

## Now You Can Simulate Nearly Anything

### Authors

#### PR Krishnan

Senior Vice President and Head, Infrastructure Services,  
Tata Consultancy Services

#### Satishchandra Doreswamy

Vice President and Global Head, Cloud Infrastructure,  
Tata Consultancy Services

#### Suranjan Chatterjee

Global Head, Cloud Apps, Microservices & API-fication Unit,  
Digital Transformation Services, Tata Consultancy Services

Organizations have long performed what-if simulations and scenario planning to test strategies and tactics, try out product concepts and service approaches, and assess the potential impact of new business models. In fact, consumers and companies today are the beneficiaries of computer simulations of complex conditions ranging from weather forecasts to the performance of aircrafts that are still on the drawing boards.

Until recently, such computer simulations were largely the realm of major government entities or large companies with access to the multimillion-dollar high-performance computing systems required to run them. Now, the emergence of cloud computing opens up a world of possibilities for companies that have long wanted to experiment with simulations but lacked the resources to do so. In short, cloud computing

makes simulation opportunities abundant and economical. Just as important, the digital data that's necessary to perform these simulations is plentiful and increasing exponentially.

The same cloud computing infrastructure that gave us cheaper email systems or subscription-based salesforce automation software is now making sophisticated software tools—many of them open sourced, some available for a credit card fee—available to a vastly wider audience. These tools, such as those that manage data exchanges among different systems, make it possible to perform the calculations required for simulations. Other tools manage the security of corporate data for simulations. And because a company can share data and computing power with partners via the cloud, such platforms enable a host of new applications.

More companies are facing a pressing need for business data visibility across the entire supply and distribution chain to make informed planning and production

decisions. An automaker, for example, may decide it needs to go beyond its tier one suppliers to second- or third-tier firms to gain more control over supply timelines, and prevent unexpected downtimes for assembly lines. This calls for a connected ecosystem of IT and processes that spans several independent companies' disparate computing environments, enabling the automaker to mine the data, and simulate possibilities. Now with cloud platforms, connecting a complete chain of systems becomes easier to simulate. This scenario also opens possibilities for the automaker to monetize data assets—like data on equipment performance, transportation lead times, and consumer product buying patterns—by exposing such insights to ecosystem partners.

Further, by conducting simulations in a cloud vendor's data center, a company can reduce the cost and risk of conducting these experiments. For example, a bank or a retailer planning a digital transformation can run a simulation to model the impact on the sales and profitability of integrating multiple consumer channels.

With significant computing power now available on demand, companies have the potential to run simulations on just about anything for which they have ample, quality data. They make it possible to pose questions they have not been able to ask before and test more ideas.

But just because companies can run computer simulation models on virtually every aspect of their business, does not mean they should. Making the best use of the requisite infrastructure, analytics talent, data management, and IT skills, requires a strategy for simulations. Companies should determine what business questions simulations are best able to answer: whether it is optimizing the supply chain, pursuing an omnichannel marketing strategy, or scheduling asset maintenance. The approaches will vary depending on a company's industry, strategy, and tactics.

## Simulation Sweet Spots

Companies in a spectrum of industries have been doing cloud-based simulations for a variety of uses. For example, since the beginning of the decade, Varian Medical Systems, a \$3 billion scientific-instruments company, has been running intensive 'Monte Carlo' computer simulations of design prototypes. That has accelerated product development.

A design for a mass spectrometer that would have taken six weeks to develop using internal computing resources, takes just a day in the cloud at a fraction of the cost.<sup>29</sup>



<sup>29</sup> Forbes, Learning from the Cloud, October 20, 2010, Accessed August 03, 2017, <https://www.forbes.com/2010/10/20/microsoft-amazon-varian-technology-cloud.html>.

University of Arizona researchers looking to develop new drugs to fight ALS are using high-performance computing resources in the public cloud to run molecular modeling simulations in just a few hours that would otherwise take months.<sup>30</sup> Using a public cloud, Major League Baseball built a tracking system that ingests videotaped player performance data from ballparks across North America. The goal: to simulate how athletes could have made better running, fielding, and other plays.<sup>31</sup> Milliman, a global provider of actuarial products and services for the life insurance industry, has lessened the cost and complexity of its compute-intensive financial modeling, which evaluates thousands of economic scenarios, by conducting it in the public cloud.<sup>32</sup>

These early adopters have a number of characteristics in common.

**They have ready access to huge amounts of data.** For example, a major airline simulates the impact of flight delays on the crew management and flight scheduling. It can also examine how delays affect customer loyalty, revenue, and crew costs by using data from multiple sources. These simulation programs built using cloud-based technologies increased the airline's ability to reschedule crews based on predicted delays, and reduced costs on hotels and transportation for crews, among other benefits.

**They identify situations where cloud-based simulations can make a big business impact.** Companies using the cloud for simulations create use cases where the ability to predict the performance of a product, service, or process can significantly improve revenues or outcomes, or substantially reduce costs and risks. Financial services firm Aon Benfield, for example, uses a high-performance public cloud-computing platform to simulate the performance of its five million insurance retirement products, and better determine its exposure to market risks.<sup>33</sup>

<sup>30</sup> HPCwire, Drug Developers Use Google Cloud HPC To Fight ALS, February 16, 2017, Accessed August 03, 2017, <https://www.hpcwire.com/2017/02/16/drug-developers-use-google-cloud-hpc-fight-als/>

<sup>31</sup> Amazon Web Services, MLB Advanced Media Case Study, Accessed August 03, 2017, <https://aws.amazon.com/solutions/case-studies/major-league-baseball-mlbam/>

<sup>32</sup> Microsoft Azure: Milliman Case Study, Accessed August 03, 2017, <https://enterprise.microsoft.com/en-us/customer-story/industries/insurance/milliman/>

<sup>33</sup> Aon case study, Amazon Web Services, Accessed August 03, 2017, <https://aws.amazon.com/solutions/case-studies/aon/>

**They do simulations to react far faster and better to daily business conditions.**

Cloud-based modeling is an ideal approach for situations in which it's critical to act rapidly or in real-time. Global food company Kellogg uses public cloud infrastructure to test the impact of potential marketing programs. Every day, it runs dozens of complex data simulations on TV ad spending, digital marketing, coupon campaigns, and other promotions, sales commissions, and display and shelving costs.<sup>34</sup> These simulations reduce waste in making these decisions, reduce time to market, and boost revenue.

**They do simulations to reveal new business models.**

The ability to conduct multiple experiments through simulations—to explore how to make a business operation more efficient or more profitable—can help executives identify new ways of generating revenue. Simulations help answer if such ideas are feasible. For example, a consortium of banks can experiment with selling services to other financial institutions to help the banks comply with a new regulation.

<sup>34</sup> Kellogg Co. case study, Amazon Web Services, Accessed August 03, 2017, <https://aws.amazon.com/solutions/case-studies/kellogg-company/>



## Seven Prime Use Cases for Cloud Simulations

There is a wide range of potential applications for cloud-powered simulations. We have found seven areas where many organizations are generating the greatest benefit:

### 1. Asset management and optimization.

Companies are using simulation modeling to predict when their assets are about to fail and may need to be repaired or replaced. General Electric's Power & Water division has developed virtual plants, using real-time simulation in the cloud. Using so-called 'digital twins' of critical pieces of equipment, the company can model the state of every asset in its gas power plants and wind farms.<sup>35</sup>



### 2. Research and development.

High-performance cloud infrastructure can be valuable for product development—enabling organizations to evaluate designs, test performance, and prevent quality issues quickly and cost effectively. Consumer products giant Unilever, for example, is combining data generated in its labs with publicly available microbial genetic data to develop new deodorants and other products.<sup>36</sup>

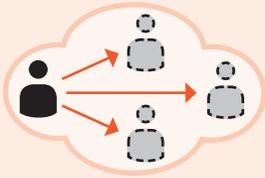


The cloud can enable similar simulation capabilities in medical research and development. Harvard Medical School's Laboratory for Personalized Medicine is using a cloud-computing platform to develop genome analysis testing models, speeding up research on the clinical

<sup>35</sup> PC World, Cloud-based 'Digital Twins' Could Make Power Plants More Efficient, September 29, 2015, Accessed August 03, 2017, <http://www.pcworld.com/article/2987525/cloud-based-digital-twins-could-make-power-plants-more-efficient.html>

<sup>36</sup> Information-age, Unilever Puts DNA in the Cloud, April 15, 2013, Accessed August 03, 2017, <http://www.information-age.com/unilever-puts-dna-in-the-cloud-123456966/>

value of new genetic tests.<sup>37</sup> Pharmaceutical company Novartis likewise accelerates its pre-clinical R&D efforts for drug development in the public cloud.<sup>38</sup>



### 3. Human capital management.

Several companies are using cloud-based simulations to recruit employees better and assign them to the right roles. A company may discover that an MBA graduate does not necessarily correlate with longevity with the company; however, it may dig deeper to discover that MBAs in smaller markets are less likely to leave while those in metropolitan areas are more likely to switch jobs.<sup>39</sup>



### 4. Customer experience.

Companies are using computer-modeling techniques to predict customer receptiveness to new products, services, offers or product functionality, from a new app to a new banking product. For example, one fashion retailer uses data from multiple channels—sales transactions, customer website visits, online and mobile behavior—to simulate the impact of discount offers on products at particular times (such as a holiday festival) to determine which will be most profitable. The simulations were successful in improving repeat sales and enhanced revenues on specific product lines.

<sup>37</sup> Harvard Medical School case study, Amazon Web Services, Accessed on August 03, 2017, <https://aws.amazon.com/solutions/case-studies/harvard>

<sup>38</sup> Fortune, Medical Researchers Use the Cloud To Do What They Couldn't Before, June 19, 2015, Accessed on August 03, 2017, <http://fortune.com/2015/06/19/medical-researchers-turn-cloud/>

<sup>39</sup> Talent Economy, Numbers Game: Managing Human Capital in the Age of Machine Learning, November 3, 2016, accessed August 03, 2017, <http://www.talenteconomy.io/2016/11/03/human-capital-machine-learning/>



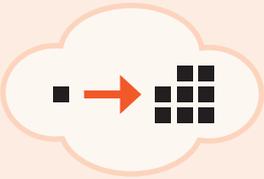
## 5. Fraud detection.

Many firms are using cloud resources to help identify, respond to, and potentially prevent fraud. Banking giant HSBC, for example, uses the public cloud in its anti-money laundering efforts. The bank runs analytics and machine learning on enormous data sets to identify patterns that indicate nefarious activity, which it can then escalate to the appropriate government agencies.<sup>40</sup>



## 6. Customer service and field service.

In the same way that airlines and utilities use modeling for the predictive maintenance of their own assets, cloud-based simulations can help companies troubleshoot service and performance issues for customers. As companies accumulate more data from internet of things connected products and field service calls, they can model scenarios to create a more flexible, on-demand field service function.



## 7. Inventory management.

Using the same principle as field service simulations, organizations with very remote divisions or service areas (such as remote health centers) can use cloud-based computer models to determine how best to serve and operate their far-flung units.

<sup>40</sup> Computerworld UK, HSBC turns to Google Cloud for analytics and machine learning capabilities, March 9, 2017, Accessed August 03, 2017, <http://www.computerworlduk.com/cloud-computing/hsbc-turns-google-cloud-for-analytics-machine-learning-3655688/>

## Where to Begin

Companies that want to pursue promising simulation opportunities need to address a number of business and technical issues before proceeding.

**Tie simulations to critical business issues.** First and foremost, organizations need to clearly define the problem they're trying to solve—or the questions they're attempting to answer—with computer simulation. Simulations are, by definition, experiments. But that does not mean they should be undisciplined. Rather, companies must ensure the simulations that they try have a business benefit attached.

**Practice strong data management to ensure quality simulations.** Companies must have the right infrastructure, tools, and processes in place to manage the volume of data required for computer simulations and validate data quality. Companies must ensure that data from disparate sources are put into formats that can be combined for purposes of simulation; otherwise they can create conflicts during the modeling process. Simulations are only as good as the data fed into them. And don't forget about the team doing this work. The investment of time, money, and talent required to prepare the data for these efforts is often underestimated and should be budgeted for from day one.

**Use simulations to ‘fail fast’ and improve the next time.** A computer simulation is always a work in progress. It must be refined over time with frequent changes to improve the model. That requires a much less rigid mindset and approach than a standard software project with strict governance and delivery date. Computer modeling benefits from a more agile approach. Organizations that pursue must invest in the increased time and overhead required to supervise the process and refine results.

While not every business problem is right for simulation, there are undoubtedly simulation opportunities for all businesses across industries. And now is the time to determine where the greatest opportunities are. The computing power is accessible. The data is available in greater quantities and varieties than ever before. If you don't take advantage of the opportunities to perform complex simulations using high performance cloud assets, chances are a competitor or an upstart will.