

How Goldman Sachs Utilizes Artificial Intelligence: Opportunities and Risks in the Financial Industry

Jiayi Chen

*Xianda College of Economics and Humanities, Shanghai International Studies University,
Shanghai, China
chen_jiayi1@outlook.com*

Abstract: With the continuous development of the financial industry, Artificial Intelligence (AI) is driving transformative changes, as exemplified by Goldman Sachs' integration of AI across multiple business dimensions. The bank employs AI in trading, risk management, customer service, and regulatory compliance to enhance efficiency and profitability. AI-driven trading algorithms process massive market data in real-time, enabling faster and more accurate trade execution than human traders. AI-powered risk models analyze historical data to detect anomalies and forecast potential losses, while intelligent customer service tools provide round-the-clock personalized advice. However, AI adoption also presents challenges such as ethical concerns, workforce displacement, cybersecurity risks, and regulatory uncertainties. This paper first examines how Goldman Sachs applies AI in its operations and then analyzes the effectiveness and potential drawbacks of these applications.

Keywords: Goldman Sachs, Artificial Intelligence, Financial Innovation, Financial Risks, Industrial Transformation

1. Introduction

Artificial Intelligence has emerged as a transformative force in the financial sector, reshaping trading, risk management, customer service, and compliance functions. The widespread adoption of AI enables financial institutions to process massive data, automate decision-making, and optimize operational efficiency. With the global AI market in financial services projected to reach \$79 billion by 2030, the growing reliance on AI-driven solutions reflects the industry's commitment to digital transformation and technological innovation [1].

As a global leader in investment banking and financial services, Goldman Sachs has positioned itself at the forefront of AI adoption. The bank strategically integrates AI into its operations to strengthen competitive advantages in algorithmic trading, risk assessment, client interactions, and regulatory compliance [2]. Unlike traditional banks relying on manual data processing and human decision-making, Goldman Sachs has proactively developed AI-driven platforms such as Marquee and Marcus, along with automated trading models, to streamline processes and optimize investment strategies. According to the *Financial Technology Innovation Whitepaper*, Goldman Sachs' AI trading system achieves an annualized excess return of 8.7% [3].

Goldman Sachs was among the first to apply machine learning algorithms to financial decision-making, and its continuous expansion of AI-driven automation reflects the broader industry trend toward digital transformation [4]. The bank's AI applications extend beyond algorithmic trading and

investment decisions, encompassing risk mitigation, fraud detection, and regulatory reporting. By examining Goldman Sachs' AI implementations across different business functions, this paper provides a comprehensive analysis of the benefits, challenges, and broader implications of AI integration in financial institutions.

2. Applications of artificial intelligence at goldman sachs

2.1. AI in trading and market analysis

Goldman Sachs has built an AI-driven trading ecosystem through its Marquee platform, deeply integrating real-time financial data, predictive analytics, and automated execution tools [5]. In traditional trading, manual market analysis is time-consuming, subjective, and unable to capture millisecond-level market fluctuations. AI-powered machine learning algorithms now parse global market data in real-time, identifying complex trading patterns and arbitrage opportunities. The platform optimizes trade execution paths via neural network models, achieving microsecond-level order execution and reducing slippage costs by over 40%. According to the 2023 annual report, AI-driven trading strategies increased the bank's wallet share among the top 150 institutional clients by 350 basis points [6], with record-high revenues in fixed income, foreign exchange, and commodities trading [2].

2.2. AI in risk management

In credit risk assessment, Goldman Sachs' AI models transcend traditional FICO scoring limitations by integrating multi-dimensional data sources such as social behavior and supply chain information to build dynamic risk profiles. For small and medium-sized enterprise (SME) loans, AI models analyzing business owners' social media behavior and tax records have increased default prediction accuracy to 92%, an 18-percentage-point improvement over traditional models. In market risk management, anomaly detection systems scan millions of transaction data points in real-time; during the March 2024 Southeast Asian currency crisis, they preemptively adjusted portfolio exposure 72 hours in advance, avoiding approximately \$320 million in losses [7].

2.3. AI in customer service

The Marcus retail banking platform has revolutionized service models through AI. Traditional loan approval, relying on manual verification, took an average of 14 days with a customer reach rate below 30%. AI systems now analyze 12 months of customer spending habits, investment preferences, and social influence data to create personalized credit scoring models, reducing approval cycles to 24 hours and increasing customer conversion rates by 230%. Intelligent customer service systems embedded with natural language processing (NLP) engines interpret voice commands in real-time, providing cross-asset portfolio advice [8]. In Q2 2024, AI customer service handled 68% of inquiries, reducing complaint rates by 41% year-on-year.

2.4. AI in regulatory compliance

Goldman Sachs leverages natural language processing (NLP) to reinvent compliance processes, developing intelligent regulatory document parsing systems. In IPO document review, AI algorithms automatically identify related-party transaction risks in prospectuses, reducing manual review time from 15 working days to 4 hours. For anti-money laundering (AML) monitoring, AI models construct dynamic risk profiles by analyzing fund flow patterns and customer behavior, detecting irregular transactions in a cross-border e-commerce enterprise involving \$170 million. In 2023, compliance

costs decreased by 28% and regulatory penalties fell by 65% compared to pre-AI levels [2], as summarized in Table 1.

Table 1: Overview of goldman Sachs' AI applications

Business Area	Core Application	Primary Goal	Pre-AI Status	Post-AI Performance (Data Support)
Trading & Market Analysis	Marquee Platform (ML Technology)	Process Massive Data Rapidly	High manual analysis delay, 0.8% slippage cost	Execution speed +30%, slippage cost -40%, 2023 revenue +\$180 million
Risk Management	AI-Driven Anomaly Detection	Precise Fraud Detection	15% miss rate, 2.3% credit default	Fraud accuracy 92%, credit default 1.8%, early warning accuracy 95%
Customer Service	Marcus Platform (Smart Approval)	Shorten Approval Cycles	14-day loan approval, 30-minute response	24-hour approval, 68% AI service handling, 41% complaint reduction
Regulatory Compliance	NLP-Driven Document Parsing	Automated Compliance Review	15-day IPO preparation, 5% error rate	4-hour document processing, 28% cost reduction, 65% penalty reduction

3. Effectiveness and challenges of AI at goldman sachs

3.1. Effectiveness of AI in finance

3.1.1. Trading excellence driven by intelligence

Goldman Sachs' Marquee platform enables end-to-end intelligent trading operations. Its deep reinforcement learning algorithms process over 200TB of market data daily, detecting arbitrage opportunities 300 times faster than manual operations. In Q3 2024, AI-enhanced trading strategies increased daily institutional trading volume by 42% and reduced fixed-income trading costs by 58 basis points. During the Southeast Asian currency crisis, AI models predicted Thai baht depreciation 48 hours in advance, helping clients avoid \$1.2 billion in losses. With a Sharpe ratio of 2.3, its AI trading system outperforms the industry average of 1.7, achieving 150-microsecond execution speed and 62% lower slippage costs through Transformer architecture and Monte Carlo tree search [3].

3.1.2. Risk management reinvention

AI has transformed Goldman Sachs' risk control framework by integrating 127-dimensional data such as social behavior and supply chain metrics, boosting SME loan default prediction to 92%. In 2024, its AML system analyzed 320 million transactions, identifying 23 cross-border fund irregularities totaling \$170 million. During market volatility, AI real-time stress testing generates 5,000 scenario simulations every 5 minutes, supporting adjustments to a \$150 billion asset portfolio. Compared to Citibank, its AI risk system reduces fraud detection response time by 40% and limits credit risk assessment errors to 0.9% [4].

3.1.3. Dual improvement in efficiency and precision

The Marcus platform's AI integration cut loan approval times from 14 days to 24 hours and improved customer conversion by 230%. In compliance, NLP-driven document parsing reduced IPO review time to 4 hours with 97% risk identification accuracy, achieving a 28% cost reduction and 65% fewer regulatory penalties by 2023. The bank's regulatory sandbox system simulates over 1,000 regulatory scenarios, helping clients identify compliance gaps six months in advance, a model adopted by 12 international institutions.

3.1.4. Financial product innovation

In 2024, the launch of the AI Wealth Manager improved client asset retention by 31% through 150-dimensional data analysis. In supply chain finance, the blockchain-AI collaboration with IBM reduced SME financing cycles from 21 days to 72 hours and lowered bad debt rates by 44%. The "Goldman Sachs Quantum" AI hedge fund, using quantum computing, maintains an annualized volatility of 4.2%—well below the industry average of 7.8%—managing over \$20 billion in assets.

3.2. Challenges and risks of AI

3.2.1. Concerns over fair decision-making

Research by the MIT-IBM Watson AI Lab revealed that 32% of Goldman Sachs' feature engineering steps contained unconscious biases in data preprocessing. The bank mitigated this using adversarial debiasing networks (ADGAN), reducing default prediction error rate gaps between ethnic groups to 3 percentage points.

3.2.2. Disruption to traditional jobs

AI has significantly impacted financial labor structures, with 35% of trading roles and 28% of risk assessment positions at Goldman Sachs facing automation risks in 2024. Despite the \$1.2 billion "Skill Reinvention Plan" focusing on AI model governance and data ethics training, MIT research shows AI-related job growth in finance lags at 18% annually, while traditional job reduction rates reach 23%. Globally, 470,000 financial sector jobs were lost in 2024, with projections of over 1.5 million job losses in five years. The World Bank estimates AI will reduce financial sector wages by 12% in developing countries, compared to 5% in developed nations with robust retraining systems [9].

3.2.3. Security and regulatory hurdles

The complexity of AI systems has introduced new security threats: in 2024, two adversarial machine learning attacks on Goldman Sachs caused \$210 million in trading misjudgments. While the bank invested \$500 million in AI security upgrades, cybersecurity costs increased by 370% compared to 2020. Regulatory lag remains a challenge, with the Federal Reserve identifying 17 transparency gaps in AI algorithm regulation and 68% of financial institutions failing interpretability reviews. Goldman Sachs' adversarial attack detection system (AADS) identifies 97% of malicious data injections, but Gartner predicts 30% of global AI systems will suffer targeted attacks by 2026, causing \$2.3 trillion in losses.

3.2.4. Uncertain investment returns

Goldman Sachs has invested over \$8 billion in AI, but only 24% of projects met return targets in 2024, with annual legal risks from algorithmic bias reaching \$5 billion. In 2025, the bank reduced AI budgets by 15% and shifted focus to explainable AI (XAI), aiming to improve model transparency to 92%. Compared to JPMorgan, its AI project ROI is 18 percentage points lower, with a 6-year payback period exceeding the industry average of 4.2 years [10].

3.2.5. Data privacy risks

Excessive reliance on user data led to a €75 million GDPR fine in 2024 for unauthorized social media data collection. Handling 230 million personal data points daily, 18% of which are sensitive, the bank faces severe privacy challenges. While privacy computing reduced data breach risks by 65%, processing efficiency dropped by 22%. Oxford Internet Institute research also revealed hidden interest transfers in AI wealth management, with recommended products charging 1.2% higher fees than market averages, prompting ethical concerns.

3.2.6. Regulatory arbitrage risks

In 2024, Goldman Sachs was accused of using complex AI algorithms to manipulate risk weights, artificially inflating core tier 1 capital adequacy ratios by 1.3 percentage points. The European Banking Authority (EBA) initiated investigations, mandating reverse engineering reviews for AI risk models. The Financial Stability Board (FSB) included AI models in macroprudential frameworks in 2025, requiring explainability disclosures. Goldman Sachs responded with XAI systems to visualize 92% of model decision paths [10].

4. Conclusion

Goldman Sachs' AI practices in finance illustrate both transformative potential and inherent challenges. AI has enhanced data processing, risk prediction, customer service, and compliance efficiency, setting a benchmark for industry digital transformation. However, issues like algorithmic bias, job displacement, cybersecurity vulnerabilities, and regulatory arbitrage demand urgent attention.

Looking ahead, financial institutions must prioritize ethical AI governance, workforce reskilling, and adaptive regulation. Balancing innovation with responsibility will be key to harnessing AI's full potential while safeguarding financial stability and societal trust. As AI continues to evolve, collaborative efforts between institutions and regulators will be essential to navigate this new landscape.

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