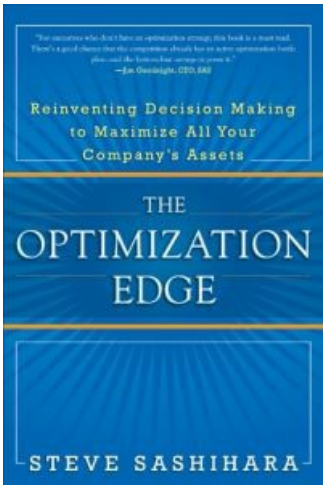

Book The Optimization Edge

Reinventing Decision Making to Maximize All Your Company's Assets

Stephen Sashihara
McGraw-Hill, 2011

Recommendation

Information technology and management consultant Steve Sashihara offers a complete guide to optimization, starting with explaining that it is the process of using the speed and power of computers to analyze information and recommend decisions. He goes beyond yes-and-no decisions, and delves into such issues as determining optimum package delivery routes (for UPS) and finding the best way to sell hotel rooms (for Marriott). Sashihara provides a history of operations research and how it works, and he elucidates what computers have added to the process. He shows managers how to present an optimization program to all levels of their companies, starting with decision-making managers. Sashihara also explains the problems that can arise with optimization programs. *BooksInShort* recommends his book to those who want to understand the decision-making process and wish to know why to optimize and how.

Take-Aways

- Information is the primary tool of business. “Optimizing” will help you make the most of your data.
- Decision makers have too much information to use it effectively.
- Managers can use computers to sort and store information, and to make decisions based on it. That is optimization.
- Companies that optimize usually outperform companies that do not.
- Cutting staff is not the best way to save money; make better use of your resources.
- To optimize, you must first know fully what information you currently have. Then identify your issues and build a team.
- The use of technology often has unintended consequences, so optimize carefully and monitor your progress.
- Optimization works best when executives use it to solve a specific business issue.
- Optimization will be far more common in the future, so welcome it now.
- Computer-based optimization is not a threat to human decisions makers, but a way to enable them to do their jobs better.

Summary

Asset Management: The Ultimate Goal

While people must rethink many of the old ways of doing business, some goals and basic realities remain the same, such as the need to make effective decisions about using your organization’s assets. Today, companies – particularly start-ups – have fewer fixed assets. Staffs are smaller. Competition is fiercer, more constant and more global. Executives instantly turn to downsizing as a way to manage assets and save money, but this is not how to grow. For that, firms must find better, more effective ways of using their resources.

What Is Optimization?

Optimization is the use of computer programs to analyze all the available information that relates to a decision. It suggests the best decision based on this data and explains the reasons for that recommendation. Optimization is the most outstanding way to determine how to deploy your company’s assets effectively. It can offer more than just yes-or-no choices; in fact, firms apply it to very complicated decisions. UPS, the package-moving company, used optimization to find more efficient routes for shipping packages – a complex task. Optimization in UPS’s case included planning driving routes with minimal left turns. To turn left, a truck driver might

waste time and fuel waiting for an opening in traffic, but a driver usually can make a right turn immediately.

Who Uses Optimization?

All managers make decisions every day. A firm's economic survival can depend on its leaders' choices and their ability to monitor which decisions worked and which went wrong. Correcting mistakes also involves decisions. Managers of successful companies "possess an uncanny ability to make complex decisions faster, more accurately and more consistently than their competition." However, optimization also supplies a competitive edge. UPS, which uses the system for ground packages, is highly successful; FedEx is its only major competition. When Airborne Express tried to compete with UPS by using old-style "seat of the pants" decision making, it fell behind and no longer exists. UPS used optimization to design smarter routes, increase efficiency, and save fuel and money.

> "There is no substitute for human brainpower, experience and judgment. But decision making is becoming more complex, the need for speed is ever greater and the value placed on the 'right decision' is increasing."

Walmart also uses optimization for decision making and, in particular, for working out the logistics of sending goods where they need to go. Buying in bulk helps Walmart keep its prices reasonable, but the ability to deliver products to appropriate stores, at appropriate times, is even more important. Walmart uses optimization to examine all stages of its supply chain continually, from supplier to customer. Walmart tracks changes at each point. Consider air conditioners. Walmart's former top competition, Kmart, tended to use simple assumptions, like stocking up on air conditioners in the summer. Walmart looks at buying patterns for air conditioners. Its logisticians examine weather reports, note when areas expect heat waves and prepare to divert air conditioners from stores in cooler places.

> "Optimization may begin as a single project, but once it is successful, changing the way decisions are made can permeate people's thinking and change the culture of an organization."

Two US hotel and restaurant chains founded in the 1920s, Marriott and Howard Johnson, spent 50 years as prime competitors. For decades, they followed similar development paths. Both opened their first travel lodges in the mid-1950s and did well. By the mid-1970s, facing increased oil prices and economic stagnation, Americans cut back on road trips. Howard Johnson's profits declined. The firm cut costs, downsized staff and served cheaper food. The loss of customers continued. In 1979, management accepted a buyout offer from a British company. Ironically, Marriott bought Howard Johnson's assets from that firm in 1985 and resold them.

> "Optimization is a woefully underutilized capability in many industries."

Marriott thrived by taking a different course. As early as 1938, Marriott's restaurants – the Hot Shoppes – supplied box lunches for 22 daily flights from Washington, DC, to New York. When airlines turned to optimization to improve their scheduling, Marriott began to use similar systems for its hotel bookings, particularly for groups, which tend to reserve rooms much further in advance than individuals. Hotel rates vary greatly, so Marriott turned to optimization to find a better way to set prices. The company's effort to promote internal acceptance of its optimization system began with gaining upper management support and convincing staff that optimization did not threaten their jobs. Marriott also uses optimization to build its image. If a Marriott hotel's lowest rate is more than a group can pay, or if the hotel lacks rooms, its staff uses the company's information base to recommend a nearby Marriott or even a competitor. The hotel might not get the group's business, but Marriott earns goodwill.

Foundations of Optimization

Managers who want to adopt optimization should ask how their company is making repetitive decisions about major assets, and whether it has underutilized assets and is using the right factors to justify its decisions. Notice if certain strategic decisions or operational issues repeatedly generate debate, and determine if your current forecasts are accurate. Optimization is both a new and a very, very old concept. People have always wanted to get the most from their assets, including their teams. "The cave people who had to decide who should go on the hunt and who should stay behind to guard the camp faced an optimization problem." Even if they thought out mental models of how to form a hunting party, cave dwellers lacked the math concepts to frame optimal questions. Basic modeling emerged as early civilizations worked out calendars not only to measure the passage of time but also to predict events, such as full moons and seasons. Mathematics existed in some form among the ancient Greeks and Romans. The Arabs made major contributions by developing algebra and introducing a better numbering system. The more direct ancestor of the math behind modern optimization arose around 1600 from efforts to predict the future – namely, attempts to find more reliable methods than trying to divine the will of the gods who controlled fate.

> "Optimization is about taking an upside-down look at things and moving into unexplored areas. Rather than starting in the boardroom...optimizers are creative thinkers continuously on the prowl for optimal solutions – starting from the bottom up."

French 17th-century mathematician Blaise Pascal contributed to "prediction science" when he tried to make gambling less risky by finding a way to predict the outcome of games. These early betting odds became the basis of modern gambling – both illegal and legal. One variation was the idea that the gambler's odds should account for both shifts in certain outcomes and their desirability. In investing, this becomes the "expected return." Science, particularly theoretical science , often runs in advance of the technology it needs to work. In the 1880s, the lag in technology kept mathematician Charles Babbage from being able to build two impressive calculating machines he had designed, including one he could program with punch cards. The first version of his machine – built 150 years after he designed it – weighed tons.

Optimization in the 20th Century

The invention of the transistor and the microchip exemplified technology's decreasing size and increasing calculating speed. This set the stage for modern optimization, even as more direct advances unfolded, such as the development of more precise methods for calculating odds of occurrence and degrees of desirability, and of actuarial methods for life expectancy, the basis of life insurance and pension calculations. The first person to work significantly in this area was Edmond Halley, discoverer of Halley's Comet.

> "Game theory involves using mathematics to model behavior in strategic and tactical situations, where an individual's success depends on the individual's wins at the expense of another."

The advent of technology and operations research – the direct ancestors of optimization – accelerated in the first half of the 20th century. The British first used radar in 1940 to detect approaching German bombers during the Battle of Britain. The British analyzed potential enemy attack patterns to plan future raids. As the war went on, "operations analysis" greatly improved the effectiveness of Allied bombings, antiaircraft fire and artillery targeting. The Allies built faster computers to use in artillery targeting, technological research and decoding. Engineers wrote linear programming to analyze problems, resources, and constraints. The process – later simplified by the debut of the "simplex algorithm" – solved problems by following a series of steps. Mathematicians' next pivotal theoretical development was "game theory," which helps predict an opponent's behavior.

> "Theory never rests."

When World War II ended, computers still filled entire rooms, and only governments could afford them. By 1951, Remington Rand had built the Univac 1 for the US Census Bureau for $1 million (equal to $8 million today). IBM demonstrated just how fast technology advances, even in peacetime, with its 608-transistor computer for $83,000 (which now would buy some 500,000 vastly more powerful laptops). The 608 was smaller, faster and cheaper than the Univac I, and consumed less electricity. The technology needed for optimization had arrived and would continue to improve. The first computer programs specialized for optimization debuted in 1955, followed by the introduction of user-friendly computer language and the microchip, which further shrank the size and cost of computers.

Optimization Today: The Need

Optimization is not the first step in computers' takeover of society, despite any number of science fiction villains, such as HAL in *2001: A Space Odyssey*. Humans are not likely to become cyborgs, despite remarkable advances in medicine and prosthetics, and they likely will always have the final "sign off" on decisions, no matter how computers develop. However, optimization reaches good decisions, often faster than a person might. Decision making must include human values, but are those values necessary in "operational decisions" – that is, ways of doing things? People cling to the familiar because they know it, not because it fills some deep moral purpose or even because it is better. Optimization can show what works best and when it can work better. People will correct failures, but they are less psychologically able to correct what seems like success.

Where Does Optimization Work Best?

Optimization works well where similar decisions must be made again and again, like when figuring out how to route packages. Optimization also functions best:

- When a large number of variables or permutations enter into the relevant calculations.
- When the decision making involves quickly sorting an enormous number of facts.
- When inaccessible information is necessary.
- When a decision calls for combining probabilities (if A, then what happens? If A and B, then what?).
- When emotions are not part of the decision.
- When the situation does not call for protracted discussion and negotiation – that is, when compromise cannot be optimized.
- When the decision-making process requires continuous processing or monitoring.
- When mathematics can model the decisions.

How to Design, Plan and Examine an Optimization Program

When establishing an optimization system, pay attention to organizational culture. Optimization has to deal with the existing culture, though its success can change that culture. People who are content with current methods need good reasons to switch to optimization, particularly decision makers who may consider themselves good at making decisions and not wish for computerized support. Those who fear that optimization will cost them their jobs will oppose it. To set up an optimization program:

- First, assess your existing information so you know exactly what you already have.
- Identify a compelling business issue that is solvable with math-based decision making.
- Assemble a team with the right attitude, energy, and a variety of complementary skills.
- Present the reasons for an optimization system. Introduce it gradually.
- Anticipate, and move to ameliorate, any unintended consequences of optimization. For example, how will success in departments that have adopted optimization affect departments that have not?
- Staffers need preparation, skills to use the program and clarity about its goals.
- Be sure employees can operate the software correctly and can provide feedback.
- Develop methods to monitor results, fix the negatives and build on the positives.
- Insist on feedback and provide it to upper management.
- Deliver value quickly. Establish momentum when introducing the program. Expand it to other areas of the company as soon as feasible. Be open and maintain transparency.

The Future

Some corporations use optimization for only some operations. UPS, for example, has not yet introduced optimization for its air service, though it is under consideration. This is in keeping with the best practice of establishing such programs piece by piece. Optimization's use expands when companies see how well it works and when people understand that computer-based optimization is a tool, not a threat to them or their jobs. It will be far more prevalent in the future, so welcome it. People will, for the foreseeable future, have to program assumptions into computers and run them, though these computers will continue to do more tasks.

About the Author

Steve Sashihara is president and CEO of Princeton Consultants Incorporated, an information technology and management consulting firm.