Chapter 1 Answer Key

**1. ABC Bottling Company’s sales have been expanding rapidly. Their single plant, which ships directly to customers, is now out of capacity. What factors should they consider when they decide whether to expand the existing plant or build another one? If they build another plant, what factors should they consider when they locate this plant?**

There are many answers here that could be considered correct. You can use this question for a nice discussion in class. You will receive many different answers, and a lot will depend on the assumptions people make about ABC Bottling Company. You can adjust this problem to add more detail to ABC (do they make bottles and sell them to a few factories that fill them with juice? Do they make a soda product and ship to hundreds of retailers around the country? Are they a national firm, or do they serve just a single city or region? And so on…).

Answer for the first part on whether to expand versus build another plant:

* They should look at the cost of expanding versus the cost of building a new plant.
* Do they have the land and space to actually expand?
* Where are the customers? Do they need a plant close to customers?
* Do they have enough qualified labor in the area if they expand?
* If they build a new plant, should they keep the old one or close it down?
* Do they have the management systems in place to handle two plants?

Answer for the second part on what factors they should consider when choosing the location of the new plant (note that this question is related to the first question, and it is acceptable to have a single list of answers):

* Cost of transportation relative to the customer base.
* Cost of production at the two locations.
* Tax implications of the new potential locations.
* Strategic implications of the new locations.
* Which customers the existing plant will serve and which ones the new plant will serve.
* How big to make the new plant—should they make it big enough for forecasted growth over the next five years? Should they make it big enough to handle double the expected growth?

**2. A producer of dog food is trying to decide whether they should change the number and locations of their warehouses to better meet projected demand over the next three years. They do a study and determine that their transportation and warehousing costs will be $51 million if they stick with their current structure. They have determined that if they close two warehouses and open two new warehouses, their costs will drop to $50.5 million. Assume that all other costs stay the same. Should they make the change?**

This question is meant to get students thinking about the savings from the point of view of a business, to think about data precision and ambiguity of cost estimates.

Many people will naturally assume that these costs are absolute truths and look at the savings from their personal point of view. If you take this view, $500,000 sounds like a lot of money, and you would be foolish to not take it!

However, the answer to this question is that ***the firm should not make the change***. First, the savings, although large to us personally, is small relative to the overall spend—about a 1% decrease. A supply chain manager would think that if they made one mistake in the implementation or the calculations, all these savings would be gone. Second, they are projecting these savings over the next three years. So, their measures for demand and transportation costs have a margin of error of more than 1%. The savings they have found is well within the margin error and is not significant.

**3. You need to set up a mathematical optimization model. Assume you are modeling a supply chain for a business with ten warehouses and 1,000 customers. If you set up the model to minimize cost, set the decision variables to decide which warehouse should serve which customers, and set up no constraints, why would you expect the minimal cost to come back as $0?**

The quick answer is that without a constraint saying that all demand must be met, the best answer will be to meet no demand. That is much cheaper, to the model, than shipping products. This is meant to show the importance of constraints, even ones that seem trivial or obvious, to mathematical models.

On this question, you could even set up an Excel optimization model and show that without this constraint, the cost comes back as $0.

But, the question is not just a trick question or a question to think about mathematical models. Often, the constraints or limits within a business are so obvious and so much part of the business that people no longer explicitly think about them. So, when trying to get people to articulate the more subtle constraints, starting with the obvious can be a great way to break the ice. For example, if the people in a firm are saying that they really have no constraints, you can start the conversation by saying that there must be a constraint to meet demand or the model won’t meet any demand. You can think of other such obvious examples in different situations. (Of course, you could set up a model where you included the revenue per customer and the objective was to maximize profit. Even this gets people talking about the constraints in a business.)

**4. You are helping a firm determine their future transportation costs between their plant in Dallas and their warehouse in Atlanta. Your best estimate, with the data you have, is that the cost will be between $1.70 and $1.80 per mile. You decide to use $1.75 as your cost because it is the midpoint. If you are asked to spend more time seeing whether the number should be closer to $1.70 or $1.80, what would be your argument against further refining this number?**

The main argument for not refining this number has to do with significant digits and precision. $1.75 per mile is only +/- 3% from $1.70 and $1.80. Because this is a future estimate, the change in oil prices is likely to impact the cost per mile more than +/- 3%. So, even if you spend more time getting more precise, the number you come up with is not likely to be more accurate.

**5. A small medical supply company in Australia has just developed a never-before-seen product with major pre-release orders from around the globe already. This company will need more production capacity to support their forecasted sales for this new blockbuster product. If they simply expand their plant in Australia, they estimate that their production, transportation, and warehousing costs will be approximately $450 million (AUD). After a careful network design study, they have found two solutions that people in the company generally like:**

1. **Solution #1: Estimated cost of $375 million with a new large plant in China to supplement their existing plant in Australia.**
2. **Solution #2: Estimated cost of $385 million with three new smaller plants in China, Brazil, and Italy to supplement their plant in Australia. These plants would service their local regions.**

**(Assume the costs listed here include all the costs that are relevant.) What would be the best reasons for picking Solution #1? For picking Solution #2? Why is it important for this firm to consider other nonquantifiable factors when determining their best course of action for expansion?**

The main argument for Solution #1 is that is the low cost solution. It is 17% lower cost than the existing strategy. But, note that is only about 3% less than Solution #2.

The main argument for Solution #2 is that it saves money (almost as much as Solution #1) and having plants in local markets may allow for better service to those regions.

The nonquantifiable aspects are important as seen in Solution #2—being close to markets may be important. But, also other factors would include the political reasons for being close to the markets, expected future growth (will it be in China or other parts of the world?), the ability to manage plants around the world, risk mitigation, and others.

You can use this question for a starting point for a class discussion. For example, you can ask students when would they not feel comfortable implementing either #1 or #2, but would stick with Australia. Also, for students who really like Solution #2, you can ask how much lower in cost #1 would need to be to get them to switch. For example, would they switch if Solution #1 cost $365M, $355M, and so on?