



## LEVERAGING AI TO TRANSFORM OPERATIONAL RISK MANAGEMENT (ORM) IN FINANCIAL SERVICES

## Overview

Operational risk (OR) is the risk of loss stemming from deficient or failed internal processes and systems, or human errors and negligence, or due to external events. It is inherent in all activities, systems, products, and processes of an organization. OR includes risks such as cyber security risk, financial crime risk (money laundering, fraud, trade manipulation, etc.), technology and IT risk, vendor and outsourcing risks, business disruption risks, and many other types of risks. In several cases, financial institutions (FIs) also report legal and compliance risks under OR.

While organizations can make profits by accepting certain financial risks (like

market risks), OR only causes losses for organizations in the form of adverse impact to bottom line, reputational damage, etc. Resultantly, robust operational risk management (ORM) is a key focus area for all organizations including FIs.

Unfortunately, today many FIs' ORM systems are found wanting. These systems are unable to keep pace with the increasing business complexities. For example, these rigid rules-based systems lack capability to process unstructured data (text, voice, charts, etc.) and to offer real-time and actionable insights on the firm's OR.

Artificial intelligence and machine learning (AI/ML)-based solutions can address many of the shortcomings that are prevalent in the traditional ORM systems. AI/ML-based solution possess deep learning, robotic process automation (RPA), natural language processing (NLP), natural language generation (NLG), natural language understanding (NLU), image recognition, graph analytics, and other advanced capabilities. They leverage sophisticated supervised (example, KNN, LDA, QDA, ANN, OCSVM, LASSO, Naïve Bayes) and unsupervised (example, X-means, GMM, Bisecting K-means, AHMMAS) ML techniques. These systems can:

|  |
|--|
| <b>Perform high-speed processing of massive volume of data</b> — both structured and unstructured — from wide array of sources to offer actionable insights                            |
| Enable <b>automated data visualization</b>   |
| <b>Automate repetitive tasks</b>   |
| <b>Self-learn and adapt</b> to changing scenarios  |
| <b>Offer accurate predictive capabilities</b> — ML algorithm can effectively take into consideration numerous levels of non-linearity, high number of variables, and large data volume |

## AI and ML Use Cases for ORM in Financial Services

There is increasing adoption of AI and ML for ORM in financial services. Refer below few use cases.



Figure 1: Examples of AI/ ML Use Cases for ORM in Financial Services

## OR Measurement and Monitoring

AI/ML-based solution can, for example, support:

|   |  |
|---|--|
|  | <b>Modeling and measurement of OR for capital calculation, risk prioritization, risk decisioning, etc.</b> — by applying Bayesian Networks and other sophisticated capabilities  |
|   | <b>Forecasting of capital reserve required for OR</b>  |
|   | <b>Optimization of regulatory capital for OR</b>   |
|   | <b>OR quantification and scoring</b> — by leveraging vast array of structured and unstructured data including historical OR loss data, incident database, internal risk indicators, control libraries, external loss data, risk reports, phone and messaging conversations, emails, adverse media/ negative news, and more |
|   | <b>OR self-assessment and development of key OR indicators</b>   |
|   | <b>Classification and aggregation of OR</b>  |
|   | Enablement of <b>early warning signals for various OR</b>  |
|   | <b>Improvements in existing OR controls</b>  |
|   | <b>Identification of idiosyncratic OR events</b> — using isolation forest model, etc. to unearth events unlikely to recur  |
|   | <b>Near real-time monitoring of OR</b>   |
| <b>Identify emerging OR</b> — by parsing through myriad public data sources       |  |

## OR Data Process Improvements

AI/ML-based solution can, for example, support:

|   |   |
|---|---|
|  | <b>Enablement of robust operational data control</b> — vis-à-vis research, reconciliation, remediation, and reporting   |
|   | <b>Data augmentation</b> — for example, analysis of free-text descriptions of loss events, NLP tagging of losses, interpolation of missing data, inferring missing attributes in control libraries based upon free text descriptions of control, etc. |
|   | <b>Automatic data categorization</b> — example, using unstructured free-text descriptions to classify loss data   |
|   | <b>Data quality assurance</b> — through automatic identification of duplicated entries, data gaps/ inconsistencies, “fat-finger” errors, etc.   |
|   | <b>Automation of repetitive and time-intensive data tasks</b> — such as collection, handling, and analysis of OR data through RPA   |

## OR Reporting

AI/ML-based solution can, for example, support:

|   |  |
|---|--|
|  | <b>Sophisticated ORM reports and dashboards</b>  |
|   | <b>Automated analysis of disclosure</b> (example, U.S. Securities and Exchange Commission (SEC) filings) to unearth risks in filings |
|   | <b>Reporting workflow automation</b>   |

## Model Risk Management

AI/ML-based solution can, for example, support:

|   |   |
|---|---|
|  | <b>OR models optimization</b>   |
|   | <b>OR models validation and backtesting</b>   |
|   | <b>Modeling of uncertainty in operational risk</b> — by leveraging probabilistic graphical models (PGM) |

## OR Stress Testing

AI/ML-based solution can, for example, support:

|   |   |
|---|---|
|  | <b>Scenario analysis for OR stress testing</b> (example, Dodd-Frank Act Stress Testing (DFAST), Comprehensive Capital Analysis and Review (CCAR))                   |
|   | <b>Optimization of scenarios</b> for OR stress testing  |
|   | <b>Automation of stress testing workflow</b>  |
|   | <b>Feature extraction for models</b> utilized in OR stress testing — ML algorithms can process massive volumes of data to extract large number of relevant features |
|   | <b>Preparation of stress testing results and reports</b>  |
|   | <b>Automated analysis by regulators</b> (example, SEC) of FIs' stress test reports — to identify anomalies  |

## Third-party Risk Management (TPRM)

AI/ML-based solution can, for example, support:

|   |  |
|---|--|
|  | <b>Enablement of 360° contextual awareness</b> of the firm's third-party relationships and risks   |
|   | <b>Sophisticated risk qualification and quantification</b> — using current and historical risk exposure data (both structured and unstructured) on the third party               |
|   | <b>Identification and prioritization of third-party risks</b>  |
|   | <b>Automatic mapping of third-party risks</b> to associated controls, line of business (LOB), and stakeholders   |
|   | <b>Management of third-party cyber risks</b>   |
|   | <b>Intelligent contract management with third-party</b>  |
|   | <b>Sophisticated reports and dashboards</b> — on concentration risk, vendors risk score, service-level agreement (SLA) compliance, etc.  |
|   | <b>Automated workflow and tools</b> — for example, intelligent third-party risk assessment tools, sophisticated alerts, advanced alert routing and escalation to concerned teams |

## Compliance and Audit Management

AI/ML-based solution can, for example, support:

|   |   |
|---|---|
|  | <b>Automated impact analysis of new/evolving regulations</b> — by evaluating and interpreting massive volume of documents and sources on federal, state, and international regulatory guidelines  |
|   | <b>Mapping of relevant regulations</b> — using ML, NLP, RPA, etc. — to the concerned LOBs, products, systems, controls, processes, etc.   |
|   | <b>Audit processes</b> — for example, a) run semantic intelligence analysis to discover audit issues; b) enable moving away from the existing auditing methodology that are based on backward-looking sampling, onto a more continuous and comprehensive monitoring; c) automatically reading through, say over 500-page contract, to ascertain if there are any legal issues |
|   | <b>Robo-advisers, virtual assistants, and chatbots</b> for internal compliance management and audit teams   |
|   | <b>Real-time non-compliance alerts</b>  |

## Conduct Risk Management

AI/ML-based solution can, for example, support:

|   |   |
|---|---|
|  | <b>Real-time behavioral analysis of staff</b> — to unearth anomalies  |
|   | <b>Automated analysis of staff related data</b> — such as e-mails, instant messaging, documents, calendar items, phone calls, activity logs, building entry/exit time, etc. — for conduct risk identification |
|   | <b>Proactive identification of misconduct by market participants</b> — for example, misleading marketing by unlicensed accountants that are engaged in providing financial advice                             |

## Cybersecurity Risk Management

AI/ML-based solution can, for example, support:

|   |  |
|---|--|
|  | Cyber risk scoring/quantification and residual-risk calculation              |
|   | Malware detection, analysis, and prevention                                  |
|   | Phishing and spam-detection and filtering                                    |
|   | Identifying the domain names generated by domain-generated-algorithms (DGAs) |
|   | Cyber threat hunting   |
|   | Pentesting   |
|   | Network intrusion detection and prevention                                   |
|   | Thwarting advanced, persistent threats (APTs)                                |
|   | Prevention of the zero-day attacks   |
|   | Automation of cybersecurity controls   |
|   | AI-based antivirus software  |
|   | Alert investigation and qualification  |
|   | False positives optimization   |
|   | Case review optimization (through document digitalization)                   |

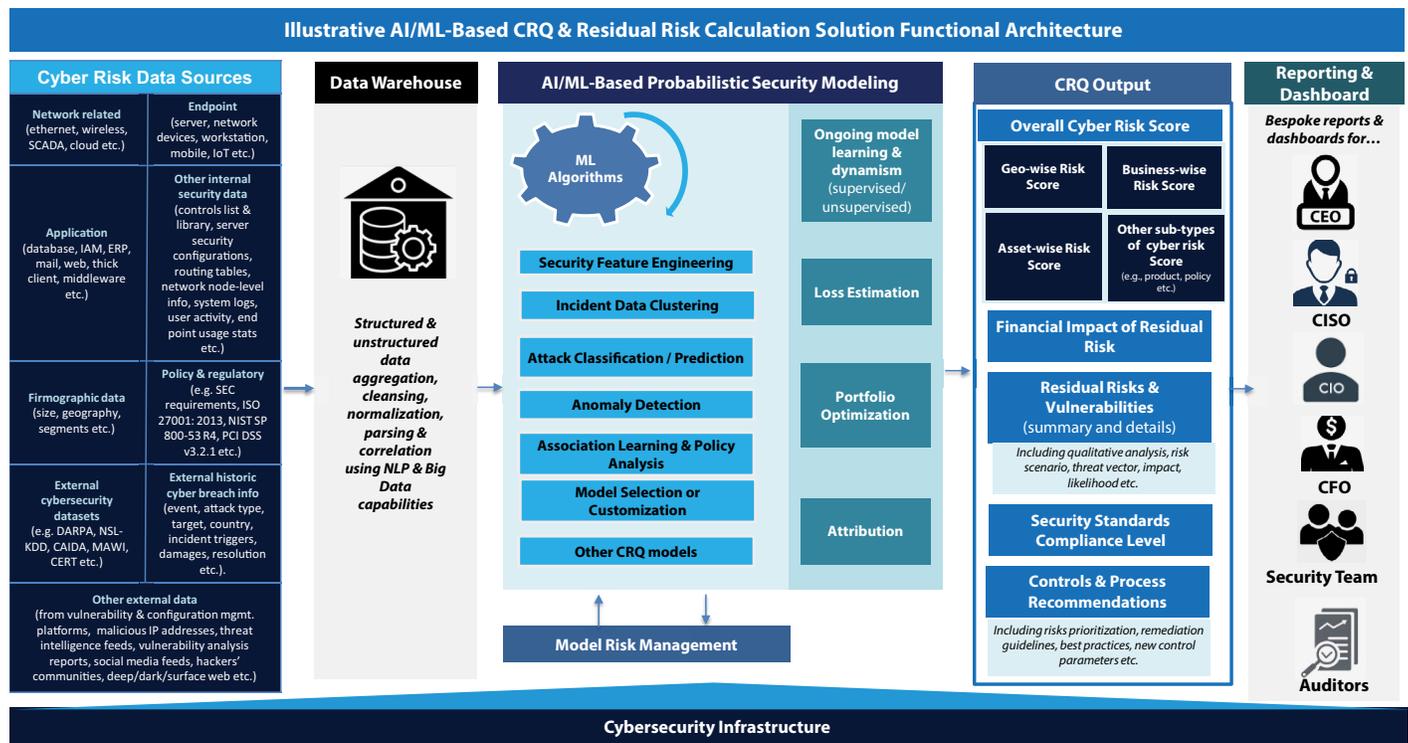


Figure 2: Illustrative AI/ML-Based Cyber Risk Quantification (CRQ) and Residual Risk Calculation Solution Functional Architecture

## Financial Crime Risk Management (FCRM)

AI/ML-based solution can, for example, support:

| Overall   |   |
|---|---|
|  | <b>Adaptive, real-time, and risk-based transaction monitoring</b>   |
|   | <b>Transaction screening</b> — to detect potential instances financial crime  |
|   | <b>Sophisticated risk scoring</b> — to aid in prioritization of investigation queues for suspicious activity reporting (SARs)   |
|   | <b>Customer onboarding and risk assessment</b> (know your customer (KYC), customer due diligence (CDD), enhanced due diligence (EDD)). For example: a) real-time transaction-based KYC anomaly detection; b) dynamic questionnaire for customer onboarding; c) intelligent customer segmentation for KYC profiling; d) identity and background pre-checks for remote KYC          |
|   | <b>Unearthing of financial crime and collusion by own by employees</b> — by tracking in real-time employees' digital activities and communications (emails, chat etc.), and multiple other system parameters  |
|   | <b>Detection of new financial crime scenarios</b>   |
|   | <b>Alert and case management</b> — for example, a) alert tuning; b) alert triage and prioritization; c) alert routing; d) alert hibernation and risk-rating of alert groupings; e) false positive reduction; f) auto-suppression/closure of low-risk alerts; g) risk-based alert scoring and prioritization; h) intelligent alert routing; i) sophisticated case management; etc. |
|   | <b>Reporting and dashboards</b> — for example, a) graphical, intuitive, and interactive visualization (of alerts, cases, etc.); b) intelligent reports and dashboards; c) support suspicious activity report (SAR), suspicious transaction report (STR), and suspicious transaction and order report (STOR), etc. submission  |
|   | <b>Workflow automation</b> — such as data processes; case management workflow; reporting workflow; customer onboarding; etc.  |

| Anti-Money Laundering (AML)   |   |
|---|---|
|  | <b>AML screening</b> — name screening; adverse media screening; sanctions and watchlists screening  |
|   | <b>AML profiling and segmentation</b> — intelligent profiling and segmentation; transaction threshold tuning  |
|   | <b>Sophisticated link analysis</b> — offering visual network maps (of relationships between entities including people, firms, suppliers, business partners, transactions, etc.) |
|   | <b>Specific AML risks intelligence</b> — geographic, temporal, emerging, etc  |
|   | <b>Ultimate beneficial owner (UBO) identification</b>   |

| Fraud Management   |  |
|--|--|
|   | <b>Real-time fraud detection via various banking channels</b> — online, mobile, ATM, etc. — using logistic regression, neural network, and other advanced techniques   |
|  | <b>Card and payment fraud detection</b> — using artificial neural networks (ANNs), fuzzy system, support vector machines (SVM), genetic algorithm (GA), hidden Markov model (HMM), and other advanced capabilities |
|  | <b>Unearth formjacking of payment card detail</b>  |
|  | <b>Fake account identification</b>   |
|  | <b>Identity theft detection</b> — by discovering inconsistencies in ID documents, etc.   |
|  | <b>Detect loan application fraud</b>   |
|  | <b>Discover account takeover (ATO) attacks</b>   |
|  | <b>Identify chargeback fraud</b>   |
|  | <b>Detect insurance claims frauds</b> (fake claims, duplicate claims, etc.)  |
| <b>Locate absconding fraudsters</b> — by searching public search engines, deep web, dark web, and available public databases to locate the whereabouts of absconding fraudsters and the banks that may be assisting them to move funds internationally |  |

| Trade and Market Surveillance   |  |
|---|--|
|  | <b>Communication surveillance</b> — by enabling a) integrated communication surveillance; b) contextualization of communication; c) deciphering of jargons and code words; d) intelligent speech-to-text transcription; e) sophisticated communication storage; and f) multilingual communication surveillance |
|   | <b>Holistic surveillance</b> — by enabling a) real-time data processing; b) smart segmentation; c) comprehensive, dynamic, and risk-based surveillance; and d) cross-asset class and cross-market surveillance   |
|   | <b>Employee and trader surveillance</b> — identify rogue traders, mis-selling by adviser, and the collusive manipulations (such as insider trading, benchmark rigging, etc.)   |
|   | <b>Unearth novel and complex trade manipulations</b> — including various forms of spoofing (including layering, vacuuming, collapsing of layers, flipping, spread squeeze, etc.); algorithmic trading (AT) and high-frequency trading (HFT) manipulations; and front running                                   |
|   | <b>AML and trade surveillance integration</b>  |
|   | <b>Support enforcement by supervisory agencies</b> — example, U.S. Consolidated Audit Trail (CAT) requirements; trade construction requirement; Regulation Best Interest (BI) and sales practices and suitability obligations; SEC filings (8-K) compliance  |
|   | <b>Regulatory change implementation</b> — for example, machine-readable rulebook, deciphering of new regulatory changes, support new regulatory change implementation; etc.  |

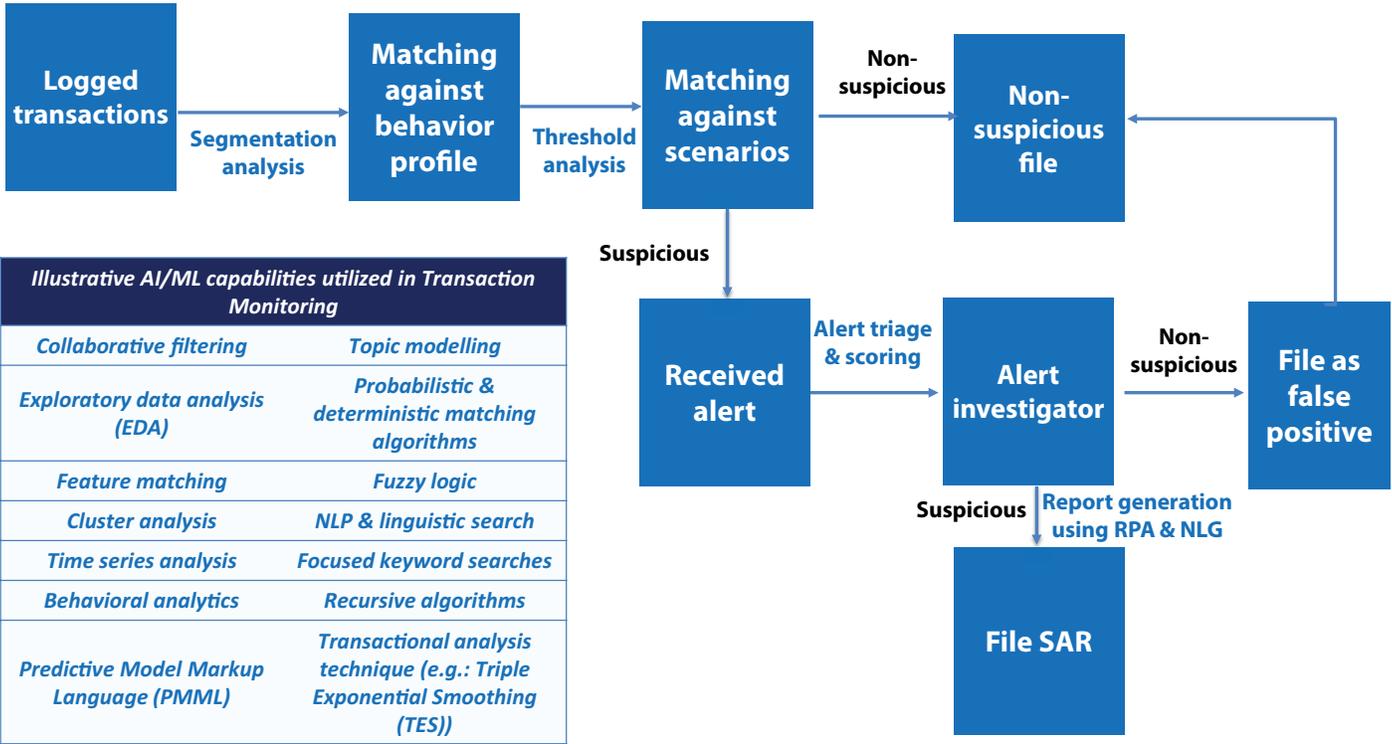


Figure 3: Illustrative AI/ML Role During Transaction Monitoring and Beyond

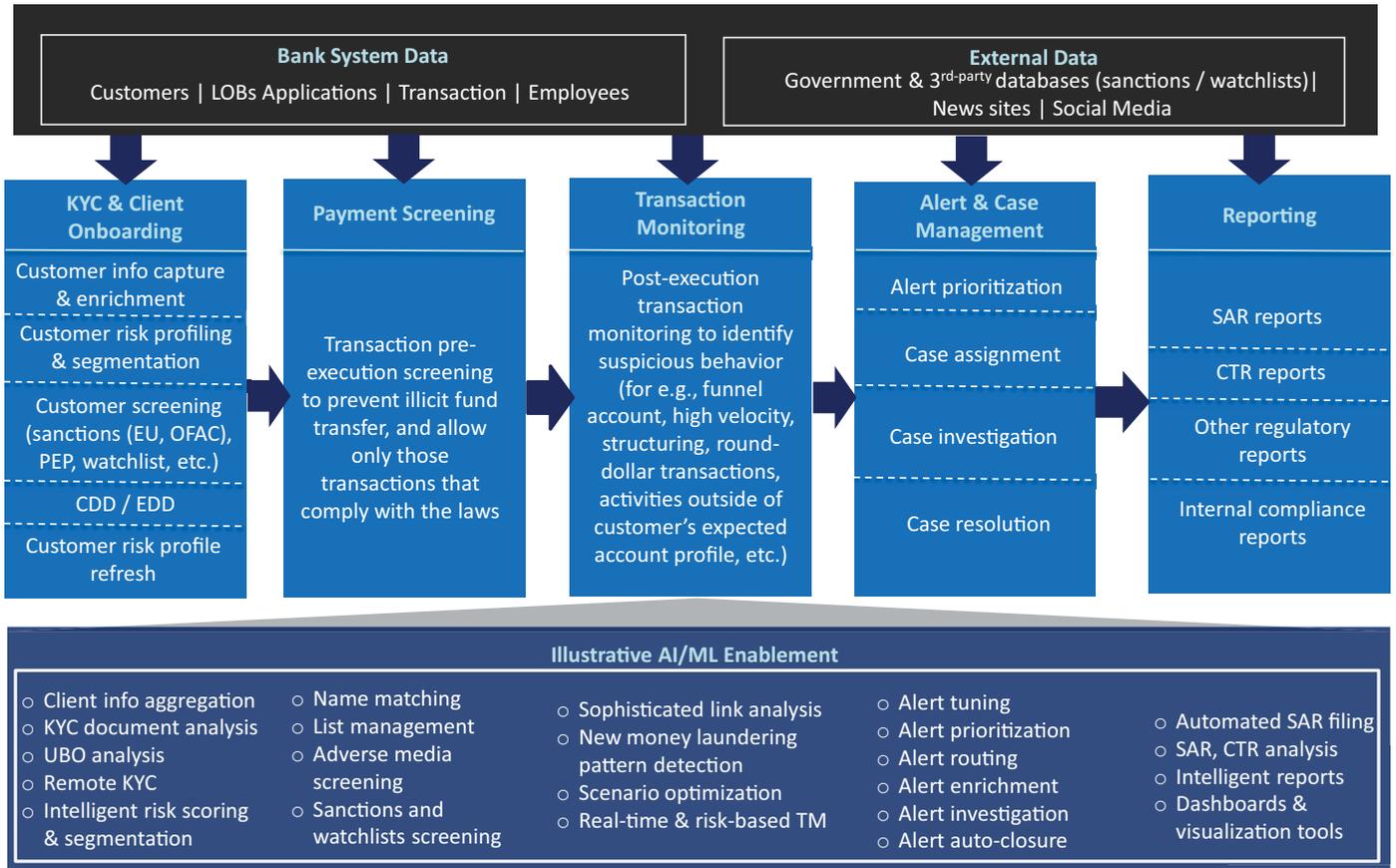


Figure 4: High-Level KYC-AML Workflow and Associated AI/ML Enablement

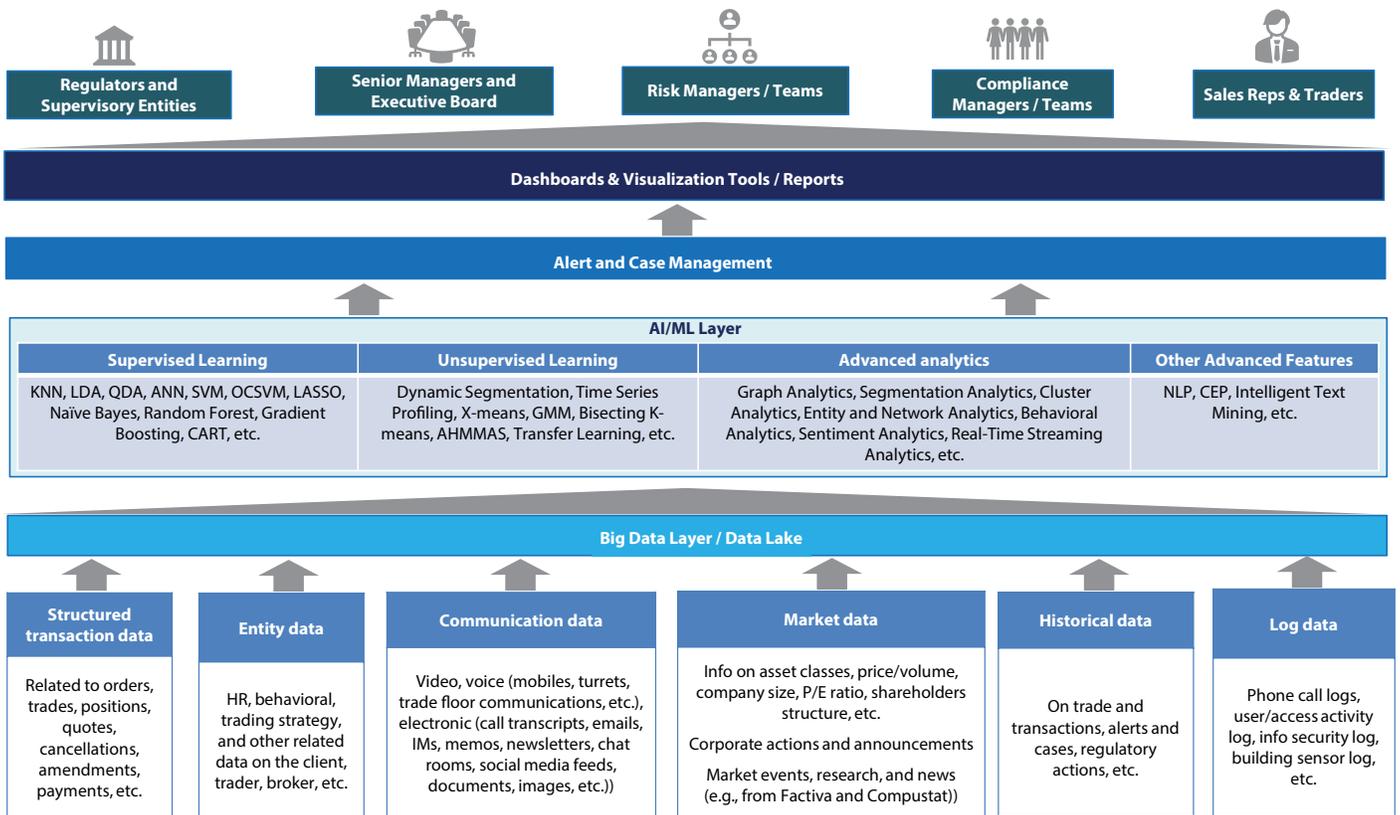


Figure 5: Illustrative Reference Architecture of AI/ML-Based Holistic Surveillance Solution

## AI & ML in ORM — Real World Examples

| Entity                       | Use Case  | Elaboration  |
|------------------------------|---|--|
| SIT & TradeFlow <sup>1</sup> | Operational Risk (OR) Measurement & Monitoring                            | TradeFlow and Singapore Institute of Technology (SIT) have collaborated to co-create an AI-driven solution to better address the operational risk and efficiency issues. They are leveraging AI and ML capabilities to monitor, measure, analyze, predict, and help manage the operational risk that a firm would face demurrage on shipments of bulk commodities across the world.  |
| Yields.io <sup>2</sup>       | Model Risk Management   | It has developed a model risk management (MRM) platform, called Chiron, that covers the entire lifecycle of model validation. The platform utilizes AI to enable ongoing model testing and validation on enterprise-wide scale. Further, it can integrate with graph databases, which enables users to better organize the MRM results. As per Yields.io, the platform helps reduce the cost of model validation by factor of 10.  |
| Diligent <sup>3</sup>        | Third-party Risk Management (TPRM)  | Its advanced ML and RPA-based solution can a) automatically detect unknown and known vendors by mapping against enterprise data sources; b) proactively identify potential for vendor failure; c) help automate entire TPRM life cycle (including onboarding, assessment, remediation, performance monitoring, and ongoing review); and d) accommodate evolving TPRM risk and regulatory landscapes.   |
| FICO <sup>4,5,6</sup>        | Cybersecurity Risk Management (CRQ and Residual Risk Mitigation Platform) | FICO released its ML-based Cyber-Risk-Score on AWS Marketplace. The solution's scoring-algorithm leverages new globally collected micro-signal data that improves the ability to quantify the cyber-risk of an enterprise in the next 12-months. The solution also offers supplementary-security-risk indicators which are especially valuable in evaluating small and medium-sized businesses. The solution offers sophisticated workflows and dashboards to stratify, compare, and manage aggregate- cybersecurity-risk.   |
| Zero Networks <sup>7</sup>   | Cybersecurity Risk Management (zero trust security)                       | Its solution, called "Zero Networks Access Orchestrator", utilizes AI to enable zero-trust network-model. The platform observes how the users and machines typically communicate, and automatically defines and enforces a zero-trust network-model across enterprise.   |
| Feedzai <sup>8</sup>         | Financial Crime Risk Management (fraud prevention)                        | Its ML-based platform can compute risk score in three milliseconds, evaluating 1000s of decisions to score a transaction in real-time. The solution's ML-models can identify patterns in transactions by analyzing customer profiles and behaviors; and leveraging external and third-party data.  |
| AUSTRAC <sup>9</sup>         | Financial Crime Risk Management (KYC and AML)                             | In Australia, AUSTRAC (Australia's financial-intelligence agency), with the help of RMIT University researchers, have enabled AI/ML tools for the detection of suspicious activity. The solution can speedily and accurately unearth unknown money- laundering networks, and precisely and efficiently flag the transactions that require further investigation.   |
| SAS <sup>10</sup>            | Financial Crime Risk Management (KYC and AML)                             | SAS AML solutions helps FIs to reduce false-positives up to 80%, achieve over 90% model-accuracy, and improve the SAR conversion-rate fourfold. The solution leverages AI and ML capabilities, and speedily processes massive amount of data. SAS has leveraged advanced analytics and ML capabilities to offer more configurable and intuitive investigation architecture; and support real-time screening capabilities. The solution can detect beneficial-owners, sanctioned-entities, and linkages in real time. SAS has also utilized RPA for AML investigations — which has helped minimize manual errors and decrease case review time by 20–30%. |

|                                       |  |  |
|---------------------------------------|--|--|
| <b>Nasdaq</b> <sup>11,12,13</sup>     | Financial Crime Risk Management (holistic market surveillance)             | Nasdaq SMARTS leverage AI and ML capabilities — over structured data (like orders, amendments and cancellations) and unstructured data (like electronic communications) — to achieve 360-degree holistic market surveillance. Further, Nasdaq has been investing substantially on enhancing the SMARTS solution — such as enabling new ML-based detection models; strengthening behavioral profiling and clustering, data discovery, and contextual surveillance capabilities; and leveraging ML for alerts ranking and scoring. |
| <b>NICE Actimize</b> <sup>14</sup>    | Financial Crime Risk Management (communications surveillance)              | NICE Actimize SURVEIL-X Communication solution leverages ML, NLP, and other advanced capabilities to offer comprehensive communication surveillance of all regulated employee in a single cloud-ready solution. The solution surveils across communication modes (IM, chat, email, documents, social media, voice, desktop phones, turrets, mobile, video, etc.) and in several asset classes and languages.   |
| <b>NICE Actimize</b> <sup>15,16</sup> | Financial Crime Risk Management (Regulation Best Interest (BI) compliance) | NICE Actimize's Reg BI Surveillance solution — which is part of its SURVEIL-X Holistic Surveillance platform — leverages NLP and ML capabilities and vast array of out-of-the-box-models to surveil 100% of all broker-dealer conversations and transactions. It automatically analyzes the disclosures and recommendations communications (both voice and electronic) of broker-dealers and raises alert.   |
| <b>FCA</b> <sup>17</sup>              | Financial Crime Risk Management (surveil financial advisors conduct)       | In UK, FCA has experimented with the usage of supervised learning and random forest techniques for predicting the probability of financial products mis-selling by financial advisors  |
| <b>Credit Suisse</b> <sup>18</sup>    | Financial Crime Risk Management (trader surveillance)                      | Has partnered with Palantir to track rogue traders — the solution utilizes big data and AI/ML technologies. Note: Palantir also had a multi-year deal with U.S. SEC to help identify cases of insider trading.   |

## Conclusion

In coming times, the usage of AI and ML by FIs for ORM is expected to increase significantly. Moreover, these new-age technologies would become a central element of an FI's future ORM strategy.



## Acronyms

| Acronym | Expansion  | Acronym | Expansion                                       |
|---------|--|---------|---|
| AI      | Artificial intelligence                          | IVA     | Intelligent Virtual Agent                       |
| AHMMAS  | Adaptive Hidden Markov Model with Anomaly States | KNN     | k-Nearest Neighbors Algorithm                   |
| AML     | Anti-Money Laundering                            | KYC     | Know Your Customer                              |
| ANN     | Artificial Neural Network                        | LASSO   | Least Absolute Shrinkage and Selection Operator |
| APT     | Advanced, Persistent Threat                      | LDA     | Linear Discriminant Analysis                    |
| AT      | Algorithmic Trading                              | LOB     | Line of Business                                |
| ATO     | Account Takeover                                 | ML      | Machine Learning                                |
| CAIDA   | Center for Applied Internet Data Analysis        | MRM     | Model Risk Management                           |
| CART    | Classification and Regression Trees              | NIST    | National Institute of Standards and Technology  |
| CAT     | Consolidated Audit Trail                         | NLG     | Natural Language Generation                     |
| CCAR    | Comprehensive Capital Analysis and Review        | NLP     | Natural Language Processing                     |
| CDD     | Customer Due Diligence                           | NLU     | Natural Language Understanding                  |
| CEP     | Complex Event Processing                         | OCSVM   | One Class Support Vector Machine                |
| CFO     | Chief Financial Office                           | OFAC    | Office of Foreign Assets Control                |
| CIO     | Chief Information Officer                        | OR      | Operational Risk                                |
| CISO    | Chief Information Security Officer               | ORM     | Operational Risk Management                     |
| CRQ     | Cyber Risk Quantification                        | PCI DSS | Payment Card Industry Data Security Standard    |
| CTR     | Currency Transaction Report                      | PEP     | Politically Exposed Person                      |
| DARPA   | Defense Advanced Research Projects Agency        | PGM     | Probabilistic Graphical Models                  |
| DFAST   | Dodd-Frank Act Stress Testing                    | PMML    | Predictive Model Markup Language                |
| DGA     | Domain Generated Algorithm                       | QDA     | Quadratic Discriminant Analysis                 |
| EDD     | Enhanced Due Diligence                           | Reg BI  | Regulation Best Interest                        |
| ERP     | Enterprise Resource Planning                     | RPA     | Robotic Process Automation                      |
| EU      | European Union                                   | SAR     | Suspicious Activity Reporting                   |
| FCRM    | Financial Crime Risk Management                  | SEC     | U.S. Securities and Exchange Commission         |
| FI      | Financial Institution                            | SLA     | Service-Level Agreement                         |
| GA      | Genetic Algorithm                                | STOR    | Suspicious Transaction and Order Report         |
| GMM     | Gaussian Mixture Model                           | STR     | Suspicious Transaction Reporting                |
| HFT     | High-Frequency Trading                           | SVM     | Support Vector Machines                         |
| HMM     | Hidden Markov Model                              | TES     | Triple Exponential Smoothing                    |
| IAM     | Identity and Access Management                   | TM      | Transaction Monitoring                          |
| IoT     | Internet of Things                               | TPRM    | Third Party Risk Management                     |
| ISO     | International Organization for Standardization   | UBO     | Ultimate Beneficiary Owner                      |

## About the Author



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Anjani has over 20 years of comprehensive experience in IT, domain, and process consultancy. He manages several strategic initiatives including thought leadership showcasing, solution enablement support, research and competency development program, and marketing efforts from a domain perspective. He has authored large number of whitepapers and articles; including many that have been published on reputed external forums.

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