Minnesota Department of Health's Journey to the Cloud

State of Minnesota — Minnesota IT Services

CATEGORY:
Business Process Innovations

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MINNESOTA IT SERVICES

Executive Summary

Aging data center equipment, technical debt, escalating operations cost, and fast-moving demands for IT service changes prompted the Minnesota IT Services (MNIT) team partnering with the Minnesota Department of Health (MDH) to pursue a bold cloud migration initiative. Over the course of 20 months, the team migrated MDH's 150 application portfolio to an Amazon Web Services (AWS)-based infrastructure. This simultaneously revamped its operational paradigm to follow a DevOps (Development-Operations) model, featuring cross-functional team integration and high-levels of process automation.

The result is a highly secure, adaptive infrastructure environment where managers use consumption-based pricing and cloud-based elasticity to deliver scalable and responsive business solutions. Following the move into the AWS-DevOps model, the team expanded its service portfolio into Artificial Intelligence-Machine Learning (AI/ML) and Data Lake technologies.

This effort has been all about modernization – catapulting Minnesota Department of Health into a future where technology is fully available as an enabling force, without the drag of legacy technologies to slow us down or to prevent us from delivering any service, anywhere. MNIT is positioning the organization to focus on their business without concern for our ability to deliver the services they need to meet their objectives. The focus on information security as a core value within the environment provides confidence that risk of information loss is effectively mitigated.

Note: This project was completed within the 2017-2019 timeframe for the nomination. As this nomination is being written, the current COVID-19 pandemic crisis has demonstrated the value proposition of this environment by allowing system administrators to rapidly scale up business systems in the face of unplanned demand. Data Lake technologies proved essential to Minnesota's COVID-19 response.

EXEMPLAR

The Minnesota Department of Health is a data rich environment that relies on information systems to inform health policy development affecting large populations of Minnesotans. MDH plays a central role in disease surveillance and the provisioning of services to prevent health problems from becoming far-reaching. The state Public Health Laboratory (PHL) is part of that mission. MDH is also a major regulatory organization that issues over 120 individual credentials and licenses. Private health information (PHI) and personal identifying information (PII) are ubiquitous, with access governed through a maze of federal and state-appointed rules.

MDH is an extremely dynamic organization, requiring technologies that are responsive to constantly shifting social, operational, and political demands. Anticipating the need for major investment in its application hosting infrastructure and recognizing the interest of state IT leadership in cloud-based services, the bold decision was made to aggressively pursue a cloud-forward provisioning philosophy and bring the entire MDH portfolio into AWS.

With cloud provisioning and a DevOps toolchain, MNIT staff are able to rapidly deploy business application updates and automate most system administrative tasks. The team can quickly provision server and database resources with extra capacity on-demand, maintaining high performance of key business applications. The change has also had dramatic workforce impacts, with innovation and progressiveness taking hold as dominate cultural values.

CONCEPT

The world is quickly evolving, and our government information systems must be highly adaptive to keep up with changes in legislation, rapid shifts in transaction volumes, public information demand, new reporting requirements, and new service delivery channels. We must also scale rapidly in response to crisis. Strong demands for fiscal accountability and cost control are increasing.

Values of adaptability, accountability, and scalability were the genesis for the project. Like many government agency environments, there was a great deal of inertia to overcome in pursuing a radically new course. MNIT began with a series of pilot projects, gaining skills in the various cloud application deployment options available to us. This allowed us to demonstrate to ourselves and our MDH business partners that the work was feasible. Executive MDH leadership approved funding for the project by repurposing the existing data center hardware maintenance budget, and providing full management support for an embedded security strategy to eliminate all critical and high security vulnerabilities in our systems prior to migrating each application.

Each business application was separated into categories based on the nature of its technical profile, and standardized, repeatable processes developed to move applications in each category through the AWS migration. Through time, automated work streams were developed that accelerated each process.

Once applications were migrated we began an optimization process to manage down costs of each deployment by setting hours of operation and capitalizing on native AWS system administrative functionality. With the team

maturing into a DevOps identity, individual and group-based innovation took hold and accelerated the optimization process.

The project used a modified agile approach focusing on collaboration across teams and the development of repeatable processes to move workloads through the system. Even then, each individual application presented challenges. The team used obstacles presented by legacy technologies as opportunities to bring more modern technology elements into the stack and even to refactor some of the code base.

At the approval stage of the effort, MDH leadership authorized $750K per year to fuel the effort (repurposed data center hardware budget). Total person-hours on the project were 20,400, and the main body of production work completed over 20 months. Total project cost was $947K plus production hosting costs during development of $375K. Annual hosting costs for the new environment settled into about $400K following the first stage of optimization (approximately $28K per month for production and non-production environments, plus $5K per month for management environments, see Figure 1). We shaved $550K off our hardware replacement budget and replaced it with a $400K expense, so that is a savings of $150K per year. This, in addition to providing superior performance and resiliency.
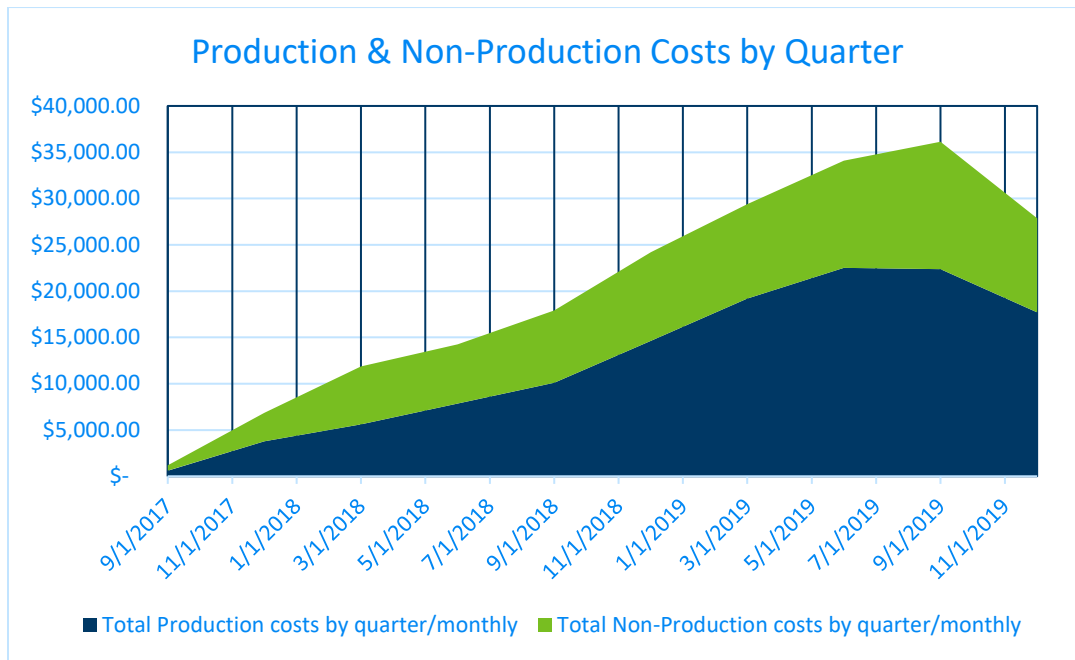

Figure 1: Monthly AWS Hosting Costs Showing Optimization Inflection Point, Third Quarter 2019. AWS hosting costs increased over time as more workloads moved into AWS. We reached our inflection point in Q3 2019, where costs decline, despite the addition of even more workloads. We achieved optimization of the hosting environment, primarily by putting systems "asleep" when not in use.

Cost benefits are also reflected in electrical utility cost reductions, with data center power consumption decreasing by over 50 percent during the last year of the effort (see Figure 2). Additional reductions are anticipated as idle legacy equipment continues to be decommissioned through calendar year 2020.

Figure 2: *Average Cost/Day Change, July 2017 – May 2020*

As a community health and services organization, MDH strives to conform to accessibility standards and these values were fully applied during the migration/remediation stage of the effort. Early on, the team adopted a "security first" paradigm over all other project values, including speed. No application entered the AWS environment with a Critical or Severe vulnerability. A total of 199 security vulnerabilities were remediated during the course of the effort. Information security professionals were integrated into the DevOps team and began injecting security controls into the automation stack. We now enforce security policies through automation.

The MDH AWS migration and subsequent DevOps optimization efforts provide a nucleus for like-minded efforts in other state agencies. Our MNIT teams provide active outreach and state IT community leadership to encourage cloud development efforts and to share expertise with other agencies.

SIGNIFICANCE

The initial scope was to transform MDH application infrastructure-operations to capitalize on the advantages offered by a modern cloud hosting environment: scalability, high-availability, resiliency, speed to market, responsiveness, agility, cost control. This new environment also required transforming ourselves – changing how we approach work, roles and responsibilities, and the very nature of team collaboration.

Ultimately, the beneficiaries of the new environment are the citizens of the state of Minnesota. Everything we do is for their benefit. Our business partners at MDH benefit because we can stand up systems and make changes much more quickly. Highly available systems provide continuity and build trust. System administrators have a wealth of information available to them to understand application performance and behavior (for example, see Figure 3).
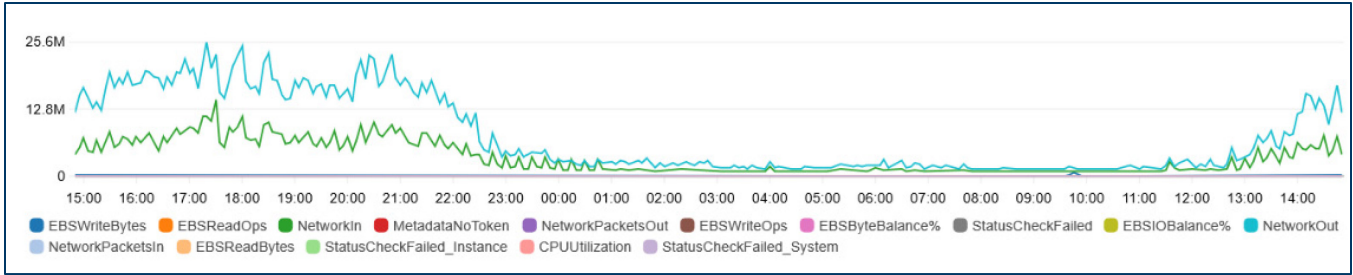
Figure 3: MR&C (Vital Records System) Daily Resource Consumption

Systems experiencing resource contention can be quickly scaled up to meet demand. For example, when our Cannabis Registry system database began running out of resources, the team took it down, made some configuration adjustments and had the upgraded system back in production within 30 minutes. This would have normally taken hours. Major system changes can be affected much more quickly. Business managers have great insight into system costs (see Figure 4) and are presented with opportunities to right size their deployments and save money.
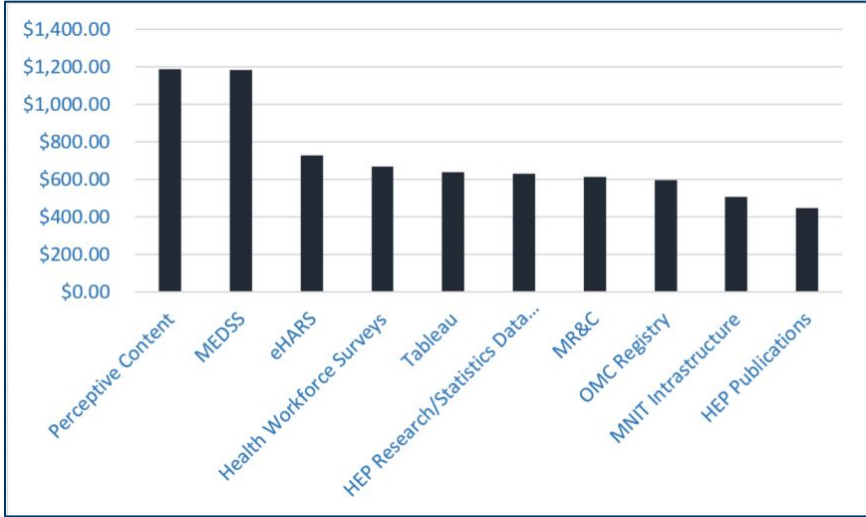

Figure 4: Monthly Cost (December 2019) for the Top 10 Most expensive MDH Systems

The primary means of saving money is by putting an application to sleep during off hours (e.g. middle of the night). When an application is spun down, it doesn't incur any cost. Applications in that state can be resurrected on demand. We are also able to provide disaster recovery services well above previous levels.

While our work might not be viewed as innovative through a private sector lens, it is ground-breaking from a government services perspective. Achieving technical and workforce transformation in the public sector is no small thing, requiring both grit and an innovative spirit. We know of no other agency in our field of view that has so thoroughly transformed its work through a comparable effort.

We are just getting started. As we continue to optimize our work toward container-based applications and serverless/microservices-based architectures, opportunities for increasing speed, agility, and interoperability within the agency and with external partners abound. The MNIT team is poised as both an incubator of

technical expertise and an accelerator for other teams pursuing similar courses. We are positioned to pursue a next-generation cloud services capability for those agency partners prepared to collaborate at this level.

IMPACT

Prior to the Cloud Transformation project, MNIT was challenged to keep pace with the demands of our business partners for application hosting, database administration, and information security services. Operations teams were fragmented and technically isolated, and experiencing difficulties approaching development and troubleshooting challenges cohesively. System upgrades were laborious, and administrative tasks were largely done manually through user interfaces. Turnaround time for significant service requests was measured in weeks. We were unable to effectively collect and communicate operating cost information to our business partners, and lacked basic transparency in our service delivery. Realistic recovery time and recovery point objectives for disaster recovery (DR) services were mostly measured in weeks.

After the project, we work in coherent, seamless work teams across multiple disciplines. Response times for significant service requests have been pared to days or hours, and sometimes minutes. Our toolchain-automation stack enforces security policies at the time of creation, and automates many of basic system administrative tasks. We are able to scale up resources quickly to handle unplanned increases in computing services demands, and place unused computing resources into a hibernation status outside of working hours. Business application user testing environments can be created on demand. Recovery of most applications in a DR scenario are measured in hours and minutes. Our system of tagging cloud assets with codes allow us to associate direct costs with every business application, allowing our business partners to understand resource consumption across divisions and programs. Our innovative and progressive spirit has allowed us to recruit and retain a younger workforce.

Immediate impact of these changes were probably not apparent to our business partners, as the application migration process itself was largely seamless. We saw modest performance improvements in some systems, but for the most part it appeared status quo from a customer side. The impact comes from our ability to maintain strong performance in the face of change, be it from higher volumes of transactions, or more processing-intensive system requirements. We are also able to upgrade systems more quickly and seamlessly, and ensure higher availability. Business application changes can be put into production more quickly, with higher levels of accuracy in the deployment through automation. But it is the future that we look forward to as the environment enables the adoption of forward-looking approaches to application development, and data integration using technologies native to the environment. We are experimenting with cloud services for a variety of file data management use cases, and automating manual processes through the use of artificial intelligence and machine learning tools. It is unlikely we would be working with these cloud-based solutions if we were not a cloud-based organization.

Our original analysis suggested that this cloud-forward approach would have lower total cost of ownership than other options available to us. We believe that to be true, although a detailed analysis demonstrating it has not been conducted. From a non-financial perspective, the project has increased the pace at which we can support our business, ensured higher availability of business applications, reduced information security risk, and provided superior disaster recovery capabilities. On an intangible level, it has transformed our IT workforce and created a culture of innovation and progressiveness.