CHAPTER 2

A PRACTICAL APPROACH TO OPERATIONS

The whole is more than the sum of the parts.

—ARISTOTLE

In Chapter 1, we examined an operational process as something that adds value to inputs to create outputs. One of the benefits of looking at organizations in this way is that it helps to identify sources of competitive advantage, as we saw with the value matrix and resource-based view techniques. While potentially useful, such results are only ideas on paper. To determine how we can manage the operation to achieve the desired results, we must extend our view of the transformation process a bit to consider the process as part of an overall system and then apply systems thinking to manage for the results we want to achieve.

After completing this chapter, you should be able to do the following:

- Explain how *systems thinking* impacts decision making
- Evaluate a business operation as a system

- Identify situations of *suboptimization*
- Apply a *business research* framework to identify opportunities for operational improvements

By understanding systems thinking, you will be able to apply a practical approach to a wide range of operational issues.

SYSTEMS THINKING

Simply put, a system is a dynamic, purposeful collection of components. Information and materials flow among these components. A system has boundaries; that which is outside the boundaries is considered the system's *environment*. Generally, the environment is considered to be outside the system's control; open systems are affected by their environment, whereas closed systems are not. *Feedback loops* provide information from one part of a system to another for purposes of adjusting the system's operation.

There are various types of systems, and they are characterized by their complexity. The number of components and subsystems, the presence of feedback loops, and the nature of the boundaries can all add to a system's complexity. Organizational systems tend to be quite complex, with multiple subsystems, numerous feedback loops, and permeable boundaries (meaning the organization interacts with its environment). In addition to current and potential rivals, customers, and suppliers,[1] environmental factors include political, economic, social, technological, environmental, and legal (*PESTEL*) factors.[2]

Origins of Systems Thinking

Systems thinking, as a formalized discipline, was a by-product of World War II.[3] We are surrounded by systems: ecosystems, social systems, transportation systems, and more. Each of us is a complex biological system with many subsystems, such as vascular, skeletal, and pulmonary. Understanding that a system's operation depends on the performance and interrelationships of its parts has been useful in a wide range of applications, including philosophy, engineering, and the sciences. Key aspects of systems thinking in management are the emphasis on *holism*, the focus on processes, the interdisciplinary perspective, and the use of feedback loops or mechanisms for system improvement.[4]

This sounds pretty abstract, but there are practical implications of systems thinking. An emphasis on holism suggests that it does not make sense to focus improvements in one area of an operation if it has a detrimental effect on another part of the system. A focus on processes highlights the interdependencies in the operational system. In the same way, considering sales perspectives as well as engineering considerations leads to a more robust and effective operation. Feedback—providing data and information about materials, processes, and results—is a hallmark of effective systems.

Arguably, the need for managers to apply systems thinking is increasing. The overall complexity of operational systems can be confounding. With the increasing pressures to make decisions more quickly, a holistic, process-oriented perspective is essential to avoid unintended consequences. Managing an operation with systems thinking can broaden a manager's perspective beyond a particular subsystem and provide new insights to improve its effectiveness. Using feedback mechanisms provides timely data for process improvement. As a result, the organization can avoid suboptimization, encourage data-based decision making, and improve operational robustness. This can sound daunting, but what it really means is that the manager can work smarter to achieve the desired results.

Systems Thinking in Operations

In Chapter 1, you were introduced to the idea of an operation as a transformation system, one that transforms inputs into outputs by adding value. A similar perspective describes an operation more broadly, transcending organizational boundaries with the concept of a *value chain*. The organizational system becomes even more complex, including suppliers, subcontractors, and even customers, when you examine the chain of activities by which value is added.

In the model developed by Michael Porter, the value chain of activities are categorized as either primary or secondary. Primary activities are directly involved in the transformation system and include inbound logistics, operations, outbound logistics, marketing and sales, and service. Secondary activities can also add value but are mostly conducted to enable the primary activities to be done. They include general administration, human resource management, technology management, and financial processes.[5]

Value chain analysis (VCA) is the epitome of systems thinking. The metaphor of a chain requires looking at the combination of activities as a whole, while recognizing the interdependencies among them. With advances in information systems and management practices, organizational boundaries are blurred, but the focus sharpens when value is added and waste is eliminated.

Suboptimization of Operational Systems

A lack of systems thinking leads to the issue of *suboptimization*, a problem that is rampant in many organizations. It often starts with an improvement in one department. This improvement might be optimal for that department, which is great, but the department is part of an operational system, and the impact of the improvement on other parts of the system has probably been overlooked. As a result, the performance of the overall system is less than it can be, or suboptimal.

This may be clearer with a few examples. Early in my career, I worked for IBM in sales and technical support. Unfortunately, I worked at one of the branches recognized for "administrative excellence." This location was terrific at submitting reports and forecasts on a timely basis, collecting outstanding accounts receivable, and managing expenses. However, the professional staff spent far more time on paperwork in the office than on selling and implementing new systems for customers in the field. In this case, the needs of one subsystem (administrative processes) dominated the needs of other components in the overall system. As a result, we optimized the average age of the office's accounts receivable, but we didn't maximize its profits.

I noted a different kind of suboptimization when I worked for the Quaker Oats Company, where I managed information systems in the late 1980s. Here, the organization tended to be optimized from a functional perspective. Marketing priorities routinely dominated decision making and funding, creating unbalanced performance in other areas. Sometimes the organization could not keep up with marketing initiatives, so expensive choices were made to satisfy demand. We will address ways in which to address capacity issues in a later chapter; for now, let's just say that short-term solutions tend to be costly. One colleague referred to this phenomenon as "air shipping concrete blocks."

This is not unlike the common scenario where budget and personnel cuts are made to meet short-term profitability targets for the stock market and investors. Optimizing for the short-term may not be in an organization's best interests for the long term. The financial results may look good, but the organization's ability to perform and compete is undermined.

Systems thinking is often referred to as "holistic," which means that the parts cannot be fully understood without examination of the whole. Psychologists use the term *gestalt* to emphasize the whole person in the context of his or her situation. *Holistic* is often used in medicine to suggest that physical symptoms should be treated with reference to psychological and social factors. Given a holistic view of an operational system, how do we decide how to "treat the patient"? How do we decide what changes to make in order to solve problems or otherwise make improvements? How do we avoid unintended consequences?

Our best thinking about management and operations stems from business research studies that have tested organizational theories, particularly in the wake of the Industrial Revolution. (That is not to suggest that management practices did not exist before then; surely the pyramids of Egypt are a testimony to very effective project management!) Whether you consider that we are now in the information, knowledge, or network age, you will find that a business research framework can still inform management practice.[6]

How can we separate the wheat from the chaff—that is, apply sound business practices and avoid the debris from the management "fad du jour"? I believe the most effective managers are those who (1) use systems thinking and (2) apply a business research framework to evaluate problems' solutions and improvement opportunities. This is the essence of our practical approach to operations management.

BUSINESS RESEARCH FRAMEWORK

The more I read (and the older I get), the more I become convinced that there are just a few really good ideas out there—each discipline just packages the concepts differently. So if you have studied the *scientific method* somewhere along the way, you'll find that business research is really the scientific method applied to questions in the context of businesses. The intent is to provide an objective, systematic, and logical basis for decision making.

Since we rarely have the controlled environment of a laboratory and a finite number of characteristics to study, business research tends to be "messier" than typical scientific research, meaning it is harder to replicate (something that works great in my business may be less effective in yours because of differences in your overall system or environment). Yet the process is remarkably the same:

1. Define the research question.
2. Develop *hypotheses* to test.
3. Collect the necessary data.
4. Analyze the results.
5. Take action, monitor, and repeat as needed.

Let's examine each step in more detail to see how the research framework is helpful for businesses.

Define the Research Question

The research question stems from a business need. The need may be precipitated by a breakdown in the operational process, an initiative in the strategic plan, a change in the operational system's environment, or ongoing continuous improvement efforts. Generally, you want to change things for the better. But how do you know what will make things better? That is the basis of the research question.

For example, let's say one of your suppliers goes out of business. This will cause an interruption in production unless you do something. That is a problem. What's the best thing to do? Well, it depends. On what? It depends on what is "best" for this operation. Do you want to minimize disruption? Minimize cost? Maximize flexibility? Your feasible solutions may range from switching the supply order to another provider, redesigning the product to eliminate the need for that supply, bringing the capability to supply that need in-house, or using this supplier issue as an opportunity to try offshore manufacturing. Make sure you are solving the right problem by asking the right question: what are the desired results?

Perhaps you are not solving a problem per se, but addressing a question that is precipitated by development or execution of your organization's strategic plan. Business research can be used to improve the performance of a business system, especially when the actual objectives are operationally related to the effectiveness and/or efficiency of operational business processes.[7] It is still important to consider the question of how to achieve a goal broadly and generate a wide array of options before settling on a specific research question. Remember, the holistic perspective is part of systems thinking, so you will want to consider various approaches in different functional areas so you can thoroughly consider the possibilities for achieving your desired results. The research question ("How can we best achieve the desired results?") can then be stated using specific performance measures.

Develop Hypotheses to Test

After formulating the question in terms of the desired results and considering the possible options, you might have an idea of what would work best. Before jumping headlong into action, however, you should test whether your idea is correct. Hypotheses are testable statements of theory. In this context, a hypothesis states the theory that *x* option will achieve *y* result. In our example of the defunct supplier, the hypothesis might be as follows:

> Modifying the product design to eliminate the need for the supplier (*x*) is the easiest way to minimize disruption (*y*); acquiring the materials needed from an offshore supplier (*x*) is the best way to minimize cost (*y*); or developing the capability to supply our needs in-house (*x*) is the optimal way to maximize flexibility (*y*).

Think of *x* as a variable representing what you can do, and *y* as a variable representing what you want. Table 2-1 has more precise terminology and typical hypotheses in an operational context. The hypothesis, then, is a testable statement of the relationship between *x* and *y*.

Table 2-1 Hypotheses in a General Business Research Framework

	x		***y***
Terminology	Action Stimuli Cause Independent variable	Relates to	Result Response Effect Dependent variable
Supplier example	Redesigning Offshore sourcing Developing in-house capability	Leads to	Minimal disruption Minimum cost Maximum flexibility
Other types of operational variables and relationships	Changes in • product design • process form • layout • location • material flow • job skills • technology • inventory control	Increases/decreases/ varies with	Results such as • productivity • quality • throughput • revenues • responsiveness • flexibility • customer satisfaction

Collect the Necessary Data

There are many ways to test a hypothesis, all of which entail collecting some form of data. The data might be as simple as anecdotal evidence of others' experiences, a compilation of expert opinion (from either primary sources or secondary sources such as published reports), a simulation of the proposed approach, or the results from a controlled trial.

It is important to remember that collecting data has a cost. Generally, you will find that the more rigorous the test, the more valid the data—and the more expensive the collection process. You should be practical in your approach and match the rigor to the risk of being wrong. (Caution: you might consider this to be common sense.)

In the case of the defunct supplier, let's assume that the desired result is to minimize disruption and that you think the best way to do this is by slightly modifying your product design to eliminate the need for that supplier's part. How should you test this? Consider the risk of being wrong. Risk is the product of the probability of being wrong and the cost of being wrong: $R = P \times C$, where R is the risk, P is the probability, and C is the cost.

In this case, the risk of being wrong is actually negligible; you may believe you can use a simpler, off-the-shelf sensor that has recently become available instead of the custom device you were purchasing. You can simply pull some of the assembled products and substitute the simpler sensor; if it works, you will know immediately. To consider the long-term risks of failure, you might take a random sample of products with the new sensor in them and run them in a stress test to see if they will fail any sooner or later than those with the old sensor.

Sometimes it really is that simple. In the consumer goods industry, research and development money is often invested in considering substitutable ingredients to avoid supplier disruptions, to extend shelf life, or to reduce the cost of goods sold. However, in a reactive situation such as our scenario, you must make sure you are thoroughly assessing the risk. It is extremely hard for an organization to overcome loss of life or a stain on its high-quality reputation. *Product recalls* are expensive in time, money, and brand equity.

Analyze the Results

This step may seem straightforward, but there are several pitfalls to avoid. First, realize that you may have three different outcomes: "Yes, this will achieve the desired results"; "No, we need to try something else"; or "It looks like we need more data." As you proceed to act on these outcomes, beware of the following potential pitfalls.

The precision of the insights from testing is limited by the data—and some people are never satisfied. You may need to press on despite the "paralysis of analysis" that can often overcome this step in business research. We all make decisions based on imperfect information, and occasionally the right answer *will* be to do more testing. But if you have followed the methodology thoroughly, then trust your results and your judgment.

Remember that numbers are not always fully numerical, so do not perform inappropriate calculations. This often happens when surveys are used for business research. For example, a company wants to measure its customers' satisfaction after implementing a new call center approach. If the survey data on gender are coded as 1 = female and 0 = male, then do not average them! In this case, the numbers are *nominal*, meaning they are just names or labels for convenience. While that may be common sense, a more insidious trap is averaging responses from a Likert scale, where the survey asks for the respondent to rate something from 1 to 5 or 1 to 10. Unless you can justify that the difference between 1 and 2 is the same difference as between 3 and 4 (which it probably is not, if you're asking for an opinion), then you should consider these numbers to be *ordinal*. That means the numerical value is really just a rank relative to the order of the other numbers. In this case, you could use the median (but not the arithmetic mean) to get an "average" response. The mean is an appropriate measure for interval (that is, 6 – 5 = 10 – 9) or ratio (50:5 becomes 10:1 numbers).

Another caveat to remember is that correlation does not imply causation. Be careful when analyzing results that you do not overstate the relationship between your x and your y. For example, a not-for-profit enterprise wondered if its annual fund-raising auction might be more successful if the dress code were casual rather than formal. The first year the committee tried a relaxed dress code, donations increased. Was it because people were dressed differently? One argument in support of this interpretation is that people were more comfortable and spent more time at the event. But it might also be that the event attracted a different set of supporters who preferred to spend money to support the cause rather than to buy new clothes for the event. Or it is possible that neither of these interpretations is true, and some other factor, such as the weather, largely led to the increase in donations.

One other caution: avoid sampling on the *dependent variable*. That sounds technical, but it means that y is a variable that can have various values. This is often overlooked when you are studying successful companies to gain a sense of their best practices. It is important to look at comparable companies that have not been successful. Otherwise, you might conclude that the CEOs of all successful companies wear wristwatches; therefore, you should wear one too, so your company will be successful. It seems to be human nature to generalize about a few success cases without considering any failures. Nothing fuels career progression faster than learning from other people's mistakes.

Cause and effect are often separated in time and space.[8] Fixing a problem in the short term may create problems elsewhere in the system over the long term. Or as renowned systems thinker Peter Senge noted, "Today's problems come from yesterday's solutions."[9] It is important to consider how the operational system works over time. It is also crucial to look beyond the proximal cause of a problem or opportunity to identify the root cause.

There is an old adage: "Give a man a fish, he eats for a day; teach a man to fish, he eats for life." Rather than overwhelm you with the specific (and typically perishable and oversimplified) techniques that proliferate in operations management textbooks, my intent is to ground your understanding of operations management in systems thinking and a research framework. In that way, as opportunities present themselves, you will be prepared to evaluate them in the context of your own operation and its operating environment.

Take Action, Monitor, and Repeat as Needed

Whenever possible, it is advisable to implement a solution on a limited scale to enable you to better gauge the full impact of your decision. This might be accomplished by piloting the solution or improvement in a limited area of the operation, such as with one product line, one retail location, or one supplier. Depending on the nature of the change, a pilot test may identify procedural issues, training needs, capacity challenges, and other glitches. It may also help you develop a "proof of concept," providing credible evidence of feasibility to ease the implementation elsewhere in the operation.

Even if a gradual implementation is not feasible, it is essential that the change be monitored to assess its impact. Was the desired result achieved? Did it create unintended consequences? The results of monitoring should be communicated to all affected parties. If the desired results have not been achieved, then the business research process should be restarted to pursue other options.

TECHNIQUE: ENVIRONMENTAL ANALYSIS

In systems theory, the system's environment is composed of those factors outside its control that have an impact on its operation. In businesses, a common technique for identifying environmental forces is to use the PESTEL analysis I mentioned earlier, which examines political, economic, social, technological, environmental (in the traditional sense), and legal factors.[10] For example, if your company manufactures educational toys, your PESTEL analysis might consider the following environmental factors:

- **Political:** An oil embargo from Venezuela could increase the cost of fuel and petroleum-based polymers, thus reducing your products' contribution margins.
- **Economic:** Rising unemployment may dampen demand for your product.
- **Social:** An increasing number of single-parent households may increase demand for your toys in day care and after-school care facilities.
- **Technological:** The availability of inexpensive programmable chips might provide an opportunity to enhance the interactivity of the toys.
- **Environmental:** An increasing number of options for alternative energy sources may require modifying the production flow.
- **Legal:** A change in trade legislation may affect your ability to produce or sell your products abroad.

By understanding your operating environment, you are in a better position to anticipate changes and avoid suboptimal decisions.

Another popular approach for environmental analysis is Michael Porter's *Five Forces model*, which evaluates the impact of customers, suppliers, competitors, substitutes, and the government on a company's competitive advantage.[10] At the level of an operational system, it is often decisions driven by other areas of the business that have an impact on the operation's effectiveness. For example, marketing and brand development may want to add or change existing products. Purchasing agents may order from different suppliers. Human resource management may negotiate a new set of terms and conditions with the workers' union. As an operations manager, you must be alert to the environmental factors that are most likely to have an impact on your operation's effectiveness.

Application and Reflection

1. In your organization, what feedback loops are used for management decision making and control? Be specific.
2. Consider a scenario in which a doctor's office is receiving complaints from patients about waiting time. Develop several hypotheses of possible causes, following the format in Table 2-1, earlier in this chapter.
3. In what situations have you experienced suboptimal decisions? What was being optimized, and what was the detrimental effect?

SUMMARY

Applying systems thinking can broaden a manager's perspective beyond a particular subsystem and provide new insights to improve its effectiveness. As a result, an organization can avoid suboptimization, encourage data-based decision-making, and improve operational robustness.

Like any system, a business operation is a dynamic, purposeful collection of components, and material and information flow among these components.

Organizational systems tend to be complex, with multiple subsystems, numerous feedback loops, and permeable boundaries with the environment (factors outside the system's control). Understanding key factors in an operation's environment puts the manager in a better position to anticipate changes and avoid suboptimal decisions.

By applying the scientific method to organizational issues and managerial questions, business research can provide an objective, systematic, and logical basis for decision making. Pitfalls to avoid in business research include overstating the precision of the research, applying quantitative analysis inappropriately, assuming causation from a correlation, sampling on the dependent variable, and ignoring the dynamics of the operational system over time.

Review Questions

1. Which of the following is *not* typically part of a system?
   a. Feedback loops
   b. Boundaries

   c. Components
   d. Environment
   e. All of the above
2. **A system's environment is defined by the weather conditions it faces.**
   a. True
   b. False
3. **Which of the following is *not* an environmental factor for operational systems?**
   a. Politics
   b. Customers
   c. Corporate culture
   d. Suppliers
   e. All of the above
4. **Why do we use systems thinking in operations management?**
   a. Human bodies are complex biological systems.
   b. An operation's performance depends on the performance and interrelationship of its parts.
   c. It has been used since World War I.
   d. Engineers find it useful.
5. **Effective systems do not need feedback loops.**
   a. True
   b. False
6. **Which of the following describes suboptimization?**
   a. Optimizing one aspect of an operation to the detriment of the operation as a whole
   b. Achieving less-than-optimal results with a decision
   c. Being useful in the resolution of subsystem problems
   d. Applying a holistic technique for system improvement
   e. All of the above
7. **A business research framework can be used instead of systems thinking for effective operations management.**
   a. True
   b. False
8. **Which of the following is *not* part of a business research process?**
   a. Defining the problem
   b. Collecting necessary data
   c. Analyzing the environment
   d. Taking action
   e. All of the above are part of a business research process.

9. **“Numbers are not always fully numerical” means that**
    a. some arithmetic functions may not apply to a specific data set.
    b. data collection can be suboptimal.
    c. correlation does not imply causation.
    d. you need to use at least two decimal places to be fully numerical.
    e. some people will not understand presentations of numerical data.
10. **PESTEL analysis examines the competitive environment and the threat of substitutes.**
    a. True
    b. False