

# Leverage Microservices And Machine Learning To Improve Patient Safety

By Architect  
(Antra Technology Services Group)

## Executive Summary

Microservices architecture fosters leveraging a range of heterogeneous technologies to meet customer needs. In this case study, you will see how a healthcare company leveraged the power of cloud-based machine learning to collect the most significant data and present it to their healthcare professionals in the industry, giving them a plenty of remarkable choices to classify the related safety events. This has been only possible after refactoring their existing monolithic SaaS system to a Microservices-based architecture.

**Keywords:** Architecture, Brown-field applications, Refactoring, Cloud, Machine Learning

## What is Microservices Architecture?

Microservices architecture is a method of developing software applications as a suite of independently deployable, small, modular services in which each service runs a unique process and communicates through a well-defined, lightweight mechanism to serve a business goal.

## Background/History

### Background

Incidents that have a direct or indirect impact on the safety of a patient in a hospital are termed as safety events. Examples: patient given wrong medication; patient was not given attention in timely manner; patient vitals were not monitored as prescribed by the attending physician. These events are ubiquitous and are categorized for an easy follow up to assess the root cause and preventive action to be taken care in the healthcare industry.

### History

The healthcare company provided an on-premise SaaS-based multi-tenant system for hospitals. The system was having a monolithic architecture built using Microsoft .NET and ASP.NET MVC technologies. Based on their customer feedback and research, it was deemed that their system would require an automatic classification to speed up the reporting process of the many safety incidents. Displaying both local and global statistical information for every healthcare facility, would motivate health workers and help them to report incidences more often than what they were used to.

### Problem

To provide these intelligent classification options would involve a performing-analysis on the present historical data. This is indeed a computationally intensive task. And to display this requisite statistical information, the system requires the usage of some specialized tools to operate on a number of large data sets. However, the existing architecture needs to be overhauled to meet the aforementioned requirements.

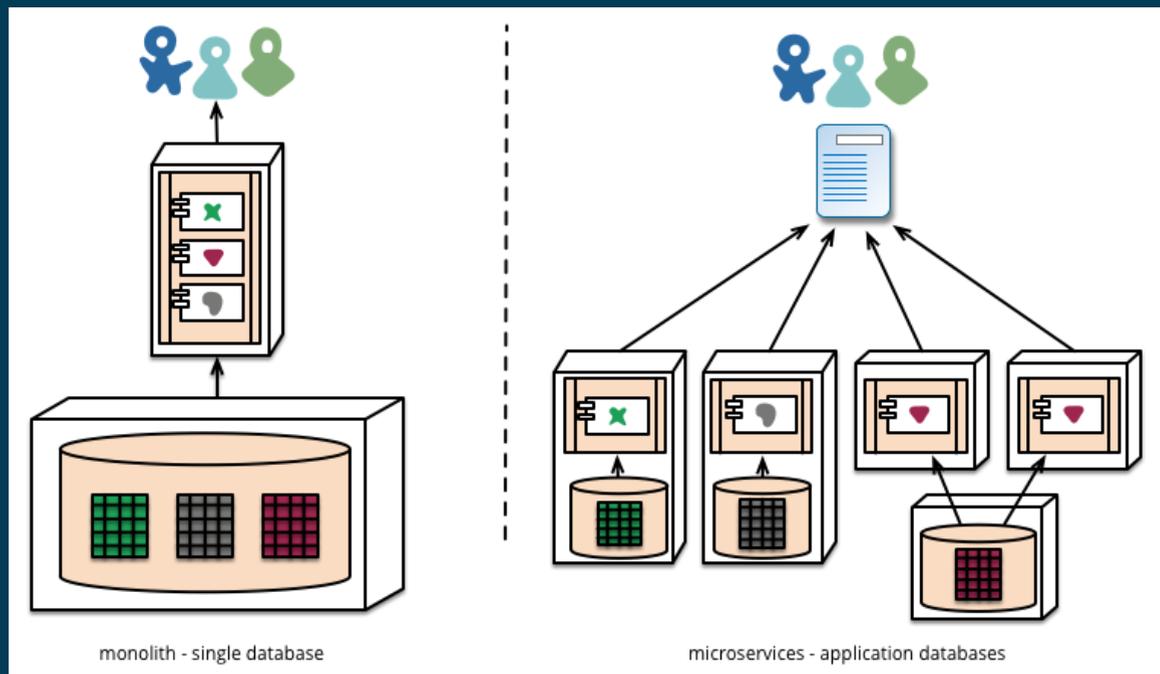
## Solution

### Summary

Given the computationally intensive nature of the new requirements, moving to a cloud-based solution seems to be the only viable alternative. Microsoft's Azure cloud solution has Azure ML for machine learning and Power BI for meeting the new requirements. Besides, the existing developer skill-set can be leveraged. Moving all of the existing system would involve a considerable risk and reworking on many of the important configurations in the system. In addition to this, the time consuming security and compliance assessments have to be redone. In short, a hybrid solution was needed. Existing architecture would need to be re-factored to a Microservices based architecture.

## New Architecture Based on Microservices

It was imperative that the existing architecture be refactored in order to meet the new requirements. The existing monolithic system was sliced vertically into 4 systems viz. the data entry piece, the intelligent classification system, the follow-up & root cause analysis system and the statistics display system.



(from Microservices by Martin Folwer, et. al.)

## On-premise Data Entry System & Follow-up System

The data-entry and follow-up system worked off of the same database. The system was optimized to scale-up the process of large transactions. This was hosted on-premise using Windows Server 2012, Microsoft .NET and Microsoft ASP.NET MVC using Knockout ,JS, jQuery.

## Cloud-based Machine Learning System

The intelligent classification structure had a system that needed to be worked off a de-normalized database, which was optimized to run some of the standard machine learning algorithms. The updates given in this database were infrequent. Changing data set every time, meant an action triggering the learner again. This would mean re-verifying the results.

## Cloud-based, Power BI-enabled Statistics System

This system used a database design optimized for reports generation. The team was able to achieve graph and table display using Azure Power BI utilities.

The ETL job to populate this database runs several times in a day.

## Integration

The service endpoints were all REST APIs. Scalability was achieved using the API gateway design pattern. This allowed for REST endpoints to be load-balanced. The system continues to use the load balancing systems that they used for the earlier on premise only application as it was able to effectively and quickly classify patients' safety events.

The new system that was built by leveraging both micro services and machine learning provided intelligent classification options for safety events. Adding ease to the system, the healthcare company was able to speed up the reporting process of the safety events and was able to improve patient safety with their all-new and full-fledged system - backed by cloud-based machine learning.

- The healthcare company was responsible for improving patient safety by refactoring their system from on-premise SaaS-based multi-tenant to cloud-based machine learning system
- The healthcare company was able to auto classify safety events and meet the needs of several healthcare professionals in the industry
- The company leveraged heterogeneous technologies offered by Micro services architecture and cloud based machine learning

## References

Lewis, J., & Fowler, M. Microservices. Retrieved from <http://martinfowler.com/articles/microservices.html>

Russinovich, M. Microservices: An application revolution powered by the cloud. Retrieved from <https://azure.microsoft.com/en-us/blog/microservices-an-application-revolution-powered-by-the-cloud/>