Simulation-Based Complexity Management

Manage complexity, reduce risks and increase earnings by 3 to 5 percentage points

In an age of paradigm shifts, the degree of complexity in and around companies is increasing dramatically, driven by massive data flows, global networking and constant market fluctuations. Yet all too many companies continue to make strategic business decisions based on experience, intuition and "gut feelings." Such decisions can result in lost earnings potential, unmanageable complexity and unnecessary risks. Using a holistic simulation-based approach, companies can predict the longer-term impact of every business decision.

With simulation-based technologies, companies that model the potential outcome of their strategic business decisions can potentially increase EBIT by 3 to 5 percentage points.

Our collective knowledge doubles in volume every 15 years. The processing capacity of computers also doubles at regular intervals—roughly every two years. It is estimated that by 2050 a $1,000 computer will have more computing power than all of mankind. As data volumes and data sources increase at companies, product cycles and the time available for market launches become ever shorter.

Despite these developments, decision-making processes in companies have changed very little in the past 20 years *(see figure 1 on the following page)*. Decisions often continue to be made in silo structures and are frequently intuitive and based on gut feelings. In an age of increased complexity—where we must deal with information overload via high-tech, data-driven, state-of-the-art communications—how can we ensure that our business decisions are grounded in relevant information?

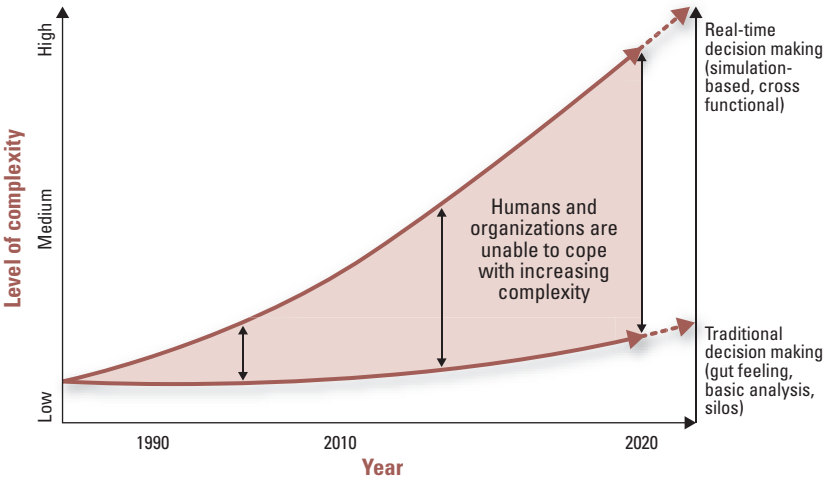
A New Basis for Decision-Making

Even supposedly straightforward decisions, such as those involved in manufacturing or HR planning, are not always made in the most optimal way. Decisions are often reached within the particular department on the basis of available know-how while knowledge and insights from those in other departments are overlooked. Yet, we have found that companies that share knowledge across the value chain can improve earnings between 3 and 5 percentage points.[1] Without cross-functional decision-making, the decision will not only produce "average" results but also may contain unnecessary and possibly unknown risks.

In addition, as the financial crisis has demonstrated, an unlikely event—a Black Swan—such as the collapse of a bank can have extreme consequences. Improbable events are predictable, but they can only be foreseen with the aid

[1] *All references to earnings in this paper refer to earnings before interest and taxes (EBIT).*

FIGURE 1: Decision-making processes have not kept up with increasing complexity



Source: A.T. Kearney analysis

of state-of-the-art computer data models. The call for banks to improve their risk management policies is therefore nothing more than a call for simulation models—technologies that allow for forecasting improbable, discontinuous and potentially destructive events.

Simulation Technologies: Science Is Already Using Them

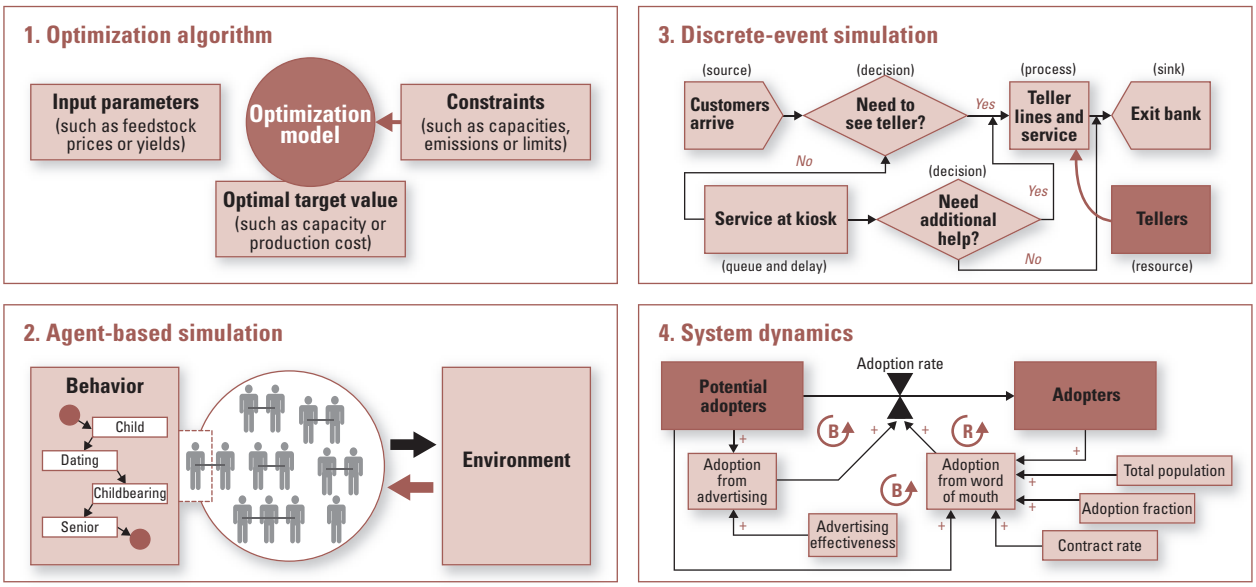
Over the past 50 years, numerous research teams have achieved major advances in the field of simulation technologies and optimization algorithms. The rapid growth of computing capacity has allowed the creation of practical applications for a modest outlay, with simulation and optimization now considered standard methods in all areas of science. The following four concepts have proven their worth in this context *(see figure 2)*:

1. Optimization algorithms. Strategic decision-making takes place in a model in which the optimal solution for a target metric is determined, taking into account all restrictions, such as capacity limitations.

Business application: Optimize the supply chain: Determine how to produce the most possible—or the most inexpensive—product or service while factoring in all relevant constraints, such as capacity, sales and marketing planning, and logistics costs.

2. Agent-based simulation. The primary focus is on the behavior of individuals, as "agents" react according to given rules and interactions in a model simulated along the time axis.

FIGURE 2: State-of-the-art simulation technologies



Sources: SAT Simulations- und Automations-Technologie AG and Simio LLC; A.T. Kearney analysis

Business application: Simulate market and customer behavior, such as gauging customers' reactions to price changes or specific market trends.

3. Discrete-event simulation. Process-based concept with simulation along the time axis.

Business application: Simulate a factory setting or a materials flow system: Reengineer work processes (for example, using Six Sigma) and reduce net working capital.

4. System dynamics. The focus is on systemic behavior by means of dynamic feedback loops in a model simulated along the time axis.

Business application: Simulate strategy decisions in the global marketplace.

These simulation and optimization technologies can also be combined, which means practically every enterprise—with its resources, customers, targets and dependence on external factors—can be modeled. And these technologies can be used to create "what if" scenarios by designing and evaluating different future tactical and strategic scenarios. Complex decisions can therefore be reached on an objective and holistic basis.

Case Studies

Supply Chain Network

Objective: Reengineer a global supply chain network (production and distribution) with $1 billion (€800 million) in annual variable costs. The complex network consisted of 20 manufacturing plants using numerous mixtures of raw materials to produce different end products for more than 5,000 clients.

Concept: SAT AG mapped the company's individual value chain in a suitable optimization algorithm, making it possible to determine monthly production allocations and costs, which were at a minimum level globally at all times. A technical tool was created simultaneously and used to revamp the entire decision-making process.

Result: Achieved annual savings of 4 percent in variable costs, mainly material and shipping costs.

Air Traffic Control

Objective: Minimize the number and duration of the holding patterns of waiting aircraft in the vicinity of an airport caused by limited runway capacity.

Concept: After modeling the airport and air traffic, a discrete-event simulation (coupled with optimization algorithms) was carried out and simultaneously incorporated into the air traffic control system.

Result: The so-called "de-peaking" of runway usage, in particular, resulted in a more even distribution of takeoffs and landings; lower fuel consumption translated into more than $27 million (€20 million) in annual savings.

HR Management

Objective: Ensure future viability of a large energy supply company in the face of changing demographics and a decline in qualified engineers.

Concept: Used a discrete-event simulation to develop a future view of all units and individual employees in them based on certain factors (age and qualifications). The simulation included effects arising from years with low birth rates, declining demand for certain engineering specialist areas, and "war for talent" scenarios.

Result: Identified present and future weak points in HR planning, enabling the firm to systematically identify and foster high-potential individuals at an earlier stage, and launch more targeted recruiting efforts. The company gained a measurable competitive edge, reduced HR budgets, and increased professionalism and acceptance of the HR sector.

Acceptance Depends on Tailor Made Models

If simulation technology is so popular and successful in research fields, why is it rarely put to practical use in the corporate world? Often because there is insufficient knowledge about these models and they are widely considered theoretical or mere mathematical gimmicks.

Furthermore, the models are considered too general and need to be geared to the company in question, which in turn calls for an in-depth understanding of the company, from procurement through research and development to sales and marketing. The influence of external factors is also crucial. A tailored model is the basis for controlling complexity.

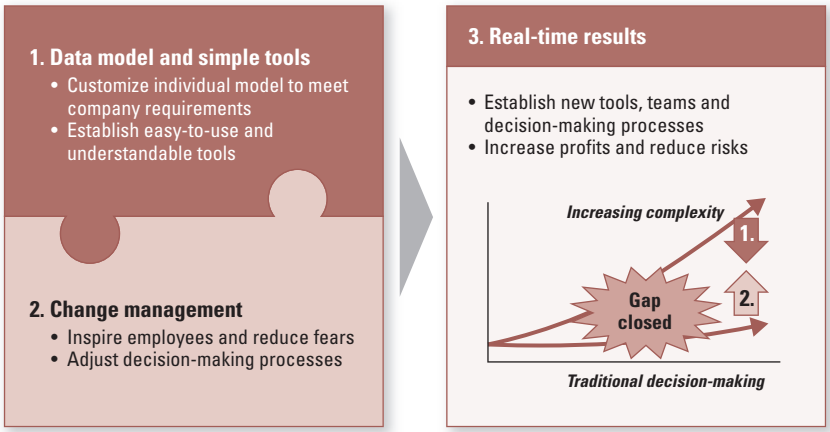
Change Management Is Crucial

Learning simulation technology is only the first step toward achieving a new type of decision-making process. Realizing long-term earnings potential can only be achieved by engaging one's own labor force. Otherwise there is a real danger of creating an "IT ruin."

Success depends on creating genuine enthusiasm for the new process. The majority of employees will initially regard this kind of technical tool with skepticism as the novelty of the methodology and the intellectual demands it makes can quickly lead to defensive reactions. What we call the

"black box" blockage can be overcome by integrating key personnel into the development and implementation phases of the tool at an early stage and then providing intensive training courses and seminars. Use of the tool in everyday work situations should be part of all employees' performance objectives. The new process is characterized by an individual data model, easy to use tools and change management *(see figure 3)*. The earnings-enhancing impact of the model should be measured systematically and its transparency ensured.

FIGURE 3: Characteristics of real-time decision-making processes



Source: A.T. Kearney analysis

Authors

Oliver Scheel *is a partner in the Dusseldorf office. He can be reached at oliver.scheel@atkearney.com.*

Volker Sieg *is a consultant in the Dusseldorf office. He can be reached at volker.sieg@atkearney.com.*

Thomas Arzt *is the CEO of SAT Simulations- und Automations-Technologie AG. He can be reached at arzt@sat-ag.com.*