

# MONTE TITOLI: ADVANCED ANALYTICS & MACHINE LEARNING ON AWS

**DATA REPLY** is the Reply Group company that offers excellent services for Big Data and Artificial Intelligence. We operate across most industries and business functions in order to support executive level professionals and Chief Officers to harvest value from data. We build Data Platforms, define and implement ML and AI models in an efficient, replicable and scalable way, by relying upon human resources highly skilled in Big Data Engineering, Data Science and Intelligent Process Automation. Always active on innovations, we are applying Quantum algorithms to support the optimization of processes with high computational needs.

**STORM REPLY** is the company in the Reply Group specialized in the design and implementation of innovative Cloud-based solutions and services. Through consolidated expertise and many years of experience in the creation and management of Infrastructure as a Service (IaaS), Software as a Service (SaaS), and Platform as a Service (PaaS) Cloud solutions, Storm Reply supports important companies in Europe and all over the world in the implementation of Cloud-based systems and applications.

Storm Reply and Data Reply supported Monte Titoli to define and develop the adoption strategy of Cloud architectures, governance of resources and ML models.

**MONTE TITOLI**, part of the London Stock Exchange Group (LSEG) provides efficient and secure settlement, custody, asset servicing, collateral management and issuer services to domestic and international clients. The company manages a wide range of financial instruments with €3.32 trillion of assets under custody. In 2019, processing over 44 million transactions with a year-end settlement rate of 96%.

## THE CHALLENGE – A NEED FOR AN ADVANCED ANALYTICS AND MACHINE LEARNING PLATFORM

Monte Titoli, the Italian central depository (CSD), part of the London Stock Exchange Group and leading provider of post-trade services in Europe, was looking for a fast and secure way to extract value from its data, previously managed on-premises with a classic data warehouse (DWH) approach.

In 2018 Monte Titoli decided to utilize AWS Advanced Analytics and Machine Learning solutions, in order to increase the efficiency of internal processes and improve their clients' overall experience. Monte Titoli chose to rely on Amazon Web Services for its Cloud platform and on Reply, AWS Premier Consulting Partner since 2014, to define and develop the adoption strategy of Cloud architectures, governance of resources and Machine Learning models.

The customer's final goal was: **achieve a flexible and scalable Cloud platform** that

supported the introduction of advanced predictive and prescriptive analytics pipelines, to **scale faster by designing and executing data science projects on Amazon Web Services** and to **speed up Machine Learning adoption across the organization**.

Due to the strict internal security policies in place and in light of the importance of the data being handled, great attention has been paid while designing a secure solution. Highly secure network design and an initial service whitelisting were also part of the challenge since this was the customer's first Cloud Native project.

# THE SOLUTION – A SERVERLESS, SCALABLE AND SECURE DATALAKE & ML PLATFORM ON AWS

## A DATALAKE ARCHITECTURE TO DRIVE BUSINESS DECISIONS BASED ON ARTIFICIAL INTELLIGENCE

The Datalake architecture, running in production since the beginning of 2019, heavily relies on the AWS serverless approach for orchestration, automation and monitoring purposes giving the infrastructure the agility to scale on-demand based on Business requirements.

The solution makes use of fully managed and on-demand, licence free AWS services and this approach led to an easy to manage infrastructure with extremely low Total Cost of Ownership when compared to other “standard” Datalake solutions that usually carry high license costs. A ML sandbox infrastructure that relies on Amazon SageMaker and Glue was added to the Datalake providing a working environment for the data science team. A ML pipeline automates the model training and prediction process that are done using extract, transform, and load (ETL) and ML AWS Services, making new insights daily available to the Business via their BI tool.

Over 70 batch raw ingestion streams consisting in several GB of financial transaction data are loaded daily to the Datalake triggering an automated ETL process (orchestrated and synchronised through Lambda and DynamoDb tables) which ultimately provides consumable data to the DWH. Aggregation queries run on the data producing business-oriented Datamarts, that are presented through Tableau Server in form of dashboards that the business consumes.

Additional ETL jobs and transforms run automatically on both freshly ingested data and pre-existing Datamarts,

producing ML forecasts that are also presented via Tableau to foresee the data trends. Leveraging Amazon Web Services and Storm Reply’s expertise, Monte Titoli was able to design and deliver a performant and compliant solution for their business needs to maximise value for their internal and external customers.

a half years of market trading information. A team of data scientists is currently working in a segregated manner on shared data, each using their personalised Sagemaker notebook instance and Glue jobs invoked through customised triggers to enforce control resource consumption. **The architecture designed by Storm**

The **entire process**, from ingestion to final dashboards and predictions, runs in **less than 1h**.



The Datalake project was developed and deployed adopting the **Agile methodology** and **DevOps approach** and it went live in less than 6 months. Currently new streams are being ingested and an ever increasing set of dashboards and predictions is produced and delivered on a daily basis using a dataset of over two and

**Reply can be scaled on demand, has zero fixed license costs and a very low management effort** since it uses mostly managed and serverless services. The proposed architecture design became a reference architecture within the LSEG group for Datalakes and Datalabs.

## ML PLATFORM TO DESIGN AND EXECUTE END-TO-END ML PROJECTS

Data Reply supported Monte Titoli in implementing a fully-fledged ML platform on AWS, with Amazon SageMaker as a core component, enabling data scientists to design and execute end-to-end ML projects both on structured and unstructured data.

The newly designed serverless architecture leverages **Amazon Glue** for ETL activities dealing with data preparation and models results post-processing; on **Amazon SageMaker**

to build, train and deploy ML models via docker containers; on **Amazon Lambda** to automate models training, hyperparameter tuning and inference, providing full compliance with strong internal security requirements.

<p><b>AMAZON GLUE</b></p> <p>ETL activities: data preparation and models results post-processing</p>	<p><b>AMAZON SAGEMAKER</b></p> <p>Build, train and deploy ML models via docker containers</p>	<p><b>AMAZON LAMBDA</b></p> <p>Automate models training, hyperparameter tuning and inference</p>
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Moreover, a custom model monitoring job continuously controls Machine Learning models performances in production and sends alerts when any data quality or model performance issues occur. All predictive insights are showed on custom business dashboards fed by models results stored in a S3 bucket.

Data Reply proposed to design a suitable data science workflow adopting Cloud-native services:

**DATA PREPARATION AND MODELS IMPLEMENTATION**

**TRAINING**

**SERVING**

**MONITORING**

Monte Titoli’s data science team, supported by Data Reply data scientists, implemented classification and regression models aimed at **improving post-trading processes and predicting settlement efficiency**. Data cleaning, merging and exploration, feature engineering, modeling,

training and testing, hyperparameter optimization, models comparison, evaluation and deploy to production, all become straightforward activities due to a seamless integration between SageMaker notebook instances, Spark Glue ETL jobs and deployed model endpoints. Models are built exploiting both AWS built-in and custom Deep Learning TensorFlow 2.0 containerized algorithms. Both training and inference pipelines are up and running in production environment, generating daily batch predictions insights and custom business reports via Tableau dashboards.

This new infrastructure enabled the implementation, training, hyperparameter tuning, deployment and monitoring of ML applications, leading to a 50% saving of the time required to design and execute a full

ML workflow. Moreover, a custom model monitoring controls ML model performance in production, enabling its retraining only

when a data drift occurs and reducing models updating costs up to 75%.

 <p><b>-50%</b> TIME TO DESIGN AND EXECUTE A FULL ML WORKFLOW</p>	 <p><b>-75%</b> MODELS UPDATING COSTS</p>
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**This flexible platform enables the development and running of an unlimited number of predictive and prescriptive Machine Learning models.** It can serve a large number of internal and external users via both batch and real-time predictions endpoints, scaling with business requirements on-demand.