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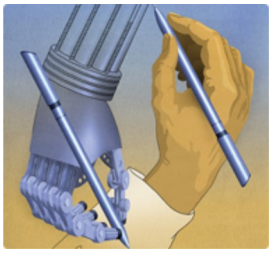

The Integrated Strategy Machine: Using AI to Create Advantage

April 19, 2016 by Martin Reeves, Daichi Ueda, Philipp Gerbert, and Ralf Dreischmeier
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In This Article

- Technology, no matter how advanced, does not guarantee competitive advantage. To enhance strategy, technology and people must coordinate to form an "integrated strategy machine."

- In an effective strategy machine, people and technology each do what they're good at.

- People are still unique in their capacity to think beyond the scope of a problem. That's why they must assemble the strategy machine, direct it toward a specific aim, and periodically reevaluate its design.

This is an age of techno-utopianism. Topics like big data, advanced analytics, and artificial intelligence are at the forefront of the CEO agenda, a sign that companies see technology as a potential answer to many or even most of their challenges.

We have good reasons to be excited: an explosion of data and advances in analytics have enabled technology to perform well-defined but complex tasks like recommending movies and diagnosing cancer—not only independently of humans but in many cases better than people can. So it's not implausible to think that technology could also address broad, open-ended, and ambiguous problems like developing and executing a business strategy. In fact, we've spoken to business leaders who believe in such an outcome—and companies such as Amazon and Alibaba are already beginning to make it a reality.

But the use of technology, no matter how advanced, does not guarantee competitive advantage. For technology to advance business strategy, it must be embedded in what we call the "integrated strategy machine."

The Promise and the Danger

Before we explore the integrated strategy machine, let's consider technology's potential to enhance strategy—and its limits.

Technology has gotten dramatically better and smarter. In the past decade, cognitively inspired algorithms have enabled machines to learn abstract concepts efficiently and without supervision. The expansion of data, by an estimated 2.5 quintillion bytes every day, has fueled more empirical and real-time approaches to business problem solving. And continued advances in hardware (and the surprising longevity of Moore's Law) and scalable computing architecture have reduced computation costs and allowed businesses to take advantage of the explosion of data.

As a result, machines are rapidly improving at tasks that require creativity and intelligence, such as composing music, grading or even taking university entrance exams, and detecting emotions. They are also getting better at interpreting and extracting insights from unstructured data, including text and images. An emblematic recent example of the acceleration in machine intelligence is Google DeepMind's AlphaGo, which shocked the world by defeating 18-time world champion Lee Sedol in Go, a game thought to be impenetrable by AI for another decade.

Given such progress, it's tempting to think that technology might permit a "strategist in a box" that can directly assist CEOs in their strategic decisions. We believe that things are not quite so simple, however.

Consider the clear disconnect between technological progress and tangible economic gains. Despite the advances in information technology, total factor productivity growth has stagnated since the 1970s and has virtually halted since the recession in 2007. The notion that "you can see the computer age everywhere but in the productivity statistics" is as true today as it was when Robert Solow first observed this several decades ago. Even at the individual company level, IT spending is often not reflected in performance. In fact, some studies have shown that the most successful companies tend to invest *less* in IT than their peers do.

It's naive and dangerous to assume that better technology and more data will guarantee better outcomes. No matter how advanced the technology, it needs to be embraced by human beings and incorporated deliberately into a human-designed strategy process.

Consider also the example of Long-Term Capital Management. LTCM was founded in 1994 by some of the best minds in finance theory, including two Nobel Prize winners. The company printed money while its financial models based on cutting-edge option theory worked, achieving annualized returns after fees of more than 40% in its second and third years. Nevertheless, overreliance on models was LTCM's downfall. The models continued to predict that the company was properly hedged against a potential Russian default, while the insight that it actually needed—that it was potentially underhedged and thereby exposed to liquidity risk—could have come only from outside the model. After the Russian financial crisis in 1998, LTCM imploded and lost

$4.6 billion.

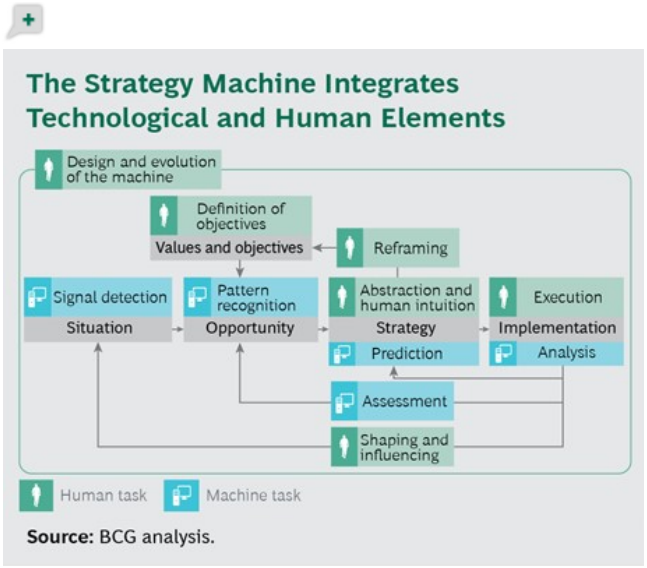
Megan Santosus, "How Company Size Relates to IT Spending," TechTarget, September 2005.
"Case Study: LTCM," hosted by C.T. Bauer College of Business, University of Houston.

The Integrated Strategy Machine

What does it take to translate technological advances into strategic advantage?

We believe that technology-enhanced strategy can be realized only in the context of an integrated strategy machine: a collection of resources—both technological and human—that act in concert to develop and execute business strategy. It comprises a range of conceptual and analytical operations—including problem definition, signal processing, pattern recognition, abstraction and conceptualization, analysis, and prediction—that connect into a seamless whole. This alignment of individual operations toward the overall aim makes the strategy machine *integrated.*

Effective business strategy development, with or without technology, must accommodate *reframing,* the process of redefinition and reanalysis of the problem that BCG founder Bruce Henderson considered to be at the heart of effective business thinking. To enable reframing, the strategy machine must span the end-to-end process of strategy development and implementation. Rather than formulating strategy in a vacuum, the strategy machine must continuously update and improve strategy by analyzing feedback and execution data. There needs to be a constant interplay between upstream and downstream elements of the strategy machine. (See the exhibit.)



Although machines and algorithms can play increasingly large and important roles in strategy making and execution, the integrated strategy machine must, at least for now, be designed by human beings: people must assemble the machine and direct it toward a strategic aim.

It is important to understand why. Human beings are still unique in their capacity to "go meta"—that is, to think outside the immediate scope of a task or problem. Machines can't yet do that well; they are good at executing a well-defined task or solving a well-defined problem, but they can't pose new questions or connect a problem to a different one they previously faced.

In other words, artificial intelligence is still far from being general. Of course, this is not to say that machines are incapable of learning these higher-order skills—we anticipate that technology will play a larger and larger role within the strategy machine.

Amazon provides an excellent example of an integrated strategy machine. The company has at least 21 data science systems, including several for supply chain optimization, an inventory forecasting system, a sales forecasting system, a profit optimization system, a recommendation engine, and many others. These systems are intertwined with one another and with human strategists to create an integrated, well-oiled machine. For example, if the sales forecasting system detects that the popularity of an item is increasing, it triggers a cascade of changes: the inventory forecast is updated, causing the supply chain system to optimize inventory across warehouses; the recommendation engine pushes the item more, and the profit optimization system adjusts pricing; these changes in turn update the sales forecast. These are only some of the first-order effects, and further interactions occur downstream. While many of the operations happen automatically, human beings design experiments and review data traces to continue to learn and evolve the machine design. Humans also extract higher-order insights from anomalies and patterns, captured by machines, that inform their next strategic moves.

Or consider how the integrated strategy machine works in the venture capital industry. Correlation Ventures thrives on the exploding amount of data around start-ups, including data on financing, investors, business segments, founding teams, and other relevant parameters. Like many venture capital firms, Correlation sources most of its deal opportunities through its human connections. However, whereas the conventional approach to deal due diligence involves repeated rounds of interviews with founders and key customers as well as deep market research, Correlation focuses on documentary information. To evaluate investment opportunities, the firm runs the data through its predictive analytics algorithm; humans then perform a more holistic review of the opportunities that pass the algorithmic screen. Thus, machines and people each contribute their unique strengths to make accurate investment decisions. Beyond predictive power, this approach also achieves speed, scalability, and evolvability: Correlation's strategy machine allows the firm to make an investment decision in two weeks, review a large number of opportunities with limited human resources, and reliably improve investment decisions over time through the accumulation of data and experience.

Vincent Granville, "21 Data Science Systems Used by Amazon to Operate Its Business," Data Science Central, November 2015.

The Requirements and the Pitfalls

How can businesses create an effective integrated strategy machine? We have identified six requirements:

1. A Relevant, Specific Strategic Aim. The integrated strategy machine must be directed at a relevant aim, a desired outcome. Humans must provide the initial question or insight into where the opportunity lies. Whereas a group of people may be able to accommodate ambiguity and find the right aim through self-organization, the strategy machine needs an explicit aim.

The opposite of having a relevant, specific aim is asking the wrong question. Powerful technology can cause us to do that by preoccupying us with what it *can* do rather than what it *should* do. The machine's capabilities, rather than human needs, then dictate the problems that we solve. In other

words, if all you have is a hammer, everything looks like a nail.

2. A Design Appropriate to the Aim. No strategy machine can be effective in all situations. Just as different environments call for different strategies, different strategies call for different designs of the integrated strategy machine. (See Martin Reeves, Knut Haanaes, and Janmejaya Sinha, *Your Strategy Needs a Strategy: How to Choose and Execute the Right Approach*, Harvard Business Review Press, 2015.) For example, strategies in stable classical environments require a process of "analyze, plan, execute," and adaptive strategies in less predictable conditions require a process that can be characterized as "vary, select, scale." The degree of variability and malleability that a strategy must accommodate suggests the optimal approach to developing and implementing it. Form must follow function.

Much as the fox cannot eat out of a narrow-necked vessel and the stork cannot drink out of a bowl, a strategy machine without the right design cannot achieve its aim. For example, a strategy machine designed to be most effective in a classical environment would fail in a more malleable environment, where companies must engage in such activities as collaborating with a diverse set of stakeholders and building an ecosystem.

3. An Integrated Approach. The components of the machine, both human and technological, must communicate with one another to create an integrated whole. This integration is critical, because aggregating local optima rarely leads to a global optimum. For example, a strategist who wants to evaluate a new business opportunity may need to consider competitive threats and strategic fit. Different components of the strategy machine could analyze those issues separately, but the strategist will be no closer to an answer unless there is a mechanism to integrate the analyses and resolve trade-offs by generating new insights.

It's easy to ensure that the components of the strategy machine share insights and coordinate their actions when only a few components are involved. However, as we ask increasingly complex questions, we risk losing coherence in our search for a solution. Therefore, human beings, with their unique ability to understand broad contexts and connect insights from disparate spheres, must design and optimize the flow of information and insights in the strategy machine. Their role is to make sure that the components of the machine—both people and technology—optimize for the global aim rather than for individual operations.

4. The Right Human-Machine Division of Labor. In an effective strategy machine, human beings and machines must each do what they are good at. Machines can usually perform tasks with a specific, well-defined context more accurately and more quickly than people can, and they can process more data while doing so. Human beings are better at thinking beyond the specified context and dealing with ambiguity by, for example, reframing a problem, asking new questions, or applying common sense.

When people and machines are not engaged in activities suited to their respective strengths, thinking often stagnates. For example, machines can facilitate abstraction or the formation of new concepts by detecting signals and patterns. Nevertheless, they are still inferior to human beings in abstracting and conceptualizing, much less adding rigor to their thinking through iterative reframing. Therefore, strategies that do not engage unique machine capabilities may lack an edge, and strategies that do not engage unique human capabilities may lack depth.

5. A Well-Designed Human-Machine Interface. The strategy machine can benefit from an appropriate division of labor only if there is the right human-machine interface. Machines must be able to communicate their observations to people; conversely, people need to be able to understand, examine, and validate those observations and provide feedback to machines.

An ineffective human-machine interface turns the strategy machine into a black box that creates outputs that are "untraceable": people cannot interpret them and therefore cannot build deeper and richer insights through successive reframing. To avoid this pitfall, architects of the strategy machine must avoid the temptation to turn machine outputs into reductive visualizations or simplified patterns. (For an example of this dilemma, see the sidebar.) People need to be able to probe the messy data from diverse perspectives in order to gain rich insights.

We have a philosophical reason to believe that this is a real threat. The 20th-century philosopher Martin Heidegger wrote in a prescient essay called "The Question Concerning Technology" that modern technology is not a neutral means to an end but something that shapes and limits the way humans perceive and interact with the world.

UNLOCKING THE POTENTIAL OF THE STRATEGY MACHINE: AN EXPERIMENT WITH NLP

What does it mean for technology to *enhance* or *inhibit* strategy? To explore this distinction, let's consider how two software tools using the same underlying technology—natural language processing (NLP)—can affect human thinking and business outcomes in opposite ways.

We believe that unstructured data—text, in particular—could transform the way we think about business strategy. According to one estimate, 80% of the data that businesses hold is text data, which conceals rich and unexploited insights. That's why we have been investigating NLP technology.

The first tool, which we developed with our collaborator Cortical.io, is a semantic engine whose role is to provide analytic horsepower and flexibility in order to stimulate human thinking. It's able to detect semantic patterns in text data and to do so from the perspective of a particular user, like a consulting firm or a pharmaceutical company.

But to produce sharp insights, the technology needs to interact with people, who are able to interpret patterns and anomalies, connect findings with outside knowledge, and form new questions and hypotheses. The program serves primarily as a partner in human thought and thus can play a role within an integrated strategy machine.

We used this tool to investigate the relationship between corporate speech and an organization's orientation toward either exploration (the search for new opportunities and business models) or exploitation (the refinement of existing products and business models). We started by using BCG strategy texts to train the algorithm to look at the problem in a strategy-specific context. We then developed hypotheses using both human-driven and machine-driven approaches: using human intuition and experience to posit testable relationships and using the machine to extract commonalities across known explorers like Amazon and Google. We analyzed the messy raw output for interesting correlations and repeatedly reframed the analyses to investigate the most promising patterns. Eventually, we found a way of accurately detecting and predicting the exploratory capability of corporations, which can be used to assess their strategic sustainability.

The second NLP tool we examined is a well-established one that is often used for "visual storytelling." The software uses keywords to search the web and presents its search output in a visually compelling and accessible way. It gives us a plausible picture of reality, onto which people can impose their own interpretations. However, we found that it doesn't point us to new concepts or questions. In fact, the outputs of this software are either questionable or obvious, because they don't allow us to easily explore and test new hypotheses. We can either accept the output, or it remains closed to further investigation.

As a result, this software gave us a very superficial view into the same question that we investigated with the first tool. The software gave us interesting visuals but no real insights about the relationship between speech and exploratory behavior.

The fundamental difference between these software tools is the extent to which they are open to human interaction. Software that can produce complete outputs by itself is closed to human reframing. But an integrated strategy machine necessarily involves both people and machines. The kind of software that can stimulate human thinking and play a role in the integrated strategy machine is, paradoxically, the one that is incomplete by itself.

> **6. Unique Tools, Data, People, or Process.** The strategy machine has not fulfilled its ultimate purpose if it does not create advantage. Therefore, it must do something better than competitors can. Some aspect of the machine must be advantaged, whether it's the tools, the data, the people, or the design.
>
> The risk of relying on off-the-shelf solutions, readily available data, or old designs is that the strategy machine becomes commoditized, a mere cost of doing business. Its outputs may be "good enough," but they are not a source of differentiation. The integrated strategy machine must itself be capable of evolving. Like the Red Queen, it must keep running simply to stay in the same place.

The Implications

To realize technology's potential to enhance strategy, business leaders must address some new questions about the interaction of people and technology.

What strategic aims do I want to achieve with an integrated strategy machine? The initial aim must come from human beings. As Bruce Henderson stated, "The first definition of a problem is inescapably intuitive. It must be in order to be recognized as a problem at all." The initial problems that the strategy machine intends to solve, in other words, must be defined outside the machine itself.

What technology, people, and design do I need in order to achieve those aims? Different aims require different capabilities, which are often costly and difficult to procure. The technology giants that have developed effective strategy machines—such as Amazon and Google—have done so by continually investing in the integration of technology into strategy and paying a premium to attract the best talent. Companies without such advantages must remain realistic about what it takes to build an advantaged strategy machine.

How can people and machines complement each other? The goal of the integrated strategy machine is to enhance, rather than inhibit, human thought. To do so, technology needs to stimulate people's ability to create new concepts, challenge their own thinking, and reframe their understanding. Conversely, human beings must interpret the outputs and actions of machines in their broader context and guide them to perform increasingly relevant analyses.

How can the strategy machine evolve? A successful strategy machine must be able to improve itself over time. It needs a mechanism to learn from its experience and continue to answer the right questions and provide novel insights. People who manage the machine must have the courage and discipline to periodically reevaluate and challenge its design.

How can the broader organization embrace the strategy machine? A strategy machine is valuable only to the extent that the organization embraces and uses it. Business leaders must pay attention to organizational realities and design the strategy machine accordingly. If the organization is not ready to rely on it, the machine may become irrelevant and ineffectual in driving actual change.

General-purpose technologies, like the steam engine, electricity, and now information technology, always take several decades to unleash their full potential, because businesses need to learn and to organize themselves to best leverage their power. For example, when electric motors initially replaced steam engines, engineers just placed the new motors where the steam engine used to be—and made no productivity gains. Electricity led to enormous productivity gains only when factory layouts were optimized for the new technology.

We believe that the integrated strategy machine can do for information technology what new factory designs did for electricity. In other words, the increasing intelligence of machines will be wasted unless businesses reshape the way they develop and execute strategy. Businesses leaders must start thinking now about how they can integrate their two key assets—people and technology—or risk falling behind.

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