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Research Article

Trust Layers: AI-Augmented Multi-Layer Risk Compliance Engines for Next-Gen Banking Infrastructure

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ABSTRACT

section_summary: New advances in technology now allow for banking operations to be completely orchestrated and executed by algorithms. The existing secure infrastructure for money and data flows, automated risk control has emerged (TRUST LAYERS), securing and automating the discovery and control of compliance violations and shady practices in those algorithmic operations throughout all layers of operation.
section_summary: Trust Layers are considered the next layer of infrastructure security after network and application security layers. Concerning banking operations, we now stand at a historical stage where all physical, financial and data flows can be orchestrated and executed by algorithms. Very soon all money and data flows in the current financial system will be processed through clouds of algorithms employing AI in one layer or another. Building on them, an extra layer of infrastructure has emerged, automation of the risk engine, securing and automating the discovery and control of compliance violations and shady practices in those algorithmic operations throughout all layers of operation. It detects and controls algorithm based compliance violations. Firstly, automatic modeling algorithms produce a digital double or shadow of all finance products, operations, obligations and rights. Secondly, control algorithms constantly monitor the real life operations and compare them with the model, detecting and combining in formal proofs any non-compliance. Next, certified proof algorithms connect violations with contracts and pass them to enforcement engines. All transactions and orders are also digitally modeled and certified, securing detection and control of market abuse, insider trading and fraud of any kind. Lastly, communication and data flows, including emails, are modeled and examined through NLP and data mining.

Keywords: New feature, AI augmented multi-layer risk compliance engines for next-gen banking infrastructure, trust layers, risk compliance workflow, software, data infrastructure and processes, financial intermediaries, assurance technologies, AI-machine learning applications, trust levels of AI-algorithms, next-generation enforcement systems.

1. Introduction

Financial institutions are transitioning towards the next-generation banking infrastructure enabling personalized financial services in real time. However, despite the increased sophistication of artificial intelligence methods used in this context, Trustworthy AI governance mechanisms are currently lacking. Here, a conceptual framework is introduced to foster the development of AI-Augmented Multi-Layer Risk Compliance Engines. In up to five trust layers, AI-LRCEs are proposed to more effectively govern the risk compliance of AI models in runtime. Each trust layer is grounded in legal or technical governance mechanisms. Recent regulatory frameworks also reflect growing concerns around unwanted behaviours caused by AI systems, for instance (i) the slavery or exploitation of vulnerable natural persons, i.e., AI systems need to follow ethical guidelines; (ii) the loss or alteration of data with severe impact on fundamental rights or macroeconomic performance, i.e., AI systems are required to ensure traceability; or (iii) the discrimination or unfairness against natural persons, i.e., AI models require certification. This emerging body of legislation implies the need for dynamic run-time AI model governance. The subsequent sections describe a holistic framework on how to enable various trust layers for AI-augmented, multi-layer risk compliance and an innovative application of

smart contracts to better ensure compound compliance. Many financial institutions are developing or are using AI models in the risk-prevention functions of open banking platforms for the next-generation infrastructure.

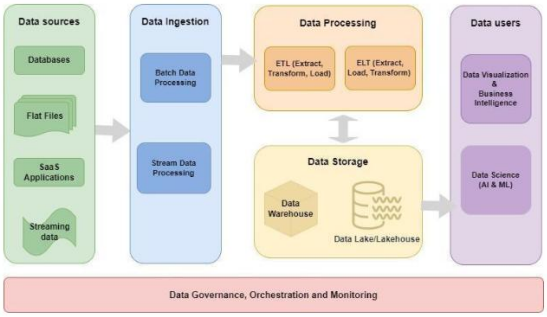

Fig 1: Data Pipeline Architecture

1.1. Background and Significance

Robust Digital Transaction Management and digital trust has gained significant importance during the Covid-19 pandemic, excessive stimulus spending, and recent inflation concerns. The rising number of cyber threats, businesses being designated by governments as consumer data custodians, and enormous business acceleration toward digital native e-commerce and mobile applications has exacerbated the relevance of trust and digital trust. This is further amplified by economic underperformance since the 2008 GFC, leading banks to be cautious with lending. The industry's increasing compliance and overhead costs have made banking services largely unaffordable for SMEs. In conjunction, better profit margins on regulated limited-risk banking products are forcing banks to reduce client intake and even closing accounts with businesses they view as potential compliance risks through no fault of the client, effectively reneging upon the banking-industry social contract.

A model of AI-Augmented Multi-Layer Risk Compliance Engines for Next-Gen Banking Infrastructure is proposed to address these problems. The model consists of a high level of Compliance Engines. Two of them act on the transactor side, maintaining and enhancing client-side and third-party compliance. Two other layers act on the transactee side, carrying out dynamic business risk evaluation and geopolitical exposure declaration. Compliance Engines in these categories are comprised of a combination of ML, highly adroit H2H input-capture, and a crowd of human verifiers. Different levels of sophistication of the Compliance Engines serve different purposes. The first level, Trust-On-First-Sight, provides instant “yes-proceed” or “no-proceed” endorsements regarding the compliance status & standing of a transacting party. It checks for the existence of necessary licenses, general reputation within the financial sector, and publicly available company records (worthiness checks, litigation involvement, officers/directors tracked history, regulatory status, and more).

Equ 1: Scalability of Data Pipelines: Throughput and Latency

$$T(t) = \frac{D_{processed}(t)}{t}$$

$$L(t) = \frac{\text{Time for Data Transformation}}{\text{Total Data Processed}}$$

Where:

- $D_{processed}(t)$ is the amount of data processed in time t.
- t is the time taken to process the data.
- $L(t)$ is the latency introduced by the pipeline.

2. Background

This article discusses how AI and other new technologies, such as the cloud, can (and are) being used to facilitate/underpin systems and processes that address these and related challenges. The installation of trust layers - accessible, AI-Augmented, Multi-Layer Risk Compliance Engines - in the still to be laid foundation of the next-generation banking infrastructure is proposed. This idea is being submitted by a company and is sponsored by an organization.

On the back of sharpened consumer focus, banking has been one of the sectors most affected by the ongoing digitalization. After certain innovations revolutionized banking in the 1970s and 1980s, the branchless banking pioneered by a financial institution followed in the 1990s and 2000s. The past decade has seen advancements in technology, Green banking and mobile payment systems. At this point, however, digitalization is speaking the very language of science fiction. Banking is no longer just a matter of services, but has become a fundamental capability for any Advanced Civilization. A notable figure once said the medium is the ritual in post-alphabetic society and there is no doubt that the need for money transactions will ultimately prove to be one of the key drivers of the science fiction banking landscape. Banks, however, are not the only ones to occupy this space. The ongoing endeavor to fulfill certain global goals requires a Global Systems Architecture to

underpin a crucial real-time Data Commons that serves them and anything related or otherwise nominal in this business.

2.1. The Evolution of Banking Infrastructure

Banking infrastructure has a wide impact on the economy and even on social justice. The infrastructures that shape the development of structural risk evolve alongside the development of banking systems. The work marks the structural risks introduced at each phase and examines the compliance and security architecture required to implement suitable risk frameworks.

Self-improving multi-layer risk compliance engines are proposed to implement AI-augmentation within the risk compliance engines and the trust layers of a banking system. Banking regulators require banks to manage an increasing amount of structural risk that spans a large number of mentioned risk dimensions. Trust layers are expected to be the next-generation security and compliance infrastructure component given increased compliance expectations. The work presents a novel and comprehensive architecture for trust layers comprising autonomous risk compliance engines and jointly configured multi-layer trust fabric.

The work requires the bank banking algorithms to minimize the amount of exposed structural risk. There's an overall risk function that depends on the value of the banking algorithm and market-generated risk factors. For most banks, there are constraints on the admissible banking algorithms that depend on an increasing number of risk dimensions. These are the bank's compliance requirements. Given the market-generated risk factors depend on the bank's strategies, it is a game-theoretic framework. This model suite includes general risk considerations with a focus on strategic liquidity management in the European banking context, as well as risk compliance and security architectures needed to implement suitably risk-aware financial systems, including network-theoretical approaches to the study of system risks. It motivates the study of trust layers and describes the novel architecture comprising multi-layer risk compliance engines and jointly-configured multi-layer trust fabric.

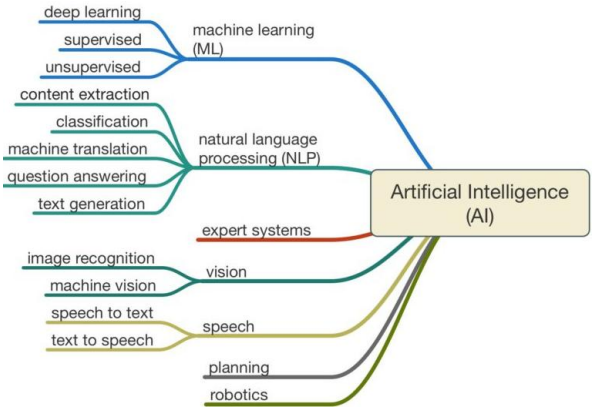

Fig 2: The Evolution of Banking

2.2. Overview of Risk Compliance in Banking

Financial crimes, cyberattacks, customer risks, operational risk event modeling, model risk management, credit risk modeling, stress testing, capital compliance, Basel III, PSD2, rogue trading, AML, and trade finance compliance risks are on the increase. States retaliate with partly stricter regulations, e.g., as a reaction to money laundering schemes in the billions of US dollars. Compliance costs are elevating, in the EU member states doubling every six years. The compliance part of IT costs often takes 70% of total IT costs in large financial institutes.

The approach and flow of TRUST LAYERS for AI-augmented multi-layer risk compliance engines A simplified presentation of the AI-augmented multi-layer risk compliance engines concept. The full flow is expected to take 10 – 20 hours for a domain expert to read through, and it is recommended to read the Reading Instructions for sections of particular interest. All figures have an associated code. It shows red arrows in the corruption circle slide because red marks are bad, some images are selected from other documents, and some boxes have wrongly colored text ("Yes").

3. Trust Layers in Banking

Digital transformation is steadily drawing a new banking infrastructure. As an integral part of it, cutting-edge interconnected technologies are applied in day-to-day financial practice. Multi-layered automation continuously assists this deeply interconnected system. It applies to all domains of the banking infrastructure, including real-time audit, surveillance, and monitoring ensemble.

The most recent tendency in new banking infrastructure with AI-augmented multi-layer risk compliance engines has been referred to as banking trust layers, which are precincts on establishing and delivering trust and assurance through an ensemble of AI systems ranging from attestation, verification, and validation agents to trust matters, integrity enclaves, and secure hardware. Digital biometry-based cryptographically encapsulated attestations secure the mutual trustworthiness of diverse elements and diminish the capability of

each individual element to compromise the security and privacy of the others. Legally compliant real-time audit, surveillance, and monitoring ensembles provide in-depth operational visibility regarding the assurance of trust layers as a whole and their constituents therein, as well as actionable insights to increase their trustworthiness and robustness.

Now is the time when the banking and finance sector is heading toward radical changes. A by-product of the financial crisis within the last decade, an escalating cascade of new regulations is enforced as an attempt to reshape this market. As a result, the compliance cost of conducting business within the finance sector has been systematically growing. It is so that today, ten years afterward, small banks are half as less as there was before that crisis. In the meantime, numerous technologies have been matured, which can facilitate the new challengers to surpass the traditional institutions in certain aspects. Nevertheless, it is the letters that provide the greater exposition of attention. Formerly characterized by their conservative stand, banks and finance institutions can now afford to revolutionize shortly. From the first sight, new rules are making banks too safe to fail; when seen from this standpoint, banks are under a continuous barrage of new regulations making them much more complicated to handle, especially the smaller legacies. Because of this being a result, a new generation of regulators is appointed empowered to exert real-time supervision over banks and to single out the ones most expected to fail, which will, however, have an escalating effect on the market unrest.

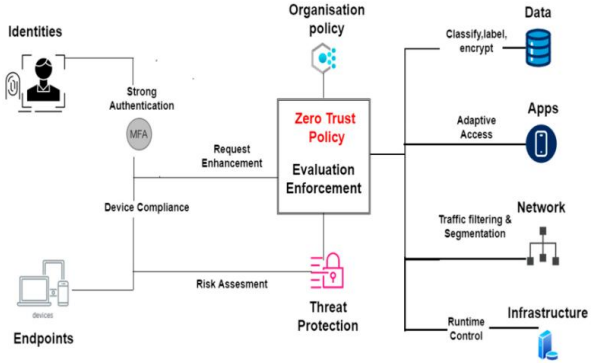

Fig 3: Trust Models in the Financial

3.1. Defining Trust Layers

In modern internet-scale computing the interaction between a large number of parties that are not known a-priori, is predominant. Each party functions both as a provider and consumer of services and information. Traditional access control mechanisms, as typically implemented in Open Systems, Distributed Systems, and Database Management Systems operations or networks face considerable limitations, since granting appropriate authorizations to each distinct party with respect to its role and relationship with all the other parties is infeasible due to the high number of grantees and the dynamic nature of the interactions taking place. Consequently, a well organized opponent could use a variety of sybil attack scenarios to symmetrically control open p2p and managed networking structures. Several aspects of systems, offering aids towards the automated verification of actions against security policies, have been proposed in the literature. In the simplest terms, an action is allowed, if the credentials presented by a party are deemed sufficient by the protection domain, although safe inter-domain operations are inhibited. The protection domain is the recipient of the proposed action, which is connected with some concept of a security policy, representing a number of rules that guard the implementation of a predefined set of actions. In general, a protection domain broadens its expanse beyond the traditional scope of a single system or a single administrative domain. However, protection policies could be enforced for a number of reasons between parties, willing to communicate or operate at a different level of abstraction or privilege within the networking infrastructure. In such cases, systems are introduced in a system with appropriate interface functionality, which can validate the requested actions in terms of the enforcement domain's security policy. Under such mechanisms, security policies, trust-related properties, and trust relationships are defined. Policies specify what actions need protection and the property of other parties that relative actions are contingent on. Involved parties can attest relevant properties as security credentials. These structures are contained in a certificate presented as part of the requested action.

3.2. Importance of Trust in Financial Transactions

Financial transactions have a base multiplier in risk and require trust layers for every transaction. A new chain and transaction architecture to redefine those trust layers in a hybrid blockchain + classic trust approach is systematically depicted, together with a complete AI engine redefinition approach to bolster that new generation of financial services that will need compliantly enabled, AI augmented multi-layer trust engines. It is at the core of society and it includes the social sector of core national infrastructures, as well as every company and service chain of services and goods that are daily used. Risk is a transaction multiplier and accounts for the multi-step and multi-agent involvement in every financial transaction. Each step and each agent changes the possible different risks involved in the transaction, whilst flow them. From a system viewpoint seven scenario

façade risk libraries of sub-trusts are proposed for a money flow based financial transaction from the customer through a transaction service up to the retailer, despite of being the step before each sub-trust is called by having each agent two parts, its front link with the customer and its end link with the transaction service. Since the base transaction itself already multiplies the risk in every step, each façade includes a set of already built-in risk multipliers. Still, all these libraries are open for upgrading along the future against new forms of threats and frauds. On its part, every fourth factory of financial services is already run with a blockchain platform that effectively boosts the moderation of trust in a digitized transaction network and hence dramatically increases the current risks for the remaining transaction systems.

Equ 2: Risk Intelligence Model: Predicting Risk Scores

$$R(t) = f_{AI}(X(t), \theta)$$

Where:

- $R(t)$ is the predicted risk score at time t.
- $f_{AI}()$ is the AI-powered prediction model.
- $X(t)$ is the set of features (e.g., credit history, transaction data, etc.)
- θ represents the parameters or weights learned by the AI model.

4. AI-Augmented Risk Compliance Engines

As the implementation deadline for Regulation approaches, financial institutions and technology providers are questioning whether the EU Commission will decide on the recognition of third countries or not. According to the European Central Bank, the current level of harmonization with EU law is generally not sufficiently set for third countries. Nevertheless, the ECB stressed that it is working to facilitate market participants' preparation for the upcoming deadline. While a common agreement is being sought, the past year has seen third countries introduce new mechanisms for data access, albeit without regulatory clarity. These included exchange of information agreements, an arrangement for the transfer of non-public data, or a memorandum of understanding for consultation and cooperation on data access and the exercise of supplier provider regulations. Additionally, the Task Force on Real-Time Instant Payments proposed extensive cooperation with payment settlement service providers for real-time monitoring data collection and mutual provision of analyzed information. Although access to data provided by the PI may have an increased international role and lead to international implications, the concern is neither the question of jurisdiction nor the cross-border operations.

In this context, AI-augmented multi-layer engines of transparency and trust are emerging. These engines are connecting local real-time information architecture with hard-coded trusted party functions, an enclave digital onboarding/contracts procedure with real-time APIs, and AI-augmented local multi-layer risk compliance engines. There are many innovative features packed in engines. For example, trusted party functions can detect sensitive operations such as sanction controls, thus guaranteeing transparency of detection in the trust layer representation. Or, contract procedures can include inserting the required formulas for real-time checking during execution such as location of the third party, data usage, or accountability about the results.

4.1. Architecture of AI-Augmented Engines

The banking infrastructure is designed and planned to provide enhanced user experiences powered by digital transformations. The existing banking architecture is critically reviewed to point out that without an advanced framework the digital transformation can undermine the trust in banks. AI-Augmented Multi-Layer Risk Compliance Engines for Banks and Financial Institutions presented to be the trust layer for the banking sector. The banking sector has been rapidly transforming itself due to the rising demand for digitalization of economic transactions. Money has become increasingly intangible due to credit card systems, internet banking, mobile banking, etc. Digital transactions are more flexible, easier and faster via mobile devices all around the world.

The proliferation of Fintech applications and competition with legacy banking systems also provoke them to adopt a digital transformation strategy. Nevertheless, the dark side of digital banking appears with a rational insecurity considering the cyber/physical security accidents and frauds affecting significant populations in recent years. The targeted attacks to critical banks and financial institutions have shown emerging challenges about the information security which is highly mandatory for guaranteeing the stability of financial systems and economic markets. As a result, the existing banking infrastructure is critically reviewed in terms of rapid development of digital banking, and the necessity of advanced AI-Augmented Risk Compliance Engine is emphasized as Trust Layer to provide a shielded banking infrastructure for advanced digital transformations.

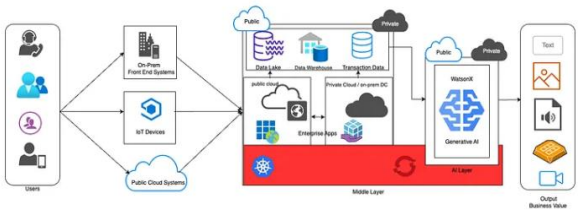

Fig 4: A Pipeline Architecture

4.2. Key Technologies and Algorithms

The engine is developed as the multi-layer trustness architecture to build out trust layers for AI-augmented compliance risk engines. The underlying components of the component engine technology stack are firstly discussed, focusing on the technology and algorithms powering more abstract components like Machine Reasoning and Emerging Risks Markets. Then, a modular engine architecture design is outlined on top of the technology overview that aims to improve compliance technology interoperability and implantability within and across primarily banking and distributed ledger technology associated settings.

Next-gen Distributed Ledger Technologies aim to revolutionize world finance. It is because automated global low-friction banking is expected to enable International and SMEs in a manner that centralized reserve FX has not. This financial inclusion agenda has given Distributed Ledger Technologies a significant head-start on competition for advancing compliant components of networks. In parallel with financial cost savings, DLTs have found their way into agreement use-cases as well, including important processes within commodification and securitization. However, for regulation-dense sectors like finance, DLTs have the added benefit of promising up to an order of magnitude legacy speed improvements in compliance tracking over spreadsheet based finance designs; where federal auditors putting in 2000 hours a year can still only track a small percentage of market-finance markets.

Distributed Ledger Technology and fintech booms could lay out complex emergent risk topographies, where compliance enforcement is notably heterogeneous and patchy. Meanwhile, Emerging Risks Markets reveal discordances between in-dwelling and exogenous risk epistemologies and are themselves heightened by finance-accompanied technological change. These derived observations set the policy computing challenge landscape reviewed herein: for a coherent, maximally informative model of converting Emerging Risk Market databases into well-specified compliance interventions; advantageously leveraging machine reasoning over a large-scale knowledgebase of compliance market epistemologies. To meet this endeavor, the deep layers of the underpinning component engine technology stack are outlined.

4.3. Integration with Existing Systems

This means that AI models are ‘smart systems’ that are typically trained on data, learn a specific task based on that data, and make decisions based on their learning. Used and operated as part of complex AI systems, these models comprise a complex system of components that, together, deliver a specific, consistent model output when fed specific model inputs in a suitable configuration. The rest of the AI systems comprise input data pre-processing and output post-processing protocols, artifact data management, as well as operational and configuration parameters. Successful understanding and safe operation of an AI system require visibility into the function and operation of the AI box in addition to all other inputs and outputs. While the transparency into input and output data, model design, relevant data pre/post processing, as well as operational details are typically in place for the initial deployment of an AI model, over time, pre-processing and post-processing scripts might change, model dependencies could become stale, or configuration parameters might fall out of date.

On a deployment perspective, however, some outputs of AI models are not easily actionable as planned, particularly in complex systems that leverage AI alongside other components. For instance, commercial AI systems can comprise more than a hundred components, consisting of data retrieval processes, model scoring services, model ensembles, feature transformations, among others. To take informed action, knowing what caused the AI system to output what it did is critical, yet previous work shows a key challenge in explaining AI outputs. A broader class of AI systems designed to solve real-world needs deploy AI models that must operate in dynamic environments, under distributions that may change over time. Such AI systems must be engineered carefully, needing extensive prototyping, controlled-environment testing, and rigorous evaluation.

5. Multi-Layer Risk Compliance Framework

Defining ‘trust layers’ as an enabler framework term for multi-layer risk understanding and compliance. Trust layers are presented as ongoing holistic actuators for AI-augmented risk compliance decisions. Proposed are risk compliance frameworks for trust layers, which empower digital acts of financial infrastructures with automated audience awareness towards all potential interaction parties. New audience awareness aims on believable trustworthiness evaluations with the open layer as novel spotlight transparency. Wide and positive public resonance on the implementing trust layer concept is found as a novel contribution.

Financial sector has survived various regulations over decades in order to stabilize rules on transactions. Emerging digitalisation and crowd finance disrupt the sector now once again. These latest movements foster the transition to new banking infrastructures that are potentially again in need for a new rule set, not only on transactions but also on technologies. Trust layers may foster a rewrite of financial regulation and assist financial infrastructures in better understanding and complying with the new rules. A new trust layer quantum-style division structure is presented, with two implementation considerations for auditing and automatic compliance risk management. A feasibility study learns trust layers online implementation gets wide media and public interest with positive resonance in 75% of all relevant contributions. In this way, bank operators will benefit from receivers' comprehensive risk evaluation acting as potential senders. A digital act analogy to financial transactions is depicted in order to envision new rules of conduct.

5.1. Layer 1: Data Security and Privacy

When it comes to AI-Augmented Multi-Layer Risk Compliance Engines for Next-Gen Banking Infrastructure, embarking on a privacy-focused banking transformation requires a shift in the way risk, compliance, and security engines operate, from a logic-based to a data-centric model, from management to engagement, i.e., a transition from rule-based compliance engines to AI-augmented multi-layer risk compliance engines.

The first trust layer focuses on the data security and privacy of Next-Gen banking infrastructure and provides detailed guidelines on the operations and requirements of AI-Augmented multi-layer risk and compliance engines at the first layer, with specific reference to the compliance and establishment of global data security and privacy legal infrastructures, and the implementation of compliance and engagement operations. In the era of next-generation banking transformation, data security and privacy has become a multi-faceted challenge. Digital assets are so deeply connected with customers and banks, sharing the same nature of money and gold. Furthermore, the explosion of the AI paradigm has modified or even contradicted existing financial regulations and policies, making it hard to secure these digital assets. Given these challenges, a data-nationalism oriented banking system will be introduced, which delivers a novel aspire model to comply with local data security and privacy laws more effectively.

The main contributions of this work at the first layer can be summarized as:

- The introduction of a novel data trust means. Theorem that not only ensures the local compliance of Next-Gen banking infrastructure but also protects the global data assets legitimacy.
- Introduction of a global legal trust daisy architecture that ensures the data security and privacy of Next-Gen banking infrastructure.
- Establishment of a dispersed data security and privacy compliance engine at the first layer that provides adjustable legal templates and establishes innovative technologies such as data trust by-pass tunnel and privacy switch.
- Introduction of an engagement operation that provides an innovative parallel engagement framework and an active engagement method. Active data trust agent.

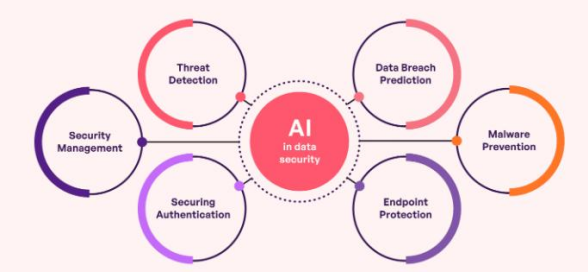

Fig 5: AI in data privacy

5.2. Layer 2: Transaction Monitoring

Layer 2, transaction monitoring (TM) follows a distributed architecture that augments commercial off-the-shelf (COTS) risk compliance engines with AI-based NLP technologies. The proposed transaction monitoring (ML-TM) comprises four facets: i) A distributed compliance engine that deals with the red alerts raised by a COTS TM system, ii) A domain-specific series of NLP microservices that enhance the compliance engine with advanced language technologies, iii) The country-specific "contextual layer" normalizing the information representation, and, iv) Link analysis calculating the risk scores based on the relationships contained in the knowledge graph (KG). In addition, four forthcoming regulations: 6AMLD, AMLD, MLD, and FAT newly emerged in the EU are studied. Three core themes emerge from responses to define a future next-gen compliance engine: AI; context-awareness; augmentability. The multi-layer risk compliance engines enriched with different AI-based NLP technologies are proposed to construct a new generation of AI-augmented compliance engines.

Understanding the "natural language" embedded in the red alert description is always knowledge-intensive. An elaborated Q&A is curated in layers: i) Terminology that explains the principle, function, and norm; ii) Modification providing common characteristics of a well-performing component; iii) Design consideration

with some important aspects to be aware of. Many disciplines including linguistics, neuroscience, and cognitive psychology have concentrated on the essence of the human language. In the computer science point of view, the natural language processing (NLP) domain is devoted to the generic processing algorithms of text written in human language. There are several different kinds of technology used to perform NLP on the red alert narrative. Broadly speaking, based on the adopted computational topology and annotation level, these technologies can be split into five respective groups: i) Tokenization; ii) Morphological Analysis, iii) Part-of-Speech-Tagging, iv) Shallow Parsing, and v) Dependency Parsing. Language processing is one of the traditionally hard tasks since the language structure is complex. It is highly context-aware and (dis-)ambiguous. The performance can be enhanced by the advancement of the AI model.

5.3. Layer 3: Regulatory Compliance

Today's banking IT landscape requires managing a complex and shifting set of risks and compliance requirements. The continuous evolution of technology and operational practices, along with the legal and regulatory environment, challenge the ability of trust and banking components to continue to work together. Firstly, the rapid growth and change of financial technology and payment technologies are evident in parts of this industry segment that allow financial transactions without the tight coupling that the banking industry infrastructure requires. There is also increased digitization of financial instruments, resulting in much faster and more flexible transactions. Second, the banks and financial payment institutions are still targets of sophisticated fraud and financial crimes. There are significant threat vectors, mostly due to the complex nature of their financial services and their near real-time execution. New attack strategies are putting more pressure on the criminal-financial industry ecosystem. Lastly, small or large compliance failures can result in heavy penalties for banks or financial institutions. Following their role in the 2008 subprime crisis, regulators imposed much tighter control frameworks on banks and financial institutions. The proposed model describes IT trust layers, an AI-augmented multi-layer risk compliance engines concept. The trust layers depicted in the model go from the physical secure delivery of the components and their operational environment, to the deep data-driven analysis of the operation of the components as a part of the banking infrastructure. It is argued that even provably secure hardware and software components, in their initial delivery and deployment environment, once interconnected and running real financial transaction services, will exhibit patterns in the data generated by their normal operation that potentially can be linked, exposed, and managed from a legal-regulatory risk and compliance perspective. Finally, the concept of minimalistic components in trust layers is discussed. The budget for AI-technology in banking is still under experimentation. This is especially true for smaller players, where multi-layer-border risk-compliance AI engines compete against core components.

Equ 3: Data Pipeline Architecture: Flow of Data

$$D_{in}(t) = f_{extract}(t)$$

$$D_{transformed}(t) = f_{transform}(D_{in}(t))$$

$$D_{final}(t) = f_{load}(D_{transformed}(t))$$

Where:

- $D_{in}(t)$ is the incoming raw data at time t.
- $f_{extract}(t)$ is the extraction function.
- $D_{transformed}(t)$ is the transformed data after processing.
- $f_{transform}()$ is the transformation function applied to the data.
- $D_{final}(t)$ is the final data ready for analysis or AI modeling.
- $f_{load}()$ is the loading function to store the data.

6. Case Studies

This section presents a discussion on the influence of information technologies on the structure and behavior of social systems. Algorithmization and automation play a critical role in the next generation of industrial and financial systems. Combined with the explosion of data availability, the sophisticated integration of public and personal data relevant to an individual, it is foreseen that the quality of the frequently cited macroscopic layer which provides the data/inputs for personal decisions will significantly enhance. Consequently, the modeling and forecasting as well as the response/adaptation capabilities of social systems will also significantly improve. The finance industry has already entered a transition into its future shape and functioning through the fourth industrial revolution that is evolving the cybersecurity threats, with the upcoming implementation of fin-tech applications and the increased interdependency in this sector. As a case study involving the future transportation sector, underlying the challenging open issues for ensuring the safety, security, and reliability of emerging systems because of the lack of transparency. Naturally, disruptive events generating wide-scale cascading effects can occur in the finance sector as well, though the root causes might differ significantly from the well-understood physical/technical processes causing blackouts or nuclear accidents.

Another area of further progress in the description and understanding of socio-economic systems is depicted based on the observation that social systems are in fact multi-layer systems, where individuals participate in various layers each with different structure. As an example of highly sophisticated social systems, the interplay between garment fashion and individuals is considered, illustrating the imposing influence that industrial strategies can have on the opinions and ultimately on the decisions of individuals, i.e., the high intra-layer

coupling present in many social systems. Similarly to other types of systems, social systems are also strongly affected by the surrounding environment. This effect introduces inter-layer couplings - the reduced resilience of the personal decision under external manipulations.

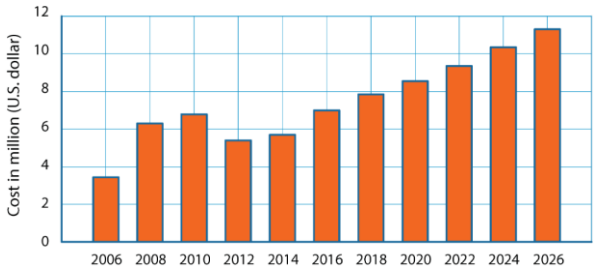

Fig : Data-First Finance: Architecting Scalable Data Engineering Pipelines

6.1. Implementation in Retail Banking

Just to summarize what was explained before in one sentence: With Trust Layers, the model suggests concrete actions to defend the customer in a preferred way, taking other elements such as identity & other device data as well as regular customer behavior into account. What was also introduced were Instant data animations safeguarding customer data according to legal provisions from an unauthorized risk including a fake ingress speed data generation algorithm for the Learn 4-Risk Compliance engine. The pending and auxiliary products or features, even if utilized and/or implemented in combination with technologically advanced products, would include a UFS card with tamper proof section, SMARTSECURE, and other products covered by the mentioned patent application. As the unauthorized party requires supervisor analysis tools the physical objects /gates, customers/, i.e. they require a strategic placement of malicious devices within the facility, violating tertiary data infrastructure would discover those elements beforehand and help to fortify the branch according, trust layers. From a strategic point of view, the existing patent strategies need to find profitable ways to apply trust layers.

6.2. Implementation in Investment Banking

Trust Layers is proposed as the next-generation set-up for AI-augmented multi-layer risk compliance engines of the rapidly evolving banking infrastructure. Trust Layers aims to democratize access to AI for financial risk compliance and regulation purposes in an explainable, transparent, cost-effective, and self-regulatory manner. The general approach and the key technical components are discussed. An investing banking use-case of Trust Layers is further investigated and an aspiring commercial level of the Trust Layers product is profiled.

Trust Layers democratizes access to AI for compliance purposes, i.e., any institution inside the data-driven regulated financial industry, that processes user personal data and/or runs financial transactions, and needs to comply to global, regional, and/or national financial regulations in using AI to process those personal data and/or transactions. Those regulations may consist of one or any combination of the following: consumer data protection, pseudonymization, sensitive data handling, personal data rights, purposes of future data processing, outsourcing, and/or secrecy of investigations. Trust Layers democratizes AI with financial compliance in a fast and affordable manner. Trust Layers democratizes AI in an explainable, transparent, and self-regulatory manner, in a way, that the black-box AI is subject to compliance, is AI under its terms and conditions and that it is the responsibility of the financial institution to define the compliance. Trust Layers democratizes AI resources for investments focused on AI compliance, rather than IT infrastructure and data science resources.

6.3. Lessons Learned from Case Studies

I ntroduction. Recent AI governance systems are not designed for the rapid turn-around times typical for vigilance procedures; they mostly support manual verification of complex standards where binary compliance is only possible by design. Benefits of dedicated risk engines are investigated that (a) enable threshold-based regulatory responses through tiered risk models, (b) produce full surveillance trails ready-for submission in case of litigation, and (c) can meaningfully be instrumented with mitigations. A generic risk architecture is outlined that can be used for the development of vertical risk engines across applications/domains. AI augmented risk engines can process asset compendiums in real-time, fully accounting for the natural randomness in the asset database. Only a small percentage of security checks need to be performed, or only a couple of mechanisms are needed to interfere with. Next, off-the-shelf trust layers for the emerging class of ransom visit banks are investigated. On the one hand, these institutions desire to automate as much of the compliance overhead as possible. In many countries, these procedures can certainly care for a significant percentage drain of additional compliance even when engaging third-party solutions. On the other hand, there is the wish to put regulatory pressure on their incumbent, highly regulated competitors. It is anticipated that those considerations will lead to an increasing number of insurmountable fines or temporary rescissions of banking licenses.

7. Conclusion

No product reading and not enough crammed magic buzz: This is AIrcraft. The world's first AI-engineered news stream surfaces it all for you ...
Since the financial crisis the European banking market has undergone major changes. While complex and big financial institutions have been dominating the market in the past, they are slowly beginning to decay. The historically small institutions often maintain a closer relationship with their customers, but lack the capabilities to place gigantic demands on the EU-wide competitive market. In view of the challenges of increasing multinational competition, EU regulation, increasing data volumes and IT security, these banks are mostly interested in solutions. Using this constellation as a basis, the idea occurred to four partners from different business spheres to think about building a next-generation IT bank infrastructure.
These partners are an IT security start-up, a public Cloud Service Provider, a regional institute responsible for open-source payments, and an organization concerned with fraud prevention. A project outline was submitted that sets out how a "Trusted Layers" IT infrastructure should work for a new generation of banks. Using innovative privacy-preserving cloud technologies, the banks are to be upgraded to AI-augmented, multi-layer risk and compliance engines that work with real-time data and drive external APIs with a minimal burden on infrastructure. Seduced by the cross-sector cooperation that goes far beyond existing events, the commission sees a benefit to the European Community and wants it to be further pursued. Now the duration until the end of 2021 is to be used specifically for the elaboration of a corresponding project application.

7.1. Future Trends

The long-standing problem of trust in AI systems, largely due to limitations of explainability, auditability and control complexity, has not been sufficiently addressed. Financial institutions must be able to trust that the explanations they get regarding AI behaviour are accurate and reliable, they must trust the audit logs, and they must be able to influence or even veto decisions made by an AI system. For this purpose, there is an investigation into the feasibility of developing a comprehensive multi-layer and multi-modal trust platform, capable of engendering trust in each of these individual components of the financial institution. Better control and auditability in AI systems can enable more trust in the systems and thus progress the utilization of AI systems. A framework for an AI system is presented that would address these needs in the financial sector. The system consists of a set of AI models, typically selecting transaction sessions but also potentially detecting cyber-attacks, along with the observation that the transactions belong to a set of clients. Together, the selection and detection models are referred to as AI policies/authors. A risk assessment of such a system is presented, using the AI system framework, an analyst and a transaction manager in order to better understand the market risks and inform further decisions regarding appropriate deployment of such AI systems. While the focus is on the financial sector, many components of the proposed system can be generalized to other sectors, and it is likely that the deployment of such systems in the financial sector would catalyze broader impact across the economy such that many other industrial sectors would adopt similar systems but attuned to their own particular needs and characteristics.
AI governance has so far focused mostly on the model building and testing processes. However, given the AI systems' growing complexity and burdensome regulatory requirements, it is timely to shift the paradigm of AI governance towards introducing more self-governing AI systems that can more easily and efficiently set up, monitor, and ensure on-going regulatory compliance of deployed AI applications. This important paradigm shift will have far-reaching implications for the control, audit, testing, and even the design of the AI aspects of the systems. There remain many challenges to ensuring fair and customer-centred AI policies and auditing the behaviour of powerful internal surveillance systems in an efficient and timely manner. There have been concerns that certain sectors will not be able to use the new technology cost-effectively. The enforcement of AI policies could diverge, with the top layers being calibrated and "light-touch", whilst the bottom layers of enforcement would incur the legal costs of always proving that the AI system was justified. It is important to explore systems for better cost-effective control and auditability of the AI systems, which may also inform debate over emerging regulatory frameworks.

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