Putting the Lesson before the Test

Using Simulation to Analyze and Develop Competitive Strategies

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Military strategists have long used simulation to plan campaigns and airlines have long used simulation to polish pilots' skills. Now managers are using simulation to understand and anticipate the dynamics of their competitive strategies. These simulations range from multimillion-dollar formal computer models to brief, informal war games in which teams of managers and consultants play the parts of rivals and customers. In this chapter, the authors discuss the value and uses of simulation to understand the dynamics of competition in their markets and to explore their competitive-strategy options.

When the astronauts of Apollo 13 were making their perilous voyage home in their damaged capsule, mission control placed an astronaut on the ground into a flight simulator to work out the delicate maneuvers needed to return the mission safely to Earth. The controllers in Houston had to balance and assess many complicated issues and options, and they knew they had only one chance to get it right. They knew there was no substitute for experience, but, as the sage said, "experience is a hard teacher because she gives the test first, the lesson afterward." The astronaut in the simulator gave them the experience they needed to make their tough decisions *before* they risked the lives of those in the real capsule.

Managers are often in a similar situation. They may have only one shot at launching a new product or making another competitive move. They have some sense of how competitors may react to their strategies but often have not worked out the complex "chess game" of competitive interactions. Usually, managers think only one move in advance, if that. But it is the combination of a whole series of moves and countermoves that determines the outcome of the game. They need to be able to think like chess champion Bobby Fischer, who is reputed to have planned *11* moves ahead in a game.

Competitive simulations offer managers a way to gain the experience they need before taking the test. They enable companies to "live through" the competitive consequences of a particular strategy or set of strategic options before committing real money and effort. As competition become more complex — with more potential players and smaller windows of advantage — it becomes increasingly important to make sure a strategy works the first time out of the box. As with the Apollo 13 astronauts, when the "oxygen supply" becomes more constrained, missteps are increasingly dangerous.

This chapter explores simulation in the business world: how it works, what options are available, and how they help strategists make decisions. We examine the benefits of strategy simulations, different types of simulations, when managers should use simulation, and how simulations can be structured. We begin with two examples that illustrate real-life uses of simulations, one to assess the impact of a planned strategy, another to block the strategy of an opponent.

$133 Million Below Expectations: Assessing a Strategy's Long-Term Impact

The Shell Oil Company recently was contemplating a major shift in its strategy in the U.S. market. It was considering building many unstaffed service stations requiring self-service operation. These stations could be set up in numerous new locations, significantly expanding the company's presence and providing the customer with easier access (more availability) and 24-hour service.

In the short run, this expanded presence seemed certain to give Shell a great advantage over its rivals. The move was based on an understanding of the market; many consumers want convenience. But one question worried managers: How would the market and competitors react?

Shell, with the help of a strategy consulting firm, Advanced Competitive Strategies (ACS), customized a version of ACS's competitive-strategy simulator, ValueWar™, to realistically simulate customer response in 10 market segments, as well as the cost structures and other factors influencing the moves of competitors. The result of the simulation was that Shell's move would be very successful…unless competitors chose to respond rather than to sit idly by as Shell captured market share at their expense. The managers' conclusion: Probable success for Shell in the short run (it takes time to react); probable failure in the long run (competitors don't like to lose).

Why would the move fail? Because, Shell managers discovered, the only logical reaction for their competitors would be to match Shell's strategy. Shell's short-term gains would quickly vanish as competitors built their own pumps. Consumer demand would not grow (people don't drive more because there are more gas stations), so the same market would be spread more thinly. Meanwhile, the battling suppliers' fixed-capital costs would increase because of the new pumps. Bottom line: Costs would rise, revenue would not, and profits would suffer.

The simulation did more than give a general sense of competitive reactions; it attached numbers to the result. By not implementing the strategy, the company would have earned a projected $211 million in one geographic market over five years. Implementing the strategy appeared to offer $315 million in additional profits — but after allowing for the likely competitive reaction, Shell would make only $182 million. In other words, rather than adding $104 million in profits, the strategy would ignite a firestorm that would consume $29 million, thus it would come in $133 million below expectations.

Shell decided to back off on the initiative, although currently it is poised to respond quickly if a competitor launches a "pump war." The simulation was able to take the company to this point five years earlier and $133 million more efficiently than actual experience. Shell gained the experience without the expense of taking the test.

Preventive Medicine: Anticipating Competitors' Moves

In addition to assessing the value of managers' own strategies, companies use simulation to anticipate competitors' strategies. For example, Sterling Health Latina, a Mexico City-based unit now part of SmithKline Beecham PLC, discovered that a major competitor was planning to launch a new over-the-counter painkiller in a Latin American market to challenge Sterling's leading brand. Led by Adrián Cruz, senior vice president for Latin America and the Caribbean, Sterling executives and ACS organized a ValueWar "war college" to anticipate the competitor's moves and to develop a defensive — or offensive — strategy of their own.

A team representing the competitor came up with a devastating advertising concept, focusing on the fact that U.S. doctors prescribe the company's painkiller more than any other. The simulation demonstrated that the campaign would undermine Sterling's position in the market.

Having identified a serious threat, Sterling ran additional simulations, during which the Sterling team came up with an antidote: an advertisement touting that Sterling's drug was the most prescribed in the particular market. The simulation showed that the ad, used preemptively, would keep customers loyal. Sterling rolled out the advertisements before the rival's launch, successfully blocking its new product.

Sterling found out later that the rival had, in fact, planned to use the reference to U.S. doctors in its ads, but scrapped the idea when Sterling's preemptive advertising appeared.

Analyzing Competitive Strategies

Managers face a variety of challenges that they can address with simulation or other approaches. Many of these strategic decisions involve big stakes, hard-to-reverse investments, and significant uncertainty, such as:

- How should we position our new product?
- Is this dip in our profits just a little turbulence or the start of a nosedive?
- Should we cut price before our competitors do, or should we react to their moves?
- Will a costly customer-loyalty program help? What if our competitors respond? Will we have gained anything?
- Our smallest competitor was acquired by a big, aggressive firm. What should we expect?
- We hear that a competitor is about to double its advertising. What should we do?
- How do I get my management team to think like strategists?

In answering these questions, managers want to assess how a given strategy might play out in the future. They use approaches ranging from simple trend-line extrapolation and brainstorming to more-complex scenario planning, war games, and computer simulations. These options differ in how they leverage the information and creativity of the organization, as shown in Figure 1.

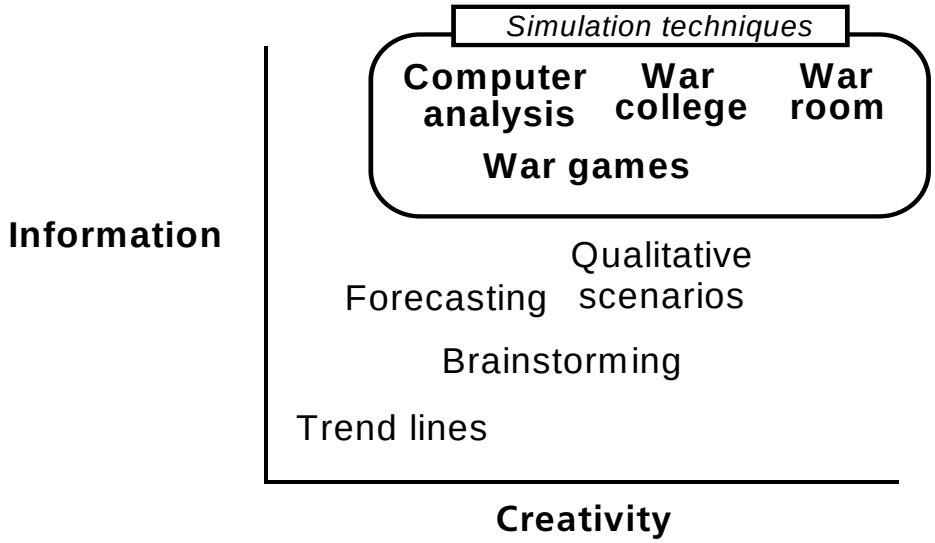

Figure 1: Assessing the Future

Adapted from "Competitive-Strategy Simulation: Using Virtual Competition to Get the Jump on Real Competitors," *Advanced Competitive Strategies White Paper*, 1995.

Each of these approaches has its strengths and weaknesses. *Trend lines* are easy to understand, require little data about the future, and (by definition) reflect real experience. However, extrapolations of the past can inject serious analytic errors if used thoughtlessly, and they encourage neither creative nor critical thinking (e.g., *why* will sales continue to grow at their historical rate?). Simple extrapolations can lead to unrealistic inferences, especially if changes occur (or might occur) in the forces underlying past trends.

Most types of *forecasting*, such as regression and econometric modeling, take into account multiple factors that might influence the dependent measure (future sales, size of market, interest rates, and so on). Forecasting offers a major improvement over trend lines because it may use multiple (and possibly causal) factors. In addition, it allows the user to test the impact of changes in the factors. A drawback, shared with trend lines, is that forecasting methods rely on the premise that historical relationships will hold true in the future. Also, if managers apply forecasting to come up with a single precise number —

that is, if they try to determine what the future *will be* — then they can blind themselves to other possible futures.

Brainstorming can identify important issues and spark creative ideas but offers little opportunity to include detailed data in the process. It is best used to identify the ideas managers need to test. *Qualitative scenario planning* is a more formal and rigorous form of brainstorming. Scenario planning focuses on imagining possible futures and on fleshing them out in sufficient detail to think through what it would feel like to live (and compete) in those futures. It provides internally consistent, high-level views of possible scenarios for the future. However, it does not always capture the impact of competitive dynamics (the give and take of competitive decisions) within these scenarios.

Technology	Example	Major Strengths	Major Weaknesses
Trend lines	Historical analysis	Fast, easy, inexpensive	Assumes the future will look like the past
Forecasting	Econometric models	Quantitative, rigorous	Usually ignores competitive reaction or multiple scenarios for the future
Brainstorming	Idea-generation teams	Fast, easy, creative	Qualitative, judgmental
Qualitative scenario planning	Scenario planning	Creative, can be quantified, proactive	Hard to evaluate desirability of scenarios or test competitive dynamics

Table 1: Non-Simulation Techniques for Analyzing Strategy

Adapted from "Competitive-Strategy Simulation: Using Virtual Competition to Get the Jump on Real Competitors," *Advanced Competitive Strategies White Paper*, 1995.

Strategy simulations can incorporate insights from brainstorming, forecasting, scenario planning, and other non-simulation approaches. The resulting model of competition, a simulation of competitive reality, can then test specific strategy options, including competitors' counterstrategies.

What is a Simulation? From the Game Room to the Boardroom

What is a simulation? Formally defined, a simulation is a facsimile of reality. It is intended to display what would transpire if the assumed conditions occur in reality.

Simulation has long been used in many areas of life. The US military simulates warfare to evaluate strategies before committing soldiers' lives. Lawyers simulate the courtroom with mock trials so they can

test how their prosecution or defense might work and to find weaknesses in the opposition's case. Pilots practice in flight simulators.

Simulations in video games such as SimCity, Doom, Mortal Kombat, and Joe Montana Football allow participants to engage in activities that would not be possible (or advisable) in real life. They allow them to risk virtual life and limb, to build a city in a short period of time, and to test different strategies for offense or defense in the major leagues.

Among the most-popular simulations on the market today are flight simulators. Why are they so popular? Partly because they allow amateurs to satisfy their instinctive craving to fly under the Golden Gate Bridge or to buzz the occupants of the Sears Tower. Perhaps more important, flight simulators give players — and real pilots — the chance to experience something far too risky to do in real life.

Try this experiment: Ask a group of people with access to computers whether they have ever used a flight simulator; many or most will answer yes. Then ask them if they've ever crashed in the simulator. Those who have "flown" will also have "crashed" (it turns out there's not much room between the bridge and the bay). Then be thankful that real pilots learn how to deal with dangerous situations in their simulators, rather than waiting for a real emergency to pop up at 30,000 real feet.

Managers are often criticized for being too conservative, for being unwilling to do something risky. Well, perhaps they're being rational: they don't want to risk adopting a strategy that only *might* fly high. In these days of "accountability," they can't afford the possibility that they could actually "crash and burn." Simulation offers them an opportunity they don't get in real life: to try different approaches, and to crash a few times, as they build the skills to reach loftier heights.

Competitive-Strategy Simulation

The use of simulation has only recently become feasible and acceptable in business. As shown by the examples that opened this chapter, simulations offer a powerful way to think through and develop strategies. Competitive-strategy simulations include war games and war colleges, test marketing, and computer analysis. A variety of consulting companies have developed competitive simulations for commercial applications, including Advanced Competitive Strategies, Arthur D. Little, Booz Allen, Mantis, Mercer, and Monitor. Simulation has been a growing business for all of these firms.

Managers can use simulations for rehearsing a specific strategy or for exploring multiple strategy options.

Rehearsal simulations move through progressive quarters of competition with teams representing the home company and various competitors. Most competitive-strategy war games fall into this category. Conceptually, managers in such war games are like actors who hold dress rehearsals to simulate the actual production. The rehearsal simulation provides two key benefits: It raises familiarity and confidence with the situation, and it uncovers snags or bugs before going public.

War games use teams of managers to represent the home company and its rivals, and sometimes a control team represents other players such as regulators. A market team or a computer model assesses demand, sales, and market shares; financial feedback comes from anything from a simple spreadsheet to a rigorous model, showing teams the profit-and-loss impact of their moves. The teams use this feedback to determine their moves for their next decision (usually the next quarter). The game usually lasts for several days.

Because rehearsal simulations can take a day or more to simulate competition for a 5- or 10-year horizon, managers have little opportunity to "roll back the clock" and try different approaches. However, the detail possible in these rehearsals helps managers uncover pitfalls and unexpected problems in implementing a strategy. Rehearsal-style simulations can help managers make go/no-go decisions, and they can help them assess how a market might evolve, thereby allowing them to develop plans to support or defend desired outcomes. Rehearsal simulations are less useful for testing multiple strategies or for experimenting to formulate a new strategy.

Test marketing is another form of rehearsal simulation. Consumer package-goods businesses consider it de rigueur to conduct test markets prior to actually introducing a product to a larger market. In general, running a test market means selecting a limited geography, introducing the product there, and observing the results. If results are sufficiently attractive, managers roll out the product to the broader market.

Marketers sometimes run test markets simultaneously in several communities to avoid being led astray by the idiosyncrasies of a particular market. This practice improves the quality of decisions and sometimes saves time, but it also obviously raises costs. In another test-market variant, marketers test multiple ways to go to market. This version gives marketers more than just a go/no-go decision; instead, they can choose from a set of alternatives.[1]

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[1] Simulated test markets offer a twist on the traditional test market. In a simulated test market, the researcher constructs a simulated (artificial) store, places products on a shelf, brings in respondents, and asks those respondents to select products. This simulation of the shopping experience offers major advantages over traditional test markets, such as testing a wider variety or number of alternative products, revealing less information to competitors, costing less, providing results more quickly, and being much easier to implement.

Exploration simulations, in contrast to rehearsals, can be run repeatedly using different strategies or different starting assumptions. They enable managers to test diverse strategies and to develop new strategies. These simulations generally use a computer model to calculate the results of moves managers nominate. First, managers select an existing model or build a new one; next, they gather data and assumptions to put into the model; finally, they use the simulation to test a wide range of competitive strategies and dynamics over time. The key is the interplay between managers and the model: They use their insights and creativity to think of strategies, then use the simulator to do the (generally complex) math, then revise their strategies based on the model's feedback; and they go through that process as often as desired.

Managers can use conjoint analysis to experiment with different product attributes in the face of competitive reactions, and so it is a form of exploration simulation. The conjoint simulation leads to an optimal set of product characteristics, given likely responses by rivals. It doesn't take much of a conceptual leap to extend simulations beyond product attributes to include other competitive factors such as competitive position, market characteristics, loyalty and switching costs, and cost structures. Some competitive-strategy simulators do exactly that in a "war college."

The war college is a new technique that's proving very useful in conducting exploration simulations. In a sense, the war college is to exploration simulations what the war game is to rehearsal simulations.

As in a war game, the war college splits managers into teams to role-play competitors. Unlike the war game, however, the teams in a war college do not come up with a single strategy for a given quarter. Instead, each team actively and repeatedly experiments with a variety of different strategy approaches. These strategy alternatives, as well as those of rival teams, are entered into a computer model, so the teams receive direct feedback on the results of their strategies. Where war games focus on rehearsing strategy, the war college (as its name suggests) is concerned with learning, as each team experiments with various strategies to develop better alternatives. Managers in the Shell and Sterling cases discussed earlier used war colleges in their simulations.

Another new technique that extends the usefulness of the simulation over time is the "war room." The war room, in this instance, is more than a room where companies store data and gather for debates as they track their rivals' moves. It is, instead, a place where teams of managers in the organization can come together periodically (or as needed, as real-time events demand) to engage in an ongoing simulation. Each simulation builds on the insights gained from the previous one and on regularly updated data. Thus, managers' knowledge about competitors and the impact of various strategies accumulates over time. In addition, the war room becomes a learning environment for managers new to the business.

Some companies further extend the robustness of their simulations by engaging in simultaneous simulations. They create two or more "parallel universes" of competitors. Groups of managers in Universe A play the company and the different competitors. A separate group of managers creates companies in a parallel Universe B. Often, the home team in Universe A finds a good strategy, only to discover that the home team in Universe B has created a strategy that leads to significantly different results. These experiences help managers look beyond existing paradigms and demonstrate that there are no absolutes in strategy or simulation. There are bad options, there are good options, and then there are even better ones.

When to Simulate?

When should managers consider simulation rather than simpler alternatives? In general, it makes sense to simulate when the decision maker must choose among numerous alternatives and when it is not clear which alternative would yield the best results.[2] Simulations that can rapidly test many dissimilar alternatives can help a great deal. This is particularly true when the situation is very complex, when the problem is unfamiliar, or when the cost of errors is very high. We will now examine each of these situations.

Complex Situations. It may seem counterintuitive that simulation could help in complex situations; after all, if the situation is so complex, doesn't that make it especially hard to simulate? Yes, especially if the decision makers must invent a new model for their situation. (Well-established simulators have encountered many complex situations and are often able to analyze them thoroughly.) Nonetheless, simulation can help in complex situations by clarifying the problem and rigorously analyzing each component. In addition, personal intuition, experience, and assessment are *least* reliable precisely when the situation is complex, which means that the alternative to simulation is less attractive.

Unfamiliar Problems. Simulation can also add value when the problem is unfamiliar to the decision maker or when the relationship among different components of the problem is unfamiliar. For example,

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[2] Our experience, not as good as data but better than just haphazard anecdotes, has convinced us that people are often more certain of the correctness of their favorite alternatives than they should be. For example, managers usually assume that businesses with heavy fixed costs should cut their prices to maximize volume, which they believe in turn will boost profits. In fact, many such businesses would benefit more from higher prices (obviously depending on the price elasticity), even if volume suffers, if they want profits. Experiment with a simple spreadsheet and you'll see.

J. Edward Russo and Paul J.H. Schoemaker discuss overconfidence in their book *Decision Traps: The Ten Barriers to Brilliant Decision-Making and How to Overcome Them* (Simon and Schuster, 1989), especially pages 70-80.

imagine competing in one of the many markets in which the "rules of the game" are changing due to shifting technology or regulations. Such industries— including telecommunications, electric utilities, consumer retailing, and pharmaceuticals—are among the heaviest users of competitive-strategy simulation.

High Cost of Errors. Finally, simulation can add value when the cost of errors is very high. When making high-stakes decisions, managers understandably retreat to very conservative behavior and avoid anything other than the tried and (presumably) true. Of course, this "safe" position may forgo tremendous benefits of more aggressive action, and it may be inappropriate if the environment has changed. "Conservative" action may even be the riskiest course. Is it safe for managers to "wait and see" or to act timidly when a competitor starts to gobble their market share? Perhaps, but not often. On the other hand, the urge to act decisively should *not* mean flailing away in panic or with ill-considered knee-jerk reactions. The ability to test a variety of options in a simulated environment, where the cost of making mistakes is very low, is obviously quite an advantage.

How to Simulate?

Some simulations operate entirely through human interactions. Others run unattended on computers. And some combine humans and computers.

Human simulations take relatively little time to set up and run (although they can still require extensive research). They may also capture the "chemistry" of the interactions among managers. However, purely human simulations cannot work well with quantitative data.

Simple computer simulations running on "autopilot" may oversimplify a competitive situation, while complex computer models are often time-consuming and expensive to create (especially if they're developed from scratch). However, the computer has an important advantage over human simulations: rapid what-if testing. Once information is in place, it becomes relatively easy to change one or more parameters. With this capability, managers can examine hundreds (or hundreds of thousands) of different possible scenarios played through years of competitive interactions. They can also back up to a given point and reevaluate a single decision. Because the computer can keep track of more data points and individual assumptions than a human could master, managers can ensure that assumptions are made explicit and are tested thoroughly.

Some simulations combine human and computer capabilities to reflect judgment and creativity as well as computational power. The Shell and Sterling cases described both worked in this fashion. They had teams of managers develop candidate competitive strategies that then served as input to a computer

simulator, which handled the number crunching. Data for "calibrating" the simulator came from company data, surveys, and managers' judgment. This method — combining people and computers — works well for competitive strategy because strategy issues inherently involve both numbers and human behavior.

Benefits of Competitive Simulation

In deciding whether to use simulation, managers should consider the following benefits:

1. *It provides time to prepare and act.* Simulations accelerate time, compressing years into minutes or days. With simulation, managers can see what the future might look like before it happens, and with that foresight, they can prepare for it.
2. *It doesn't hurt.* Managers can get the gain without the pain. Because it is all simulated, large losses of profits and market share are not real. (Of course, managers can't take large gains to the bank either.)
3. *It promotes creativity.* With risks removed, managers can experiment with how they might behave in unsafe, unpleasant, unexpected, or unconventional situations. As with flight simulators, they can make the daring move that would be too risky in real life, but that just might work out.
4. *It's experimental*. Simulating competitive strategies makes it possible to test options in light of the strategies that competitors might adopt. Thus, although simulation doesn't tell managers what *will* happen, it helps them explore what *may* happen. In addition, by learning what has to happen to make a strategy work, they can develop contingency plans so that they can switch gears quickly, decisively, and only if really necessary. Simulation helps managers discover whether a strategy dominates (that is, whether it is always the best option) across a range of possible competitive scenarios.
5. *It's experiential*. The process of creating and implementing simulations gives managers hands-on insights. Beyond the results, the process of creating and implementing a simulation is an education for the managers.
6. *It helps managers think like their competitors*. War games, war colleges, and other simulations don't just ask managers to anticipate their competitors' moves; they ask managers to *be* their competitors. These simulations give the managers and the company fresh insights into how their rivals think.
7. *It's rigorous.* The simulation process captures and codifies the accumulated wisdom of the organization (which is usually more than managers think at first). It also forces managers to make their assumptions explicit. The simulation creates and applies a repository of competitive and market information.
8. *It's unifying.* Managers develop a common view of their competitive situation, a shared language for strategy, and consensus around the strategy they select.
9. *It's private*. Unlike test marketing, simulation occurs in the privacy of the company, allowing managers to test new ideas without tipping their hand.
10. *It's useful.* Simulation facilitates generating and selecting a competitive strategy.

Changing Perspectives of Managers

One of the most powerful benefits of simulation is that it changes the managers who participate. Going through a simulation changes how managers view their companies and their rivals. Simulation has the power to shock and enlighten managers in ways that detailed discussions or drawn-out analyses cannot match. Simulation gives managers a visceral feel for the impact of their strategies as well as the impact of their competitors' strategies. Here are some examples drawn from our experience:

- **Visiting the Ghost of Profits Future:** Managers often become fixated on an approach to strategy. They usually don't change their approach until the company is in trouble. Like Scrooge in *A Christmas Carol,* managers can experience the future via simulation and still wake up in time to change their actions the next day. For example, the vice president of a company convened a war college to find a way to resurrect dismal profits. The firm's product had become a commodity business, managers insisted, and declining prices meant that the company would lose a projected $500 million over the next five years. Could the company differentiate itself to break this cycle? Impossible, said the managers, but they had a better solution. They would cut costs. The new strategy was put into the simulator immediately. The projected result: They would lose *only* $450 million. The model demonstrated that managers' habit of competing on price would lead them to pass the cost savings along to customers. This outcome was a shock, and convinced the managers that they had to do something more creative. By the end of the war college, they had filled a wall with ideas for differentiating their products. They implemented their ideas in real life…and began making money.

- **Clearing the Rose-Colored Glasses:** Managers tend to paint too optimistic a view of the future; simulation can provide a much-needed reality check. For example, during simulations teams of managers usually develop strategies for their company and its competitors. We often ask each team independently what share of the market it expects to capture. Summing the independent estimates usually produces a total well over 100 percent, which means that some or all of these rivals will be disappointed. Independent estimates may imply 123 percent share, but simulation forces internal consistency. By capturing all the known information in one coherent system, the simulation helps impose discipline on the strategy-development process.

- **Thinking Long-Term:** In another war college, a group of managers representing a rival company had developed a specific strategy. For six consecutive quarters, the managers watched their profits fall. For six quarters, this team resisted pressure to shift its strategy, but finally it gave up and changed course. The next quarter, profits went up, and they continued to rise for the rest of the five-year horizon. The managers were understandably pleased; they had turned the situation around. But what would have happened if they had held the course with their original strategy? In a few minutes, they found that profits would have turned around at the same time, and by the end of the simulation they would have made *twice as much* as they would have under their revised strategy. Simulation can help indicate when it might be judicious to hold the course, despite short-term profit pressures, and it can test whether a "fix" will really make matters better. Otherwise, how do manager know when they are sliding down a long-term decline or just about to turn around?

Obstacles to Simulations

With all these benefits, why don't more companies use simulation? We think there are several reasons:

- They are hard to build, as we know from our own and others' experience. For example, they should take into account processes such as customer purchase decisions and competitive dynamics, but those processes are hard to model.
- Because they are hard to build, they can be expensive to build. Computing power — that is, computer hardware and MIPS — is now almost free, but developing a realistic simulation can cost a great deal of time and money.
- They require new paradigms and analyses. For example, financial extrapolations and accounting rules don't work well in strategy simulation (or in real life), but they're hard to dislodge from conventional wisdom.
- Relatively few strategists know that they're possible (and that they work), so there's little explicit demand.
- Software developers usually aren't experts at competitive strategy and competitive strategists usually aren't experts at software development. Or perhaps both developers and strategists see better job opportunities elsewhere.
- Some managers distrust the "answers" that they think computers will "give" them (which is not how most simulations work).
- Managers don't have enough hard data, and they worry about GIGO (garbage in, garbage out).

Cost issues are probably not to blame. As the Shell case demonstrates, simulations can produce enormous returns on investment because they affect competitive strategy, the highest-leverage decisions the firm has to make.

Maybe the fear of GIGO scares managers away from simulation. They apparently worry that using judgment and estimates instead of hard data will compromise the simulation's analysis. Unfortunately, there is no such thing as *data* about the future; the future hasn't happened yet. By the time data are available, it's too late. Meanwhile, managers must make decisions. They need to get comfortable with using the best information available — which may be judgments and estimates — to make the best decisions possible when the decisions need to be made.[3]

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[3] Some forms of simulation support sensitivity analysis, which can relieve some of the anxiety over GIGO. When one or more numbers seem prohibitively soft, sensitivity analysis can test whether the *decision* depends on getting better accuracy. For example, perhaps managers don't know whether a market will grow at 5% or 10% over the next few years. They can run the simulation at 5% growth and at 10% growth, and see if they should change their strategy. If so, they've learned that they should develop contingency plans or that they should invest in better research or forecasts of market growth. (The simulation

Whatever the cause(s) of the slow spread of simulations, the effect is that many more managers have experienced flight simulators than strategy simulations, even though they are far more likely to be engaged in shaping strategy than in flying planes. We expect that situation to change.

How to Develop and Apply a Simulation

What are the stages companies need to go through to develop an effective simulation? There are many ways to develop simulations, but the following is a typical approach that highlights some of the key stages of building and running a simulation. It is drawn from a simulation developed by ACS for a major airline.

1. Specify the Domain

The first step is to determine the specific market to model. Managers should simulate strategy on a market-by-market basis, since the set of competitors and customer demand and sensitivities differ significantly by market. In the airline simulation, the model was constructed on a route-by-route basis. A highly contested market was selected: the Detroit-Chicago route. The competitors were American Airlines, Midway Airlines, Northwest Airlines, Southwest Airlines, and United Airlines. The airline simulation modeled business and leisure travel separately because business and leisure travelers differ greatly on needs, prices paid, price sensitivity, and more.

2. Identify the Relevant Data

The next step is to determine what factors the simulation would have to use to model the positions and capabilities for each of the competitors. These data may include competitors' market shares, variable and fixed costs, capacities, the costs of and trigger levels for adding more capacity, time requirements for adding capacity, current price levels, market-perceived quality levels, awareness levels, and other factors. Table 2, showing some of the factors in ValueWar simulations, illustrates the wide range of possible factors that simulations can use.

Managers may want to use certain factors for which they lack data. They must decide whether to use only those factors for which they can obtain "objective" data, or whether to use the best information they *can* get so as to use the factors they consider relevant.

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results can even help calculate how much they should be willing to pay for that information.) If not, they've learned that they don't need better data on market growth; they can proceed with their strategy.

In the airline case, much of the data were readily available from public information. For example, airlines publish their flight schedules along with the type of aircraft, thereby providing the data for the capacity levels. Other data were reported to the FAA and thus were easily retrievable. (Obviously, many other industries would not have the public-domain data that exist in the airline industry.) For other inputs, it was necessary to turn to data that had been gathered by one of the competitors based on customer surveys, such as market-perceived quality levels and awareness.

When they cannot obtain objective data, managers should use the best assumptions available to them. Relying on assumptions is often a sticky issue since almost everyone feels uncomfortable using "soft" data (see the previous discussion of GIGO). The alternative, however, is to ignore the factors for which assumptions would be required. Doing so doesn't take advantage of what knowledge of the market managers do have, however imperfect. More important, it implicitly, indiscriminately, and almost certainly incorrectly attributes capabilities to all competitors.

For example, suppose the firm does not know what level of awareness each of its competitors enjoys, and so it deletes the awareness factor from its simulation model. That deletion is equivalent to assuming that each competitor has 100% awareness and that none is limited by awareness in its access to the market. That assumption would do no harm if 100% awareness were as good as any other assumption, but omitting this factor from the model simply because the answer is not precisely known hides an important underlying assumption. Hidden assumptions make it hard for others to question (and learn from) the data and to modify the input as better information becomes available.

Making uncertain factors explicit highlights candidates for sensitivity analysis. Perhaps managers "guesstimated" an airline's awareness at 80%. Would their strategy decision change if awareness levels were 50% or 95%? The numerical results will almost certainly change as the assumption about awareness changes, but managers need to know whether different levels of awareness should cause them to *act* differently.

Category	**Representative Factors**
Competitive Position (for each competitor)	• Perceived attribute levels (market-perceived quality (MPQ) ratings) • Price and perceived price • Market share, sales

Category	Representative Factors
Customer Preferences (by segment)	• Attribute (MPQ purchase criteria) importances/utilities/partworths • Evolution in customer preferences • Sensitivity to price and MPQ
Market Characteristics (by segment)	• Growth rate, cycles, and seasonality • Demand elasticities • Time to perceive and act on competitors' moves
Competitors' Access to Customers (for each competitor, by segment)	• Awareness and consideration • Distribution • Suitability of product or service
Loyalty and Switching Costs (by segment)	• Customer loyalty • Disloyalty • Trends over time
Cost Structures (for each competitor)	• Fixed, variable, and capacity costs • Cost changes over time (e.g., productivity) • Costs of changing perceived attribute levels (levels of MPQ)
Competitors' Capabilities (for each competitor)	• Rates of and limits to change in perceived attribute levels (levels of MPQ) and price • Frequency of changes • Time to perceive competitors' moves and to act

Table 2: Representative factors used in simulations

Factors included in ValueWar simulations. Adapted from "Competitive-Strategy Simulation: Using Virtual Competition to Get the Jump on Real Competitors," *Advanced Competitive Strategies White Paper,* 1995.

3. Specify the Market-Response Model

Perhaps the most difficult task in developing a competitive-strategy simulation is specifying the market-response model. The model should capture the underlying drivers of the market; it should describe

how the market demand (and the corresponding market shares) will be allocated to the different participants in the market.

One common way to determine the market-response model is to estimate it based on historical information. With a long enough time series, it would be possible to estimate the necessary response parameters. Note, though, that this approach makes a critical assumption: that the drivers of the past will also drive the future. Model builders can, of course, override this assumption with their judgment of what they believe will be the trends in the future.

The historical-data approach makes another, more subtle assumption, perhaps best described by example. Imagine that competitors in a market have always moved their prices in lockstep. What, then, would be the effect on demand of charging a price higher or lower than competitors in the future? If that event has not occurred in the past, then the future effect *cannot* be revealed by statistical analysis of historical data. Managers *must* make an assumption.

Finally, historical data may confound effects of multiple factors that, at least in the past, happened to move together. For example, if businesses in a market tended to cut prices in times of slow growth, then the historical effect of price changes would be entangled with the effect of slow growth. What would happen if a business cut its price during fast growth? It may be hard to tell.

A better approach may be to use the market-response model as a starting point for sensitivity analysis. That is, managers could estimate the historical market-response model, modified perhaps for the reasons just described, and then simulate what would happen if, for example, the market were (or were to become) more or less price-sensitive. If a simulation leads managers to the same conclusions regardless of the level of price sensitivity, then they have learned something: They don't have to worry about price sensitivity. (In decision-analysis terms, they have found that the value of information regarding price sensitivity is zero.) On the other hand, if they find out that their best future actions change depending on price sensitivity, then they have learned something else: They had better do more-rigorous analysis of price sensitivity, or at least monitor it so they can change course if it shifts.

Unfortunately, often the historical information required to estimate the market-response model is not available. Under those circumstances, managers must gather the underlying data in other ways. Managers can use survey data (perhaps from conjoint analysis) or develop thoughtful judgments. In either case, it is prudent to contrast information with historical patterns and to run sensitivity analyses like those described.

In the airline simulation of the Chicago-Detroit market, managers felt there were two major segments and it would be best to specify two separate market-response functions. These two segments were the

business and pleasure travelers, with the former caring more about quality[4] than price and the latter the reverse. It was also necessary to specify the costs associated with increasing or decreasing the market's perceived quality (for each component of quality; e.g., in-flight service, scheduling, on-time service, etc.) of each airline.

4. Input the Data

Once they've identified the relevant factors, defined the model, and gathered data on the factors (including estimates and assumptions), managers must get the data into the model.

The first step includes the physical process of typing, scanning, or electronically transferring the numbers into the simulator. In addition, the user might have to adapt numbers to specific scales, translate financial data from different countries into a single currency, or adjust data to remove the effects of inflation.

But entering the numbers is not enough. Managers should perform validity and "sanity" checks on the data before running large-scale, high-visibility, big-impact simulations.

Validity checks ensure that the data are "legal." For example, sales and market-share data should never be negative; market-growth rates should not lead to absurdly large or small markets; financial data should add up (e.g., sales minus costs should equal profits).

"Sanity" checks require some judgment. They might involve running several simple simulations to see if the results make sense. Although this step might seem to incur a cost, it actually confers a benefit: It shows how the data work as a system, which often surfaces inconsistencies in data and assumptions that managers need to resolve. What if pursuing the current strategic course seems certain to lead to ruin? Such results should lead managers to question their inputs: then, if the inputs prove solid, managers have received their first insights from the simulation.

In the airline case, managers easily ensured the validity of the data, then proceeded to sanity checks. Given how customers perceived the airlines, did the market-share projections make sense? The people working on the simulation made sure that if the airlines made no changes in their prices or their market-

[4] Remember that "quality" means perceived attribute levels, combined into a measure of market-perceived quality (MPQ). One of the airlines in the market gathered survey data on what attributes travelers use to decide on an airline (by segment) and how important they considered each of those attributes (also by segment). In this case, MPQ included attributes such as on-time service, convenience of schedule, safety, and in-flight service, that travelers use to select an airline. The simulation also included passengers' perceptual ratings on those attributes of the airlines competing on the Detroit-Chicago route.

perceived quality, then market share should shift over time toward the airlines offering high value and away from the airlines offering poor value.

5. Decide How to Handle Uncertainty

Managers will rarely feel completely confident that their input data are correct. (It's probably safe to say that if they are sure they are right, they are probably wrong. Nothing personal; it's just that most people tend to overestimate the accuracy of their data or estimates.) Simulation models can deal with uncertainty in two ways.

A *deterministic* model handles uncertainty as changes in the input data. Managers can run the model with different values for the input data, but each time they run a particular combination of inputs they will always get the same output. To observe the effects of uncertainty, they can change the input data, run the model, observe the results, and then repeat with different values for the input data. They may have to run each iteration by hand, or may be able to set up "batch" runs with appropriate ranges of input data.

A *stochastic* model directly associates uncertainty with the input data, selecting different values (within specific ranges) each time managers run a simulation. Thus, the simulation's output will be different in each run, and managers run the model repeatedly — perhaps many thousands of times — to see not only the most-likely outcome but also the variation in outcomes.

Whatever the structure of the model they build or buy, managers can and generally should run multiple simulations to analyze the effects of uncertainty on their decisions. For example, in building the market response model, they could specify different relationships between competitors' marketing actions and the sales they generate. Then managers would run the simulation repeatedly, randomly sampling from the distribution of the parameter estimates (i.e., the distribution of relationships between actions and sales). The output of this process, called Monte Carlo simulation, would show the likelihood of the alternative results that could occur.

Given that the quality of the input data varies significantly, this approach offers one way to account for the differing levels of certainty in the data. For example, it can reveal whether an attractive strategy has a significant possibility of turning into a disaster under some circumstances.

Of course, the downside of developing a Monte Carlo simulation is that it increases the data and analytic demands. Managers must not only determine a best guess for each factor in the model but also specify a level of uncertainty around those best-guess numbers.[5]

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[5] When simulation inputs are estimated from historical data, the statistical analysis leading to parameter estimates automatically includes uncertainty. However, this uncertainty refers to the confidence

6. Develop Strategy Options to Test

Once the model and data are in place, the next challenge is to develop the specific strategies to test in the simulation. The most common way to develop those strategies is to set up teams of managers who role-play the home company and its rivals. These managers develop initial strategies and then revise them based on feedback from the market during the simulation. They can derive strategies from competitors' actual planned strategies (as in the Sterling case) or from the planned strategies of the home company. The starting strategies can be an input to the process or they can be developed during a war-game or war-college program.

The objective of developing these strategy options is not to find "bad" strategies for competitors. It's easy to beat paper-tiger competitors by forcing them to follow a stupid or complacent strategy, but that's neither realistic nor helpful. True competitors often compete vigorously and tenaciously. It's important to explore the strategies that competitors actually may adopt in real life.

Similarly, the objective is not to find "good" strategies if those strategies cannot be implemented. What good is it to discover that unprecedented improvements in perceived quality, coupled with simultaneous and similarly unprecedented reductions in costs, produce better profits? Managers should try to develop realistic strategies, including "stretch" goals, but be wary of overly optimistic strategies that won't come true and that will discredit the strategy-development process.

It helps to populate the firm's home team *and* the competitors' teams with comparably skilled managers. (In other words, don't stack the deck by putting the best people on the home team.) Give all the teams incentives to try to win, and make sure the teams define "winning" as the real-life competitors do. The best results come from competing against worthy adversaries, not against pushovers.

7. Analyze Simulated Outcomes and Track Real Outcomes

Quantitative simulations can display outcomes not only at the end of the time horizon but also at points along the way. Managers can use this capability to further analyze their strategies and to develop implementation road maps. Further analysis can address concerns such as short-term sacrifices for long-term gains, the robustness of strategy options, and contingency planning. Implementation road maps can help with internal management, performance monitoring, and decisions to switch strategies.

(or lack thereof) that the parameter estimate is correct *given* the historical data. Unrepresentative or constrained historical data has a kind of hidden uncertainty. For example, if one gathers market data from a brief period of stable and steady growth, then one will not observe the uncertainty in market growth rates that could come from future changes in the economic climate.

Analysis: Short- vs. long-term. All else being equal, managers will obviously prefer a strategy with a higher expected outcome than one with a lower expected outcome. But all else is not always equal. For example, what if the strategy with the highest market share after five years involves seriously negative profits for the next two years? Such a pill might be too bitter to swallow, especially if the future benefit looks too distant or uncertain. Check intermediate-term results and examine multiple measures of success before adopting a strategy.

Analysis: Robustness. The sensitivity-analysis techniques described can also provide valuable insights before selecting a strategy. Perhaps the most likely outcome of a strategy looks attractive, but it carries volatility or downside risk that the firm cannot tolerate. Managers might prefer a strategy whose most likely outcome is slightly worse if it is less vulnerable to external events or to internal hiccups. A strategy that's relatively insensitive to other forces — that is, a strategy whose outcome is primarily under the firm's control — is called a "robust" strategy.[6]

Analysis: Contingency planning. Managers may discover during a war college or sensitivity analysis that their strategy works beautifully if (for example) a key competitor focuses its product line on new features, but that the strategy flops if the competitor emphasizes image and service. If managers reach such a conclusion, they should explore different strategy options in case the competitor takes the latter tack. They can then develop a contingency plan: Do strategy A if the competitor works on new features, and do strategy B if it promotes image and service. Contingency plans need to link tightly to decisions to switch strategies, as described next.

Implementation: Internal management. The simulation should show not just outcomes (market share, profits, and so on) but also what has to happen to make those outcomes come true. Many of those have-to-happen events refer to actions that the business takes. For example, perhaps the simulated strategy involves improving market-perceived quality on reliability from a rating (by the market) of 55 to 80 within 2 years. That part of the strategy then should translate into action for those parts of the organization that affect reliability and market perceptions of reliability. The results also have implications for performance monitoring, as described next.

Implementation: Performance monitoring. In the preceding example, the strategy calls for a significant improvement in the firm's market ratings on reliability. For the quickest feedback on whether

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[6] We tried to find a good adjective to describe the opposite, that is, a strategy whose outcome depends a great deal on forces outside its control. The thesaurus gave us words such as frail, shaky, weak, infirm, and even wishy-washy. The best we found was "fragile". We leave finding a better adjective as an exercise for the reader.

the strategy is on course, the firm can periodically measure market perceptions of its reliability. If managers find that market ratings lag behind their expectations, then they know they must take remedial action or adjust their strategy and expectations. Monitoring leading indicators in this way provides two big advantages over just monitoring outcomes (market share, profits, and so on): first, managers see whether they are on track early, rather than late; second, they see *what* is going right or wrong, which helps to direct corrective measures.

Implementation: Decisions to switch strategies. Suppose managers have developed contingency plans to identify under which circumstances they need to shift strategies. They need to know if those circumstances come to pass. They should set up market- and competitive-intelligence operations to monitor those key events[7]. After all, it doesn't do any good to have contingency plans if no one tracks the triggers that would demand a change in course.

8. Ongoing Strategy and the "War Room"

As discussed, companies are starting to couple competitive-strategy "war rooms" with strategy simulators. Managers use the war room as a place to collect up-to-date market and competitive intelligence that they then analyze through simulation. This approach helps them react quickly and appropriately to changes in their competitive environment. Equally important, it helps them know when *not* to react. Managers naturally want to *do* something when confronted with a change or event — they feel that they're not "managing" if they don't act — and so the ability to quickly analyze the incoming intelligence can prevent wasting effort or even making a situation worse.

Managers should consider the possibility of creating such a war room as they design or select a strategy simulator. Using or building a simulation that's narrowly focused on a specific strategy decision may be efficient, but it may be unable to handle an unexpected event. For example, imagine that a company has built a custom simulation to test the impact of pricing moves against its current competitors and their existing product lines. That simulation won't help much if a competitor exits the market, if a new competitor enters the market, or if a competitor changes its product line, or even if the firm itself scores a new-product breakthrough.

A simulation better suited to the war room would have the flexibility to adapt rapidly to internal and external events. Look for (or build in) a broad, structured framework designed to accept new data easily and to analyze what-if questions quickly.

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[7] Note that those events might be internal to the business. For example, managers may wish to switch to a more-aggressive strategy if an R&D project achieves a breakthrough.

9. Teaching Strategy, and the Selected Strategy, to the Organization

The impact of the simulation doesn't end with the close of the formal simulation. Managers can apply the simulation in two more ways after they have completed their strategy development.

First, they can make it part of the firm's management-development programs. Simulation works well at enlivening the educational process and at engaging people from a variety of functional backgrounds. Further, it helps them better understand how their market behaves.

Second, managers can use the simulation to communicate their selected strategy and to convince people that it's the right way to go. Letting colleagues go through a similar (or abbreviated) war college can be more persuasive than simply announcing that everyone must immediately and fondly embrace the new strategy. For example, one company embedded simulation results into an interactive presentation that individual managers could run to test their strategy skills against the selected strategy.

Conclusion: Decisions, Not Precision

Simulation can play a powerful role in developing and analyzing competitive-strategy options. Using simulation, managers have developed successful strategies, anticipated events that later occurred in real life, and learned about strategy, and their own businesses, at each step of the simulation process.

On the other hand, sometimes managers spin their wheels in a well-intentioned quest for precision. Such efforts are inevitably doomed to fail for two reasons. One: too many things can go off in wildly different directions (which is why exploring different scenarios is vital). Two: there is no such thing as *data* about the future that managers can use as input to their simulations.

The key to using simulation effectively is to focus on exploring options to find the best strategy for the possible multiple futures and the various competitive dynamics that affect them. The result is *better competitive-strategy decisions*. And, as a side benefit, the simulation process creates better strategists.

After participating in a war college, Barbara McCloskey, Manager of Leisure Strategy at British Airways, summarized the major benefits of simulation: "There's huge value in being able to test your assumptions and your customers' perceptions of you before you put your strategy into place. You see things you normally don't even recognize because they are so pervasive. Plus, the work you go through in building the model is like a master's-level course in your own business."

Simulations can take some of the "luck" out of formulating successful strategy. They give managers something that athletes have always had: the ability to practice before facing actual competitors. To paraphrase golfing great Gary Player: "The more I practice, the luckier I get."

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