



The Untold Story of Rescuing HealthCare.gov

We have all heard the story of how Silicon Valley helped save HealthCare.gov. Less known, however, is the story of how MarkLogic, a global technology company based in Silicon Valley, laid the foundation for the website's rescue two years before the system went live.

KEY POINTS

- Implementation of the Health Insurance Marketplaces (“Marketplaces”), including the consumer-facing website, HealthCare.gov, was the Centers for Medicare & Medicaid Services’ most significant challenge in its 50-year history, as well as the most significant challenge for the nation’s healthcare access and delivery ecosystem.
- Both the Data Services Hub for all of the Marketplaces and the Online Eligibility and Enrollment System for the Federally-Facilitated Marketplaces run on the MarkLogic® Enterprise NoSQL database. The unique capabilities of this technology enabled the team to complete the rollout of this complex system in less than two years, despite shifting requirements and the burden of adapting poor initial database architecture. Although the initial go-live launch of HealthCare.gov proved rocky, the MarkLogic database enabled CMS to shave critical months off of the development schedule and, ultimately, achieve the intended functionality.
- At the close of the second year of open enrollment in February 2015, HealthCare.gov had enabled over 11 million enrollments or automatic re-enrollments. All of the critical system-of-record functions run on the MarkLogic Enterprise NoSQL database.

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If it were not for MarkLogic, we would have been in a much worse place than we were in October of 2013. In October, when things were bad, we had the option to pivot, to scale out of a poorly written application without the need to rewrite large portions of the app during open enrollment. MarkLogic gave us a set of options that would not have been possible with other technologies.



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The Challenge

At the time of the Affordable Care Act's (ACA) passage in 2010, there were nearly 50 million uninsured Americans¹. Many of the uninsured had poorly managed chronic conditions and, without access to a primary care physician, used the most expensive form of care—the emergency department—for basic primary care services. This dynamic contributed to an unsustainable rate of healthcare spending growth in the U.S. To reduce the number of uninsured and relieve economic pressure on the healthcare system, the ACA created the Health Insurance Marketplaces ("Marketplaces"), which would work in concert with the ACA's expansion of Medicaid and the Children's Health Insurance Program to expand access to affordable health insurance coverage.

The ACA gave primary responsibility for implementation and operation of the Marketplaces to the Centers for Medicare & Medicaid Services (CMS), the largest agency within the U.S. Department of Health & Human Services. Under the ACA, every state plus the District of Columbia must have its own Marketplace, where individuals can shop for and enroll in affordable health insurance coverage. The ACA gave each state a choice—either establish its own State-Based Marketplace or allow CMS to establish a Federally-Facilitated Marketplace (FFM) to serve that state. Although the number of FFMs has varied over time, a majority of the states has always been served by a FFM.

The Marketplaces had to be fully operational in time for the first open enrollment period to begin in October 2013. CMS knew that there was no roadmap for implementing a project of this complexity and magnitude in the timeframe required under the law; in fact, it would be the first of its kind for the Federal government.

Implementation of the Marketplaces required CMS to create a complex technological infrastructure, including:

- The Federal Data Services Hub (DSH)
- An Online Eligibility and Enrollment System (OEES), with a consumer-facing website ultimately called "HealthCare.gov"

As the consumer-facing digital component of the Marketplaces, HealthCare.gov needed to enable millions of Americans to:

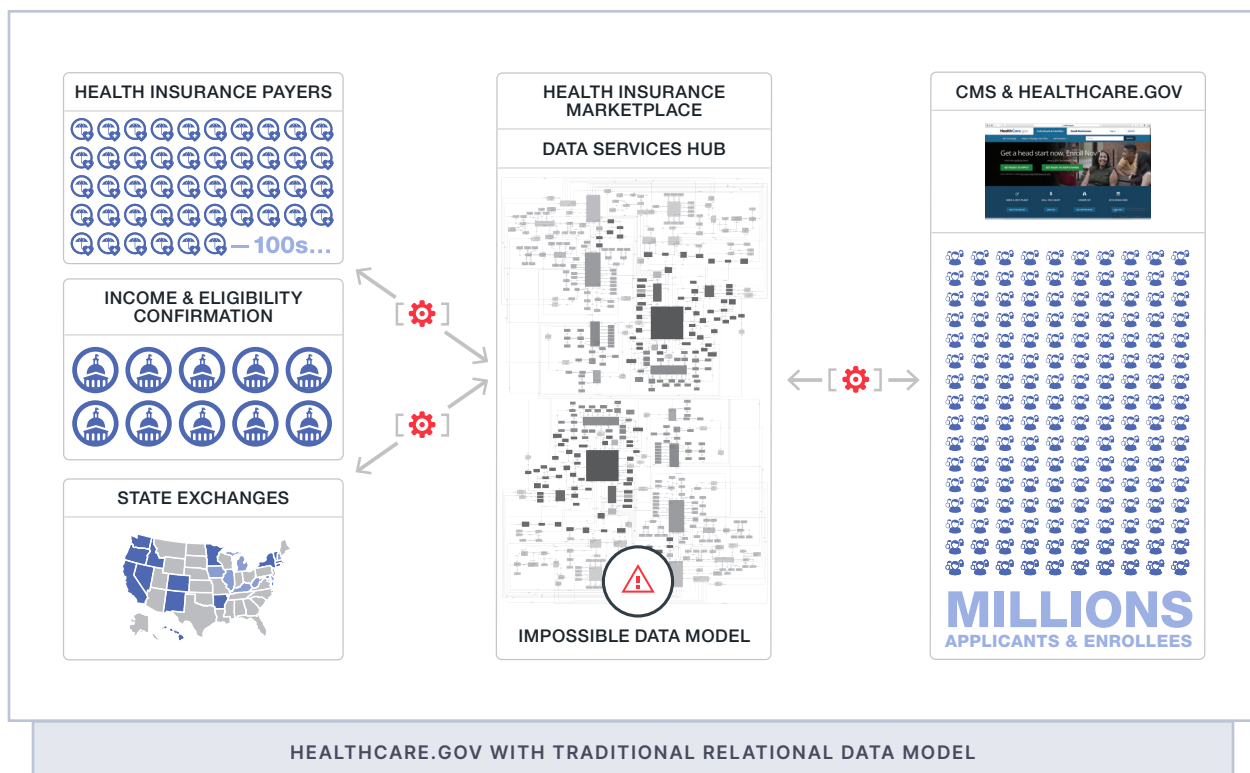
- Apply for tax credits to reduce the cost of coverage
- Shop for Qualified Health Plans (QHPs) and dental plans
- Submit an enrollment application for a QHP or dental plan

Further complicating matters, HealthCare.gov would be unique in terms of its scale because it would have to handle millions of concurrent users, much like Facebook* or Google*. However, unlike those websites, HealthCare.gov would be a fully transactional system with the necessary security to protect sensitive personal healthcare data comparable to modern large-scale financial systems.

1. U.S. Census Bureau, "Health Insurance Highlights – 2010", <https://www.census.gov/hhes/www/hlthins/data/incpovhlth/2010/highlights.html>

Behind HealthCare.gov, CMS had to create a complex infrastructure to manage how consumers interacted with the website. For instance, an application for tax credits or to enroll in a QHP required that the OEES not only store data submitted by the applicant, but also perform a complex stream of transactional activities to verify eligibility, adjudicate the application, and ultimately effectuate enrollment. What is more, the infrastructure would also need to keep secure an extremely high volume of sensitive information, such as applicants' Social Security Numbers and income.

Eligibility and enrollment processes required building the DSH to interface with the numerous disparate Federal authoritative data sources, including the Social Security Administration, the Internal Revenue Service, the Department of Homeland Security, and several other Federal agencies. Because the DSH would be used by all of the Marketplaces, including those established by individual states, it would need to communicate seamlessly with appreciably different state-level information systems. Finally, the DSH would need to perform all of these transactions in real-time, in order to provide consumers with a seamless shopping experience.



The Rollout

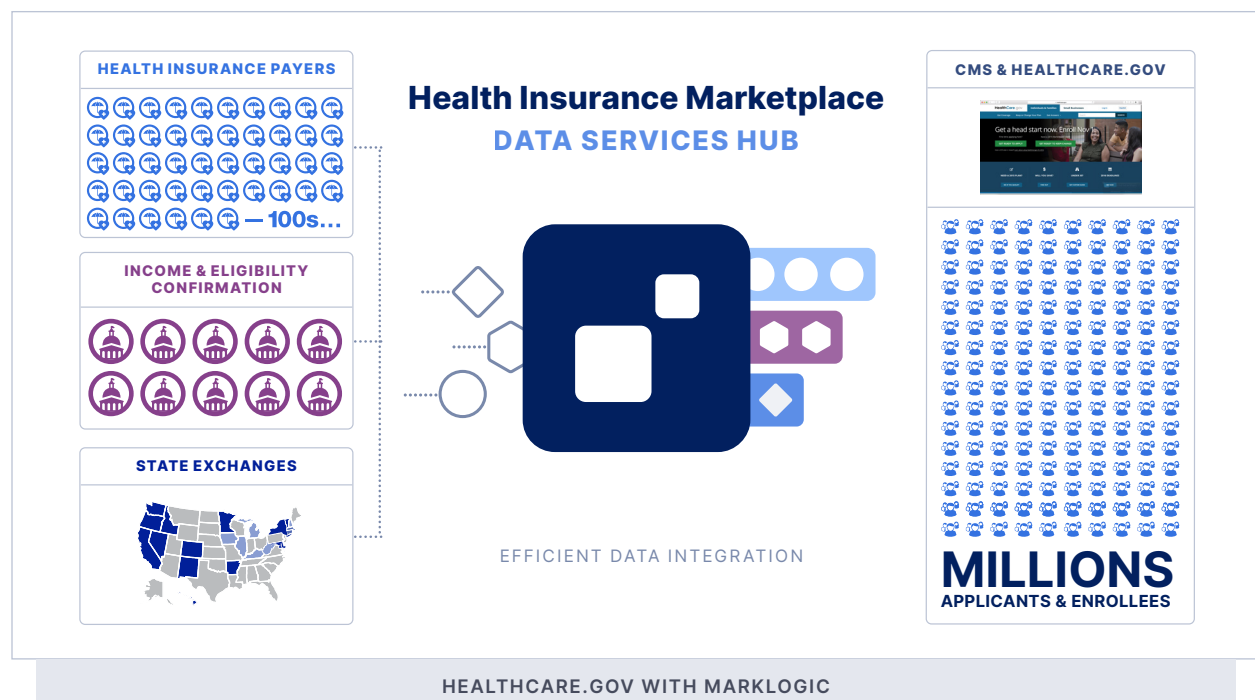
At the beginning of open enrollment in October 2013, CMS's rollout of the Marketplaces had both well-publicized struggles and less well-known successes.

WHAT WORKED? The DSH functioned as intended, allowing for seamless information exchange between various Federal agencies and programs, and numerous state-level systems.

WHAT DID NOT WORK? The consumer-facing digital component of the Marketplaces, HealthCare.gov, did not function properly and greatly hindered the ability of consumers to shop and apply for coverage.

More specifically, HealthCare.gov initially struggled to cope with:

- Unreliable, failing, and limiting infrastructure, from network bandwidth to load balancers, virtual machines, and network attached storage devices
- Hardware configuration issues that created serious instability problems across the overall system
- A malfunctioning third-party application that stalled transactions
- Poor database architecture based on automatically generated, simplistic code that forced massive data model saves at every step, slowing system functionality
- Significant “technical debt” because of too few automated tests, poor configuration management processes, and no code quality checks, all of which resulted in numerous system bugs



Why MarkLogic?

The magnitude and complexity of CMS's challenge in setting up the Marketplaces required unique and extraordinary technological capabilities.

THE DSH RUNS ON THE MARKLOGIC DATABASE. MarkLogic's new-generation database technology provided, and continues to provide, a seamless interface with various Federal agencies and programs, and all Marketplaces, to drive eligibility and enrollment processes.

HEALTHCARE.GOV RUNS ON THE MARKLOGIC DATABASE. CMS made the decision to switch over to the MarkLogic platform less than two years before the launch of HealthCare.gov because it realized that legacy relational database architecture could not provide the necessary system capabilities in the required timeframe. Because of the MarkLogic database's unique capabilities, the team was able to adapt most of the existing database architecture, so that OEES was completed in just 18 months. The enduring ramifications of early architectural issues and last-minute changes to components of HealthCare.gov affected its user functionality and brought about the website's struggles during the early weeks of open enrollment.

CMS chose MarkLogic's new-generation Enterprise NoSQL (Not-only SQL language) database technology because of its unique capabilities.

NOSQL. The MarkLogic database ingests data "as is" regardless of schema. This allows both the DSH and OEES to easily manage various data types, even as they change over time, without the need for the extensive upfront data modeling required by a traditional relational database.

SCALABILITY AND ELASTICITY. The MarkLogic database scales horizontally, rather than vertically. This means that it can run across multiple servers, each working in concert and sharing part of the load. MarkLogic scales quickly, without architectural workarounds, on commodity hardware in a cloud environment. These capabilities allow MarkLogic to handle the extraordinary data volumes required for eligibility and enrollment processes, all within the Marketplaces' cloud-based infrastructure. What is more, when data volume demands are reduced between open enrollment periods, MarkLogic has the ability to easily scale back, helping CMS avoid unnecessary data management costs.

ENTERPRISE FEATURES. Unlike other NoSQL databases, MarkLogic has the enterprise-grade technology to ensure the reliability of transactions throughout the DSH and OEES, provide the high availability and disaster recovery capabilities needed to ensure consistent and uninterrupted system performance, and certified security to protect the sensitive data collected during eligibility and enrollment processes.

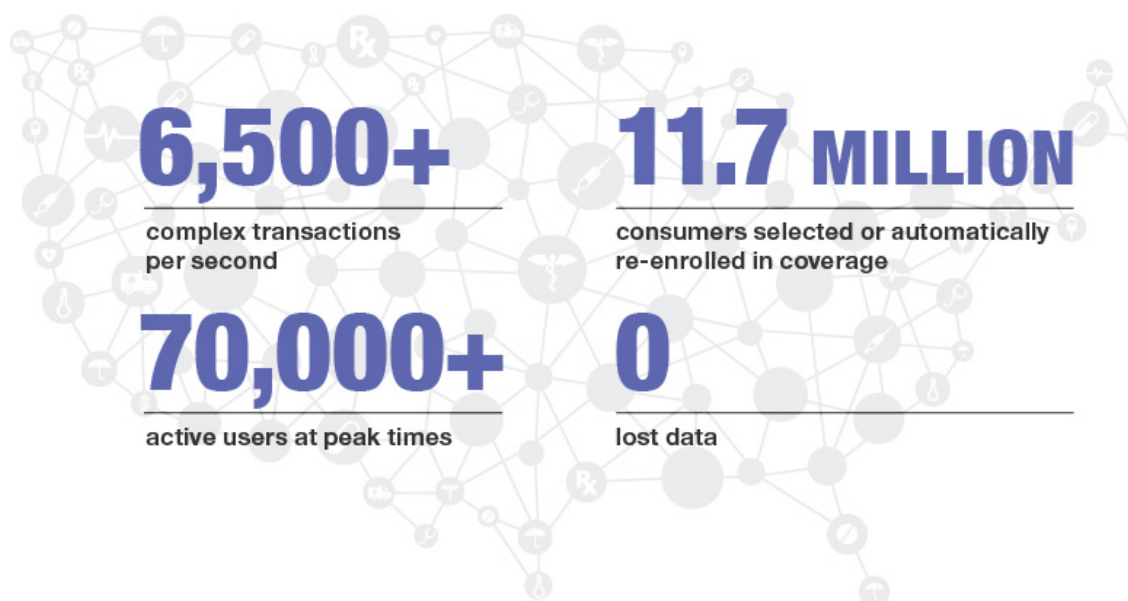
What's more, MarkLogic is much more than just a new generation of database technology. When HealthCare.gov struggled during open enrollment, MarkLogic's engineers and consultants helped the U.S. Digital Service, the elite team formed to turn around the website, achieve its objectives. In just ten weeks, MarkLogic's engineers and consultants worked tirelessly to deploy additional hardware and software to improve HealthCare.gov's struggling infrastructure, reduce bottlenecks and, ultimately, accelerate enrollment.

MarkLogic's results tell the story

CMS celebrated its 50th anniversary in 2015. For CMS's most mission-critical project to date, MarkLogic's technology and team produced results. Without any data loss, the MarkLogic Enterprise NoSQL database supported:

- 1000s of transactions per second
- 280,000 concurrent users
- 99.9 percent availability
- 99.9 percent of queries with response times under 0.1 seconds

When the second year of open enrollment came to close in February 2015, HealthCare.gov supported over 11 million enrollments or automatic re-enrollments². All of the critical system-of-record functions continue to run on the MarkLogic database.



2. U.S. Department of Health & Human Services, "Open Enrollment Week 13: February 7, 2015 – February 15, 2015" (Feb. 18, 2015), <http://www.hhs.gov/healthcare/facts/blog/2015/02/open-enrollment-week-thirteen.html>



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