organizations need leaders who make good decisions; and team members want confident, capable and decisive leaders who can take them in the right direction. Clearly, people who make wise decisions are highly respected, which makes mastering the skill of decision making particularly important.

No matter how experienced you are, you can usually improve your decision making skills still further. There are many techniques available to help you do this, but Decision Tree Analysis is one of the most reliable for making decisions based on their financial implications. Here, you take a decision you need to make and quantify your options by assigning values to them, which makes the process clearer, more objective and, generally, better.

In this **Skillbook**, we'll explore how to use decision trees to make formal decisions. In around one hour, you'll:

- Learn what a decision tree is.
- Complete one for an example situation.
- Assign probability values and choose the best alternative.

By the end of this **Skillbook** you'll be able to use this tool to make better decisions, you'll have a good understanding of rational decision making, and your confidence will increase.

> **Note:**
>
> This **Skillbook** will seem quite complex. Work through the example, though, and you'll see that decision tree analysis is actually a simple but powerful approach for making good decisions.

2.   Can't See the Wood for the Trees?

Often, we are urged to try to "see the big picture" when making a decision and avoid getting caught up in the details. That's all very well, however, making complex decisions in this way can lead you to miss important alternatives, so it's important to think things through carefully.

Using a decision tree is an excellent way to do this. The technique "forces" you to investigate each alternative and its potential outcome, to determine which offers the best balance between risk and reward.

Decision trees help you predict the possible consequences of various courses of action, which are represented by separate branches with assigned values (you would typically choose the outcome with the highest value).

Let's work through a sample problem to understand and practice the application of these powerful decision-making tools.

> ### Action:
> Print off the blank worksheet on page 12, and use this as you work through this Skillbook.

Example

Imagine that your boss has asked your team to come up with a new product to boost your organization's sales. You brainstorm ideas, and finally narrow these down to two suggestions. But how do you know which one to choose? Your options are:

- Develop and market a new laptop, using an established operating system. The initial cost is high but you expect good returns because many people have used the operating system successfully – this is the "safe choice."
- Develop and market a new e-reader. The initial cost is lower, but the market is less predictable, which might affect your returns.

3.   Creating a Decision Tree

Let's create a decision tree to identify which option you can pursue with the greatest chance of success.

Step 1

Your first step is to identify the decision you want to make. In our example, this would be "choose a product."

Action:

Record your decision statement on the decision tree on page 12.

Step 2

Next, you create a branch of the tree, for each of your two options.

Action:

Write down your two options (like the list on page 2) in the box on the next page, and add them to the decision tree on page 12. Keep them as concise as possible.

Tip:

We suggest writing in pencil if you've printed this workbook out, just in case you want to change your answers to any questions in this exercise.

Option branches:
1.
2.

Step 3

There are no further decisions to make, so you draw a circle at the end of the branch to indicate that you need to identify possible outcomes.

> ### Note:
>
> Appendix 2 shows the "solution" to our example.

Step 4

Now that you've mapped out the options, you need to think about their values.

Decision trees can have different evaluation criteria. For example, some will use scores, while others will list monetary values. Here, we are going to look at expected profit to identify the option with the greatest potential return.

> ### Note:
>
> We'll keep this example and the calculations as simple as possible, and assume that the new product will be sold for one year only.

These are the development and marketing costs for each option:

> **Option A: Develop and Market a New Laptop**
>
> Cost: $6,000,000.
>
> **Option B: Develop and Market a New E-Reader**
>
> Cost: $1,500,000.

These numbers are fixed, but the next figures you need for your profit model have to be estimated. These are sales, production expenses, and the probability of having a higher-than-average, average or lower-than-average first year. These have a bearing on which option provides the best first-year return.

When you estimate the probability of each outcome, you need to ensure that the total comes to 100 percent at each circle connector. If you have data on past products, you may be able to make accurate estimates of the probabilities. Otherwise, make your best guess.

These figures are given below:

Laptop	Higher-Than-Average Return	Average Return	Lower-Than-Average Return
Sales	2 x development and marketing cost	1.5 x development and marketing cost	1.2 x development and marketing cost
Production Expenses	30 percent of sales	35 percent of sales	40 percent of sales
Probability	40 percent	50 percent	10 percent

E-Reader	Higher-Than-Average Return	Average Return	Lower-Than-Average Return
Sales	2 x development and marketing cost	1.75 x development and marketing cost	1.5 x development and marketing cost
Production Expenses	25 percent of sales	30 percent of sales	40 percent of sales
Probability	35 percent	45 percent	20 percent

Action:

Write the branch labels for each outcome we're considering in the box below. (These are the lines that radiate out from the circles you added in step 3. We've filled in the first one for you.)

Add these to the decision tree on .

1. Higher than average.
2.
3.

Step 5

We're now going to record the probability of achieving each outcome.

Step 6

Next, you calculate the net profit for each potential outcome and multiply it by the appropriate probability to get a final rating for each. Use the simplified formula below to calculate profit and return. (The values you need for this formula are on page 5. We'll do the calculations on the next page.)

Formula to Calculate Profit and Return

Total Sales – Production Expenses = Profit; less Development Costs = Return

Example

Option A: Develop and Market a New Laptop

Higher-Than-Average Profit			
Sales	2 x development and marketing cost	2 x $6,000,000	$12,000,000
Production Expenses	30 percent of sales	0.3 x $12,000,000	-$3,600,000
		Profit	$8,400,000

Action:

Finish the calculations for the remaining potential outcomes for option A in the table below. Record the figures at each of the end points on the decision tree on page 12. Correct answers are shown on page 13.

Average Profit			
Sales	_____ x development and marketing cost		
Production Expenses	_____ percent of sales		
		Profit	

Lower Than Average Profit			
Sales	_____ x development and marketing cost		
Production Expenses	_____ percent of sales		
		Profit	

Action:

Complete the table on the next page for option B, and record the figures on the decision tree on page 12.

Higher Than Average Profit			
Sales	2 x development and marketing cost		
Production Expenses	25 percent of sales		
		Profit	

Average Profit			
Sales	1.75 x development and marketing cost		
Production Expenses	30 percent of sales		
		Profit	

Lower Than Average Profit			
Sales	1.5 x development and marketing cost		
Production Expenses	40 percent of sales		
		Profit	

Step 7

Next, you need to calculate an overall values for each option. You can do this by multiplying the profit for each possible outcome by its probability (from page 5), and then adding all the results together. This gives you the "expected value" – your best guess of the value of this option, taking into account the probability of different outcomes.

Action:

Complete the figures for option A on the next page. You can find the answers on onwards, but remember that it's useful to get plenty of practice doing the calculations yourself!

Option A: Develop and Market a New Laptop

Outcome	Total Profit	Probability of Outcome	Total Profit x Probability
Higher-Than-Average Profit	$8,400,000	40 percent	$3,360,000
Average Profit		50 percent	
Lower-Than-Average Profit		10 percent	
		Total Probable Profit	

Option B: Develop and Market a New E-Reader

Outcome	Total Profit	Probability of Outcome	Total Profit x Probability
Higher-Than-Average Profit	$2,250,000	35 percent	$787,500
Average Profit	$1,837,500	45 percent	$826,880
Lower-Than-Average Profit	$1,350,000	20 percent	$270,000
		Total Probable Profit	$1,884,380

Action:

Add the total profit figures for each option to the decision tree on .

Step 8

Finally, you calculate the value of each option at the end of the first year. To do this, you subtract the cost of developing and marketing the new product from the total profit.

Action:

Calculate the value of each option. Complete the table on the next page.

Option	Total Profit	Less Development and Marketing Costs	Value at end of First Year
A			
B			

Step 9

Lastly, you analyze your final values to determine which option holds the greatest potential for return by the end of the first year. The option with the highest value will be your solution.

For our example, the option of developing a new laptop turns out to be the choice with the highest probable return, at $717,000.

4.   Key Points

Decision trees help you think about complex decisions by assigning values to each possible solution and quantifying the potential outcomes for each.

The solution that comes from Decision Tree Analysis is only as good as the assumptions and predictions that go into it. If you take enough time to determine the input values for the potential outcomes, you can greatly enhance your decision-making skills.

However, bear in mind that, while costs are easy to assess, probabilities are very difficult to estimate with any level of accuracy. Treat your conclusions with care!

Decision Tree Worksheet

Total Probable Profit:

Total Probable Profit:
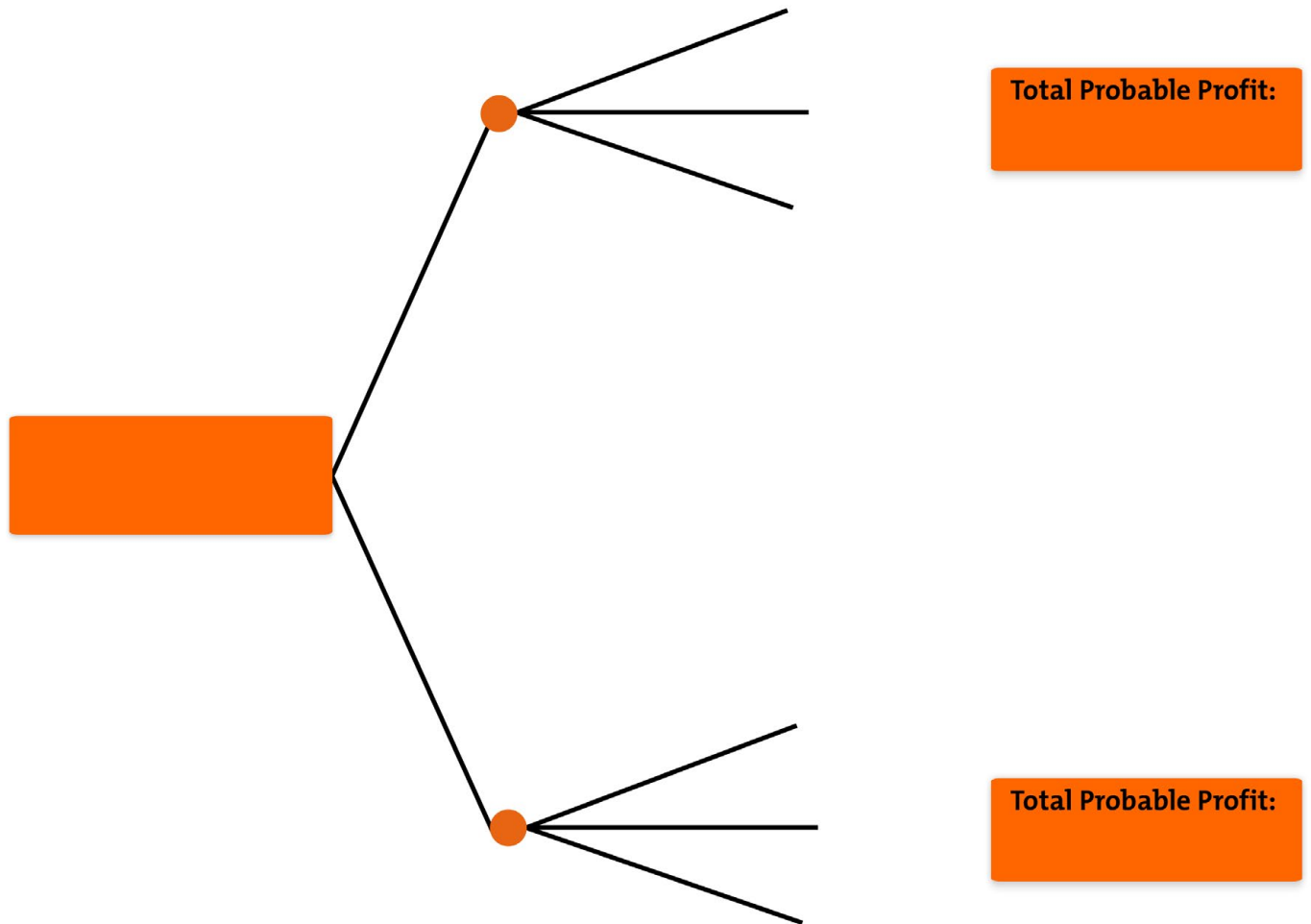
Appendix 1: Calculations

Option A: Develop and Market a New Laptop

Higher-Than-Average Profit			
Sales	2 x development and marketing cost	2 x $6,000,000	$12,000,000
Production Expenses	30 percent of sales	0.3 x $12,000,000	-$3,600,000
		Profit	$8,400,000

Average Profit			
Sales	1.5 x development and marketing cost	1.5 x $6,000,000	$9,000,000
Production Expenses	35 percent of sales	0.35 x $9,000,000	-$3,150,000
		Profit	$5,850,000

Lower-Than-Average Profit			
Sales	1.2 x development and marketing cost	1.2 x $6,000,000	$7,200,000
Production Expenses	40 percent of sales	0.4 x $7,200,000	-$2,880,000
		Profit	$4,320,000

Outcome	Total Profit	Probability of Outcome	Total Profit x Probability
Higher-Than-Average Profit	$8,400,000	40 percent	$3,360,000
Average Profit	$5,850,000	50 percent	$2,925,000
Lower-Than-Average Profit	$4,320,000	10 percent	$432,000
		Probable Profit	$6,717,000
		Probable Return of Option A	$717,000

Option B: Develop and Market a New E-Reader

Higher-Than-Average Profit			
Sales	2 x development and marketing cost	2 x $1,500,000	$3,000,000
Production Expenses	25 percent of sales	0.25 x $3,000,000	-$750,000
		Profit	$2,250,000

Average Profit			
Sales	1.75 x development and marketing cost	1.75 x $1,500,000	$2,625,000
Production Expenses	30 percent of sales	0.3 x $2,625,000	-$787,500
		Profit	$1,837,500

Lower-Than-Average Profit			
Sales	1.5 x development and marketing cost	1.5 x $1,500,000	$2,250,000
Production Expenses	40 percent of sales	0.4 x $2,250,000	-$900,000
		Profit	$1,350,000

Outcome	Total Profit	Probability of Outcome	Total Profit x Probability
Higher-Than-Average Profit	$2,250,000	35 percent	$787,500
Average Profit	$1,837,000	45 percent	$826,880
Lower-Than-Average Profit	$1,350,000	20 percent	$270,000
		Probable Profit	$1,884,380
		Probable Return of Option B	$384,380

Appendix 2: Completed Decision Tree

Probable Return of Option A = $717,000

Choose a Product

New Laptop
Development and Marketing: $6,000,000

- Above Av. (40%) — $8,400,000
- Average (50%) — $5,850,000
- Below Av. (10%) — $4,320,000

Total Probable Profit: $6,717,000

Probable Return of Option B = $384,380

New E-Reader
Development and Marketing: $1,500,000

- Above Av. (35%) — $2,250,000
- Average (45%) — $1,837,500
- Below Av. (20%) — $1,350,000

Total Probable Profit: $1,884,380