

# Operational Challenges in Basel IV Credit Risk Compliance

Ravikumar Mani Naidu Gunasekaran  
Independent researcher, California, United States

## Article Info

### Article history:

Received Aug, 2023  
Revised Aug, 2023  
Accepted Aug, 2023

### Keywords:

Banking Regulations;  
Basel IV;  
Credit Risk Compliance;  
Data Governance;  
Data Lineage;  
Digital Transformation;  
Financial Risk Management;  
Internal Ratings-Based (IRB) Models;  
Model Risk Management;  
Output Floor;  
Regulatory Compliance;  
Regulatory Reporting;  
Risk-Weighted Assets (RWA);  
Standardized Approach (SA)

## ABSTRACT

The implementation of Basel IV regulations represents a significant advancement in global banking supervision, with a strong focus on enhancing the accuracy, consistency, and transparency of credit risk measurement. While these reforms strengthen the resilience of financial institutions, they introduce substantial operational complexities, particularly in the areas of data management, system integration, model governance, and regulatory reporting. This paper examines the key operational challenges faced by banks in complying with Basel IV credit risk requirements, including the adoption of revised standardized approaches, restrictions on internal ratings-based (IRB) models, and the introduction of the output floor. The study highlights critical issues such as fragmented data architectures, legacy system constraints, increased computational demands, and the need for robust data lineage and governance frameworks. Additionally, the paper discusses the implications of heightened regulatory scrutiny and the requirement for greater model transparency and validation under evolving compliance standards. To address these challenges, the paper outlines strategic approaches involving modernization of technology infrastructure, adoption of cloud-based platforms, automation of reporting processes, and integration of advanced analytics. By providing a comprehensive assessment of operational barriers and potential solutions, this study aims to support financial institutions in navigating the complexities of Basel IV implementation. The findings underscore the importance of aligning organizational processes, technology, and governance frameworks to achieve effective and sustainable compliance in an increasingly data-driven regulatory environment.

*This is an open access article under the [CC BY-SA](#) license.*



### Corresponding Author:

Name: Ravikumar Mani Naidu Gunasekaran  
Institution: Independent researcher, California, United States  
Email: [rmg.ravikumar@gmail.com](mailto:rmg.ravikumar@gmail.com)

## 1. INTRODUCTION

The Basel framework has long served as the cornerstone of global banking regulation, providing standardized guidelines for managing financial risks and ensuring the stability of the international banking system. Following the global financial crisis of 2008, regulators recognized significant shortcomings in existing

frameworks, particularly in the areas of credit risk measurement, capital adequacy, and risk-weighted asset (RWA) variability [1]–[3]. In response, the Basel Committee on Banking Supervision (BCBS) introduced a series of reforms under Basel III, which have since evolved into what is commonly referred to as Basel IV—a comprehensive set of measures aimed at finalizing and strengthening the regulatory framework [1].

Basel IV introduces substantial changes to credit risk measurement methodologies, including revisions to the Standardized Approach (SA), constraints on the use of Internal Ratings-Based (IRB) models, and the implementation of a minimum output floor (72.5%) to reduce variability in RWA calculations across institutions [1], [4]–[6]. These changes are designed to enhance transparency, comparability, and risk sensitivity while addressing inconsistencies in banks' internal risk models [1], [4]. However, despite these regulatory benefits, the operational implications for financial institutions are significant and far-reaching [7]–[9].

One of the primary challenges arising from Basel IV is the increased granularity and complexity of data requirements. Banks are now required to capture and process vast amounts of detailed credit risk data, including borrower characteristics, collateral attributes, and exposure classifications [4]. This level of granularity places considerable strain on existing data infrastructures, many of which were not designed to handle high-volume, high-frequency, and multi-dimensional datasets [8], [9]. As a result, institutions must invest heavily in modern data architectures, such as data lakes and integrated enterprise data platforms, to support compliance requirements [7], [8].

In addition to data-related challenges, Basel IV imposes substantial demands on technology systems and integration capabilities. Most large financial institutions operate with fragmented legacy systems across risk, finance, and treasury functions, leading to inconsistencies in data definitions and reporting outputs. The need to integrate these systems into a unified framework that supports accurate and timely RWA calculations presents a complex operational hurdle. Furthermore, parallel calculations under both standardized and internal model approaches—necessary for applying the output floor—further increase computational complexity and system workload.

Another critical area of concern is the reduction in reliance on internal models,

particularly under the IRB approach. Basel IV introduces stricter eligibility criteria and parameter floors, limiting banks' ability to use internal risk models for certain asset classes. This shift toward standardized methodologies reduces modeling flexibility and forces institutions to redevelop or recalibrate existing models. Consequently, banks must also enhance their model validation, governance, and documentation processes to meet heightened regulatory expectations.

Operational challenges also extend to regulatory reporting and compliance governance. Basel IV requires more detailed and frequent reporting, with a strong emphasis on data lineage, traceability, and auditability. Regulators expect financial institutions to demonstrate full transparency in how data flows from source systems to final regulatory reports. This necessitates the implementation of robust data governance frameworks, automated reporting systems, and comprehensive audit trails—significantly increasing operational costs and complexity.

Moreover, the successful implementation of Basel IV depends heavily on organizational alignment and skilled human resources. Institutions must coordinate efforts across multiple departments, including risk management, finance, IT, and compliance. At the same time, there is a growing demand for professionals with expertise in regulatory frameworks, data engineering, and advanced analytics, creating a notable skills gap within the industry.

Given these challenges, Basel IV compliance is not merely a regulatory exercise but a strategic transformation initiative that requires significant investment in technology, data management, and organizational capabilities [7]–[9]. Financial institutions that adopt a proactive and integrated approach—leveraging digital transformation, automation, and advanced analytics—will be better positioned to navigate the complexities of Basel IV while enhancing operational efficiency and competitive advantage [7], [8].

This paper aims to provide a comprehensive analysis of the operational challenges associated with Basel IV credit risk

compliance, focusing on key areas such as data management, system integration, model governance, and regulatory reporting. It further explores potential solutions and best practices to help financial institutions achieve effective and sustainable compliance in an increasingly complex regulatory environment.

## 2. BASEL III vs BASEL IV: COMPARATIVE ANALYSIS OF CREDIT RISK FRAMEWORK

Basel IV represents a fundamental shift from model-driven flexibility under Basel III to standardization and transparency [1]. While it enhances financial stability and comparability, it significantly increases operational complexity, data requirements, and compliance costs [7]–[9].

This section clearly demonstrates the evolution of regulatory requirements and highlights why Basel IV introduces significant operational challenges [1], [4]–[7].

Table 1. Basel III vs Basel IV: Comparative Analysis of Credit Risk Framework

Aspect	Basel III	Basel IV (Finalized Basel III Reforms)	Operational Impact
Objective	Strengthening capital adequacy and liquidity post-2008 crisis	Improve consistency, transparency, and comparability of risk measurement	Increased regulatory scrutiny and reporting requirements
Credit Risk Approach	Mix of Standardized Approach (SA) and Internal Ratings-Based (IRB) models	Revised Standardized Approach with greater risk sensitivity; restrictions on IRB models	Increased reliance on standardized rules; reduced flexibility
Standardized Approach (SA)	Less risk-sensitive, broad risk weights	More granular with risk drivers such as LTV, counterparty type, and external ratings	Requires detailed data collection and classification
Internal Ratings-Based (IRB)	Widely used across asset classes	Restricted for certain portfolios (e.g., equities, low-default portfolios)	Need for model redevelopment and validation
Output Floor	Not present	Introduced at <b>72.5% of standardized RWA</b>	Requires parallel RWA calculation (SA vs IRB), increasing complexity
Risk-Weighted Assets (RWA)	Higher variability across banks	Reduced variability due to standardized constraints and output floor	Improved comparability but increased operational burden
Data Requirements	Moderate data granularity	Highly granular and detailed data requirements	Significant investment in data infrastructure and governance
Model Risk Management	Required but less stringent	Strong emphasis on model validation, auditability, and transparency	Increased compliance and validation workload
Regulatory Reporting	Periodic reporting with less granularity	More frequent, detailed, and traceable reporting	Need for automation and real-time reporting systems
Capital Requirements	Based on internal and standardized models	Likely higher due to output floor and conservative measures	Potential capital increase and balance sheet impact
Data Lineage & Governance	Limited focus	Strong emphasis on traceability and audit trails	Implementation of data lineage tools required

Aspect	Basel III	Basel IV (Finalized Basel III Reforms)	Operational Impact
Technology Requirements	Legacy systems often sufficient	Requires advanced analytics, big data platforms, and integration	Significant IT transformation and cost
Operational Complexity	Moderate	High due to parallel calculations, granular data, and reporting	Increased operational overhead
Implementation Effort	Incremental changes	Large-scale transformation initiative	Requires cross-functional coordination

### 3. OVERVIEW OF BASEL IV: CREDIT RISK FRAMEWORK

#### 3.1 Overview

Basel IV (often referred to as the “finalization of Basel III”) introduces enhanced credit risk methodologies aimed at improving [1]:

- a. Risk sensitivity
- b. Consistency across banks
- c. Transparency in capital calculations

The framework significantly impacts how banks calculate Risk-Weighted Assets (RWA) and manage credit risk exposure [1], [4]–[6].

#### 3.2 Key Components

##### a. Revised Standardized Approach (SA)

More granular risk-weight calculations based on borrower characteristics.

##### b. Internal Ratings-Based (IRB) Restrictions

Limits use of internal models for certain asset classes.

##### c. Output Floor (72.5%)

Minimum RWA must be ≥ 72.5% of standardized approach.

##### d. Credit Risk Mitigation (CRM)

Revised rules for collateral and guarantees.

##### e. Exposure Classification

Detailed segmentation of exposures (corporate, retail, real estate).

##### f. Off-Balance Sheet Exposures

Updated credit conversion factors.

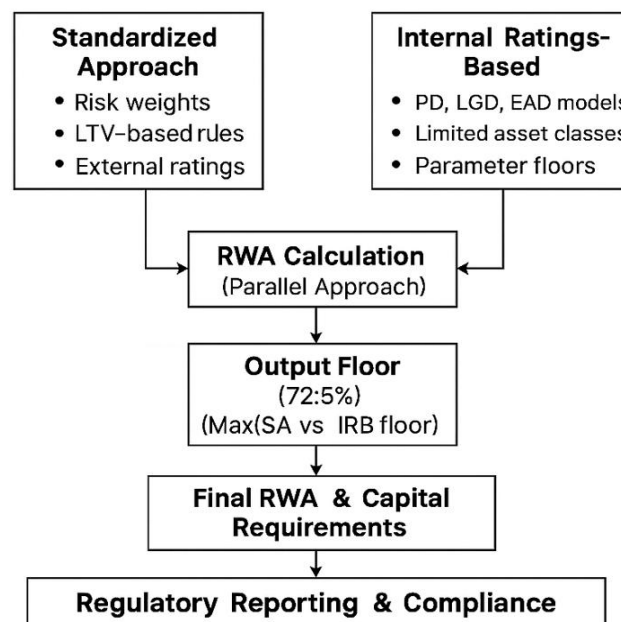


Figure 1. Basel IV Credit Risk Framework

### 3.3 Basel IV Credit Risk Framework

#### 1. Dual Approach to Credit Risk

Banks calculate RWA using:

- a. Standardized Approach (SA).
- b. Internal Ratings-Based (IRB) (where allowed).

#### 2. Revised Standardized Approach

- a. Loan-to-Value (LTV).
- b. External credit ratings.
- c. Counterparty classification.  
More risk-sensitive than Basel III.

#### 3. IRB Model Restrictions

- a. Limits use of internal models.
- b. Introduces.
- c. Parameter floors (PD, LGD).
- d. Removes IRB eligibility for certain portfolios.
- e. Reduces variability across banks.

#### 4. RWA Calculation

Banks perform parallel calculations:

- a. RWA (SA).
- b. RWA (IRB).

#### 5. Output Floor (Core Feature)

Final RWA must be:

$$RWA_{Final} \geq 72.5\% \times RWA_{SA}$$

Ensures minimum capital consistency.

#### 6. Final Capital Requirement

Based on:

- a. Adjusted RWA.
- b. Regulatory capital ratios.

#### 7. Regulatory Reporting

Requires:

- a. Detailed disclosures.
- b. Data lineage.
- c. Auditability.

The Basel IV credit risk framework introduces a hybrid structure combining standardized rules and constrained internal models, enforced through the output floor mechanism [1], [4]–[6]. While this enhances transparency and consistency, it significantly increases operational complexity, data requirements, and technological demands, making implementation a

major challenge for financial institutions [7]–[9].

## 4. KEY OPERATIONAL CHALLENGES IN BASEL IV CREDIT RISK COMPLIANCE

The summary of key operational challenges highlights the multi-dimensional nature of Basel IV implementation, emphasizing that compliance extends beyond regulatory calculations into data, technology, governance, and organizational transformation. Unlike previous frameworks, Basel IV introduces increased data granularity, stricter model constraints, and enhanced reporting requirements, which collectively impose significant pressure on existing banking infrastructures [1], [4]–[6].

At the core of these challenges lies the data ecosystem, where issues such as data quality, fragmentation, and lineage directly impact the accuracy of Risk-Weighted Asset (RWA) calculations and regulatory reporting. Simultaneously, the reliance on legacy systems and siloed architecture complicates system integration and slows down the ability to process large volumes of data efficiently.

From a modeling perspective, constraints on Internal Ratings-Based (IRB) approaches and the introduction of the output floor mechanism reduce flexibility while increasing computational demands through parallel calculations. In addition, heightened expectations around regulatory compliance, transparency, and auditability require financial institutions to invest in robust governance frameworks and automated reporting systems.

Operationally, these changes are further compounded by high technology costs, scalability requirements, and a shortage of skilled professionals, making Basel IV not just a compliance initiative but a complex, enterprise-wide transformation program. Institutions must therefore adopt a holistic and integrated strategy, combining advanced data architectures, scalable computing, and strong governance practices to effectively manage these challenges.

## Challenges in Basel IV Credit Risk Compliance

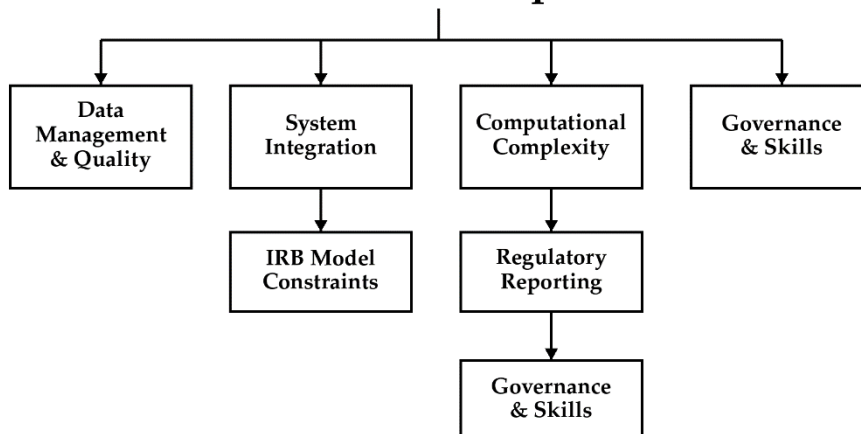


Figure 2. Challenges in Basel IV Credit Risk Compliance

Table 2: Summary of Key Operational Challenges

Category	Key Issues	Impact	Mitigation
Data	Quality, fragmentation	Incorrect RWA	Data governance
Systems	Legacy infrastructure	Integration delays	Modern architecture
Models	IRB constraints	Reduced flexibility	Hybrid models
Computation	Parallel calculations	Performance issues	Distributed computing
Compliance	Reporting complexity	Regulatory risk	Automation
Technology	High cost	Budget constraints	Cloud adoption
People	Skill gaps	Implementation delays	Training
Governance	Data lineage	Audit Risk	Governance tools

### 4.1 Core Challenge Areas

The diagram groups challenges into four primary domains:

- a. **Data Management & Quality:** Foundation for all calculations, Drives accuracy of RWA and reporting.
- b. **System Integration:** Links fragmented systems, Enables unified data processing.
- c. **Computational Complexity:** Arises from Parallel RWA calculations and output floor requirements.
- d. **Governance & Skills:** Cross-cutting layer impacting all areas.

### 4.2 Interdependencies

- a. **Data and system issues feed into:** IRB Model Constraints.
- b. **Computational complexity leads to:** Regulatory Reporting pressure.
- c. **All challenges ultimately require:** Strong governance and skilled workforce.

## 5. REAL-WORLD EXAMPLE: BASEL IV IMPLEMENTATION CHALLENGE

Case Study: Global Tier-1 Bank (Representative Scenario). A large Tier-1 institution such as US Bank, Wells Fargo) undertook a Basel IV transformation program to comply with revised credit risk requirements, reflecting the type of implementation issues frequently discussed in industry analyses of Basel IV and Basel 3.1 implementation.

### 5.1 Key Challenges Faced

#### 1. Fragmented Data Landscape

- a. The bank had multiple legacy systems:
  - Retail lending platform
  - 1) Corporate credit systems.
  - 2) Treasury and collateral systems.

- b. Data inconsistencies were observed in:
    - 1) Borrower ratings.
    - 2) Collateral valuation (LTV ratios).
  - c. Impact:
    - 1) Inconsistent RWA calculations.
    - 2) Frequent reconciliation issues.
- 2. Output Floor Implementation**
- a. Required parallel calculation of:
    - 1) Standardized Approach (SA).
    - 2) Internal Ratings-Based (IRB).
  - b. Challenge:
 

The bank's infrastructure was not designed for dual computation.
  - c. Impact:
    - 1) Increased computation time by 2–3x.
    - 2) Need for major system upgrades.
- 3. IRB Model Restrictions**
- Certain portfolios (e.g., low-default corporate portfolios) were no longer eligible for IRB. Impact:
- 1) Rebuilding models using standardized rules.
  - 2) Loss of capital optimization benefits.
- 4. Regulatory Reporting Complexity**
- Required: Detailed data lineage, End-to-end traceability
- a. **Impact:**
    - 1) Manual intervention in reporting.
    - 2) Audit challenges.

Initial budget underestimated transformation effort.
  - b. **Outcome:**
    - 1) Program cost increased by 30–40%.
    - 2) Multi-year transformation timeline.

## 5.2 Solution Adopted

The bank implemented:

- a. Centralized data lake architecture.
- b. Cloud-based processing (Azure/AWS).
- c. Automated RWA engines.
- d. Data lineage tools (Collibra-like solutions).

## 5.3 Key Outcome

- a. Improved RWA accuracy.
- b. Reduced reporting time.
- c. Achieved regulatory compliance.
- d. High transformation cost and effort.

## 6. USE OF ADVANCED TECHNOLOGIES

The implementation of Basel IV necessitates the adoption of advanced technologies to address the increased complexity in risk modeling, data processing, regulatory reporting, and compliance governance. Technologies such as machine learning, big data platforms, robotic process automation (RPA), and explainable AI (XAI) play a critical role in enabling efficient and scalable compliance frameworks [10], [11].

### 6.1 Machine Learning for Risk Modeling

#### a. Overview

Machine Learning (ML) enhances credit risk modeling by enabling data-driven, adaptive, and more accurate estimation of key risk parameters, including:

- 1) Probability of Default (PD).
- 2) Loss Given Default (LGD).
- 3) Exposure at Default (EAD).

#### b. Applications in Basel IV

- 1) Improved segmentation of borrowers using clustering techniques.
- 2) Nonlinear modeling of credit risk drivers.
- 3) Early detection of credit deterioration.
- 4) Enhanced scenario analysis and stress testing.

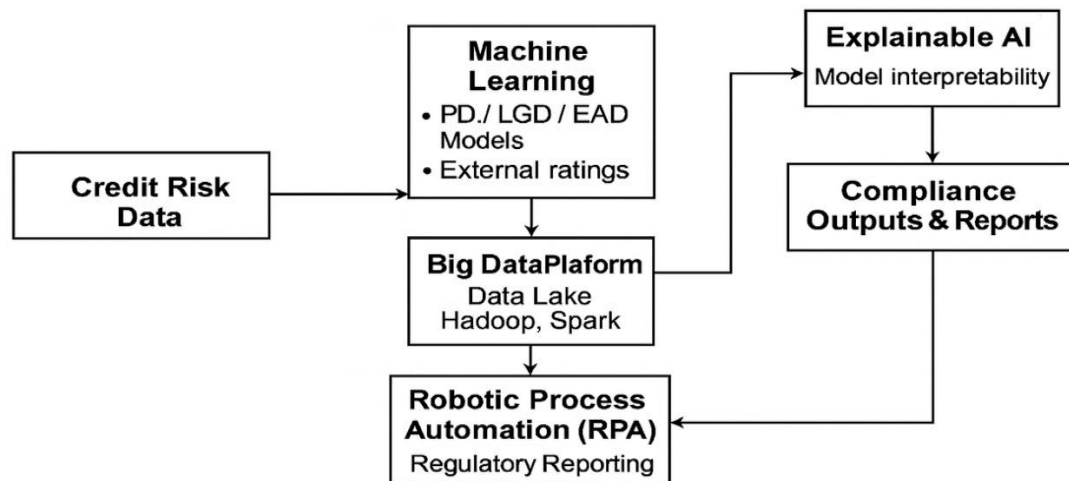


Figure 3. Leveraging Advanced Technologies for Basel IV Compliance

### c. Techniques Used

- 1) **Regression Models:** Predict PD, LGD values.
- 2) Gradient Boosting (XGBoost): High-accuracy risk prediction.
- 3) Neural Networks: Capture complex relationships.
- 4) **Time-Series Models:** Forecast default trends.
- 5) **Benefits**
  - a) Higher predictive accuracy compared to traditional models.
  - b) Ability to handle large and complex datasets.
  - c) Continuous learning from new data.

## 6.2 Big Data for RWA Calculations

### a. Overview

Basel IV requires processing large volumes of granular data across multiple systems, making big data technologies essential.

### b. Key Capabilities

- 1) Integration of structured and unstructured data.
- 2) Real-time processing of exposures and risk parameters.
- 3) Scalable computation of Risk-Weighted Assets (RWA).

### c. Architecture Components

- 1) **Data Storage:** Hadoop, Azure Data Lake.

- 2) **Processing Engine:** Apache Spark.

- 3) **Data Ingestion:** Kafka, ETL pipelines.

### d. Benefits

- 1) Efficient handling of high-volume, high-velocity data.
- 2) Faster RWA computation.
- 3) Improved data consistency across systems.

Advanced technologies are critical enablers for Basel IV compliance, helping financial institutions address the increased complexity of credit risk modeling, data management, and regulatory reporting. When integrated effectively, these technologies provide:

- a. Scalable infrastructure for handling large datasets.
- b. Accurate and adaptive risk models.
- c. Automated and efficient reporting processes.
- d. Transparent and compliant model outputs.

However, successful adoption requires balancing innovation with regulatory expectations, governance frameworks, and operational readiness.

## 6.3 Integrated View of Advanced Technologies

- a. **Machine Learning:** Risk modeling (PD, LGD, EAD).

- b. **Benefit:** Improved predictive accuracy.

- c. **Big Data:** RWA calculation and data processing.
- d. **Benefit:** Scalability and speed.
- e. **RPA:** Reporting automation.
- f. **Benefit:** Efficiency and cost reduction.
- g. Explainable AI: Model transparency and governance.
- h. **Benefit:** Regulatory compliance.

## 7. FUTURE OUTLOOK

The Basel IV framework represents a major step toward strengthening global banking resilience; however, its implementation is only the beginning of a broader transformation in credit risk management and regulatory compliance. Several emerging trends are expected to shape the future of Basel compliance:

### 7.1 Digital Transformation of Risk Management

- a. Banks will increasingly adopt cloud-native and data-driven architectures.
- b. Shift from legacy systems to integrated, real-time risk platforms.

#### Impact:

Enhanced scalability, faster RWA calculations, and improved operational efficiency.

### 7.2 Increased Use of Artificial Intelligence and Machine Learning

AI-driven models for:

- a. Credit risk assessment.
- b. Default prediction.
- c. Portfolio optimization.

Continuous learning models adapting to new data.

#### Impact:

Improved accuracy and proactive risk management.

### 7.3 Real-Time Regulatory Reporting

- a. Movement toward near real-time or continuous compliance reporting.
- b. Integration with regulatory APIs and reporting platforms.

#### Impact:

Reduced reporting lag and improved transparency.

### 7.4 Strengthening Data Governance and Data Lineage

Greater emphasis on:

- a. End-to-end data traceability
- b. Data auditability.

Adoption of **enterprise data governance frameworks.**

#### Impact:

Enhanced regulatory compliance and audit readiness.

### 7.5 Growth of RegTech Solutions

Expansion of regulatory technology (RegTech) tools for:

- a. Automated compliance.
- b. Reporting workflows.
- c. Risk monitoring.

#### Impact:

Reduced operational cost and improved compliance efficiency.

### 7.6 Standardization and Global Regulatory Alignment

- a. Ongoing efforts to harmonize regulatory requirements across jurisdictions.
- b. Reduction of inconsistencies in RWA calculations globally.

#### Impact:

Improved comparability between banks and reduced regulatory arbitrage.

### 7.7 Integration with ESG and Climate Risk

Increasing regulatory focus on:

- a. Environmental, Social, and Governance (ESG) factors.
- b. Climate risk integration into credit risk models.

#### Impact:

Expansion of Basel frameworks beyond traditional financial risks.

## 8. CONCLUSION

Basel IV represents a significant evolution in the global regulatory landscape, with a strong emphasis on enhancing the consistency, transparency, and robustness of credit risk measurement. While these reforms strengthen the stability of financial institutions, they also introduce substantial operational complexity and implementation challenges.

This paper has highlighted key challenges associated with Basel IV compliance, including:

- a. Data quality and integration issues.
- b. Legacy system constraints.
- c. Increased computational complexity.
- d. Restrictions on internal models.
- e. Enhanced regulatory reporting and governance requirements.

The introduction of the revised standardized approach and output floor fundamentally changes the way banks calculate Risk-Weighted Assets (RWA), requiring parallel processing frameworks and significantly higher data granularity.

To address these challenges, financial institutions must adopt a holistic transformation strategy that integrates:

- a. Advanced technologies such as machine learning and big data
- b. Automated reporting through RPA
- c. Strong governance frameworks supported by explainable AI

Moreover, Basel IV compliance should not be viewed as a purely regulatory obligation but as an opportunity to modernize risk management infrastructure, enhance data capabilities, and improve operational efficiency.

In conclusion, banks that proactively invest in technology, data governance, and skilled resources will be better positioned to navigate the complexities of Basel IV, achieve sustainable compliance, and gain a competitive advantage in an increasingly data-driven financial ecosystem.

## REFERENCES

- [1] B. C. on B. Supervision, "Basel III: Finalising post-crisis reforms," Bank for International Settlements, 2017. [Online]. Available: <https://www.bis.org/bcbs/publ/d424.htm>
- [2] M. Drehmann and K. Nikolaou, "Funding liquidity risk: Definition and measurement," *J. Bank. Financ.*, vol. 37, no. 7, pp. 2173–2182, 2013, doi: 10.1016/j.jbankfin.2012.01.002.
- [3] L. Allen and A. Saunders, "Incorporating systemic influences into risk measurements: A survey of the literature," *J. Financ. Serv. Res.*, vol. 26, no. 2, pp. 161–191, 2004, doi: 10.1023/B:FINA.0000037545.38154.8a.
- [4] B. C. on B. Supervision, "CRE20: Standardised approach: individual exposures," Bank for International Settlements, 2025. [Online]. Available: [https://www.bis.org/basel\\_framework/chapter/CRE/20.htm](https://www.bis.org/basel_framework/chapter/CRE/20.htm)
- [5] B. C. on B. Supervision, "CRE30: IRB approach: overview and asset class definitions," Bank for International Settlements, 2020. [Online]. Available: [https://www.bis.org/basel\\_framework/chapter/CRE/30.htm](https://www.bis.org/basel_framework/chapter/CRE/30.htm)
- [6] B. C. on B. Supervision, "CRE36: IRB approach: minimum requirements to use IRB approach," Bank for International Settlements, 2022. [Online]. Available: [https://www.bis.org/basel\\_framework/chapter/CRE/36.htm](https://www.bis.org/basel_framework/chapter/CRE/36.htm)
- [7] S. Schneider, G. Schrock, S. Koch, and R. Schneider, "Basel 'IV': What's next for banks?," McKinsey & Company, 2017. [Online]. Available: [https://www.mckinsey.de/~ /media/mckinsey/business\\_functions/risk/our\\_insights/basel\\_iv\\_whats\\_next\\_for\\_european\\_banks/basel-iv-whats-next-for-banks.pdf](https://www.mckinsey.de/~ /media/mckinsey/business_functions/risk/our_insights/basel_iv_whats_next_for_european_banks/basel-iv-whats-next-for-banks.pdf)
- [8] Deloitte, "Capital requirement calculations under Basel 3.1," Deloitte, 2023. [Online]. Available: <https://www.deloitte.com/se/sv/services/consulting-risk/perspectives/capital-requirement-calculations-under-basel.html>
- [9] PwC, "Big bang - or the endgame of Basel III? BCBS finalises reforms on RWA," PwC, 2017. [Online]. Available: <https://www.pwc.com/il/he/bankim/assets/2018/basel-iv-big-bang-or-endgame-of-basel-iii-201712.pdf>
- [10] T. Chen, "XGBoost: A Scalable Tree Boosting System," *Cornell Univ.*, 2016.
- [11] I. Goodfellow, Y. Bengio, and A. Courville, *Deep learning*. MIT Press, 2016. [Online]. Available: <https://www.deeplearningbook.org/>