

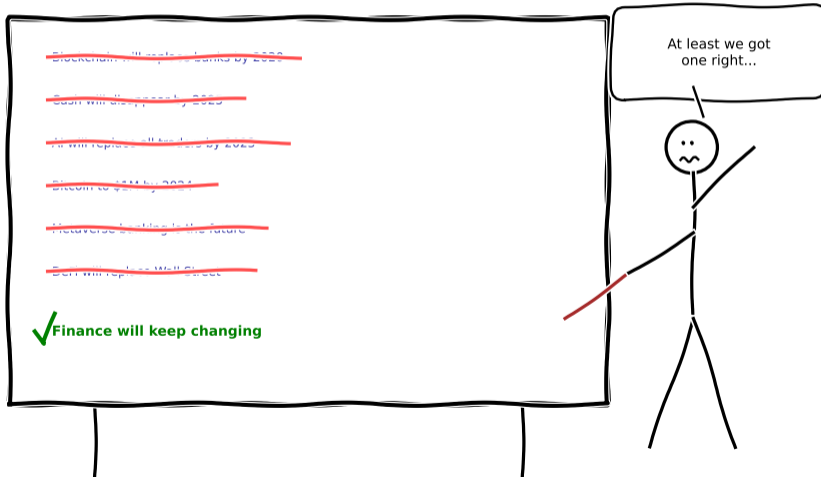
# Lesson 8.4: The Future of Finance — Synthesis and Scenarios

Module 8: The Future Problem

Prof. Dr. Joerg Osterrieder

Digital Finance — BSc Course

## FinTech Predictions: A History



After completing this lesson, you will be able to:

- 1 **Describe** the S-curve model of technology adoption and the Gartner hype cycle [Understand]
- 2 **Apply** Carlota Perez's framework to the current FinTech transformation [Apply]
- 3 **Construct** scenario analyses for the financial system in 2030–2035 [Apply]
- 4 **Synthesize** how technologies from all eight modules converge [Analyze]
- 5 **Evaluate** emerging patterns: embedded finance, autonomous finance, programmable money, AI-native institutions [Evaluate]
- 6 **Assess** career implications and the evolving skills landscape in digital finance [Evaluate]

**Bloom's levels covered:** Understand, Apply, Analyze, Evaluate

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This is the final lesson of the course. It synthesizes everything from Modules 1–8 into a forward-looking view.

### Lesson 8.3 — Climate finance:

- ESG frameworks and climate risk taxonomy
- Carbon markets and green bonds
- TCFD and ISSB disclosures
- Climate reshapes *what* we finance

### Lesson 8.4 — Synthesis:

- Technology adoption theory (S-curve, hype cycle, Carlota Perez)
- Scenario planning for 2030–2035
- Cross-module convergence of all eight themes
- Emerging patterns and career implications

*Climate reshapes what we finance.*

*This lesson synthesizes **how** we finance.*

### All 8 modules connect here:

1. Cost → 2. Access → 3. Trust
4. Risk → 5. Automation → 6. Infra
7. Compliance → 8. Future

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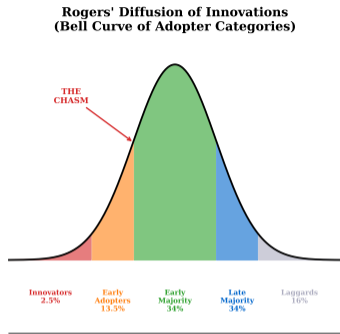
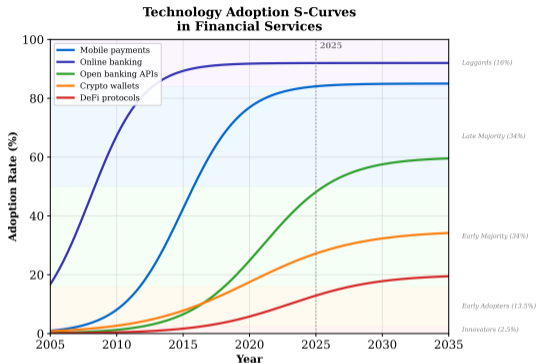
This is the capstone lesson of the entire 32-lesson Digital Finance course.

# Part I

## Technology Adoption Theory

How innovations move from labs to mainstream finance

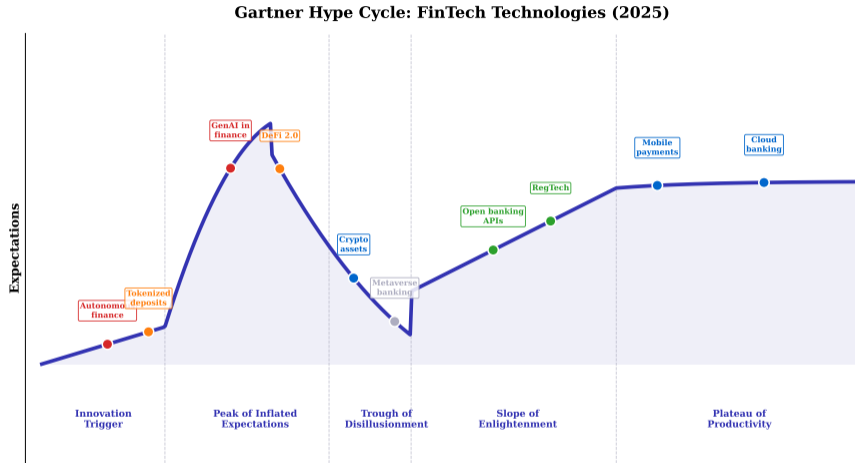
# Why Do Some Technologies Take 20 Years to Go Mainstream?



- **What you see:** Left panel shows S-curves for 5 technologies; online banking (92% adoption) and mobile payments (85%) reached plateau; open banking APIs (60%) crossing early majority; crypto wallets (35%) and DeFi (20%) still in early adopter phase. Right panel shows bell curve with "chasm" between early adopters and early majority
- **Key pattern:** Technologies spread slowly at first (innovators), then rapidly (early/late majority), then plateau; the chasm at 16% adoption is where most startups die
- **Takeaway:** Mobile payments took 10 years to cross the chasm; DeFi is still stuck there — crossing requires product-market fit for mainstream users, not just enthusiasts

The "chasm" between early adopters and early majority is where most FinTech startups fail (Geoffrey Moore, 1991).

# The Gartner Hype Cycle: Expectations vs. Reality



- **What you see:** Classic hype cycle curve with FinTech technologies positioned along it; GenAI and DeFi 2.0 at peak of inflated expectations; crypto assets in trough of disillusionment; RegTech and open banking climbing slope of enlightenment; mobile payments and cloud banking at plateau of productivity
- **Key pattern:** Technologies move from innovation trigger → peak hype → trough (crash) → gradual enlightenment → stable

## Where Are FinTech Technologies on the Hype Cycle?

Phase	Technology	
Innovation Trigger	Autonomous finance, tokenized deposits	3
Peak of Inflated Expectations	Generative Artificial Intelligence (GenAI) in finance, Decentralized Finance (DeFi) 2.0	5
Trough of Disillusionment	Crypto assets, metaverse banking	3
Slope of Enlightenment	Open banking APIs, RegTech	6
Plateau of Productivity	Mobile payments, cloud banking	1

- Technologies can spend years in the “trough” before finding product-market fit
- Some never reach the plateau (e.g., blockchain voting, ICOs)
- Position on the cycle shifts rapidly: GenAI moved from trigger to peak in ~18 months

Placement is based on industry consensus as of early 2025. Individual firms may experience these phases differently.

**Key thesis (2002):** Every major technological revolution follows a repeating pattern:

- ① **Installation period** — Financial capital floods in; speculation and bubbles
  - ICO bubble (2017), FinTech Special Purpose Acquisition Company (SPAC) mania (2021), Artificial Intelligence (AI) hype (2023–)
- ② **Turning point** — Crash or crisis; regulation catches up
  - Crypto winter (2022), FinTech funding collapse, FTX/Terra implosions
- ③ **Deployment period** — Production capital builds real infrastructure; broad adoption
  - Real-time payments (UPI, FedNow), embedded finance, RegTech at scale

**Perez's prediction:** We are now entering the *deployment period* of the FinTech revolution — the phase where lasting value is created.

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Perez studied five technological revolutions (1770s–2000s). The pattern held for canals, railways, steel, oil, and ICT.

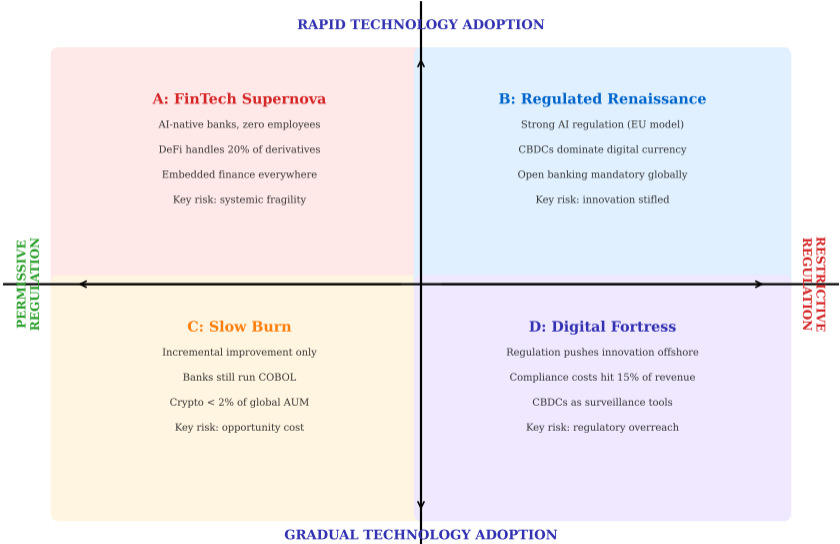
# Part II

Scenario Analysis: Finance in 2030–2035

Four plausible futures based on two key uncertainties

# Scenario Planning: The 2x2 Matrix Method

## Scenario Planning Matrix: Finance in 2030--2035



# What If AI Banks Replace All Human Lenders?

## What this world looks like by 2032:

- AI-native “banks” with zero human employees process 95% of retail lending
- DeFi protocols handle 20% of global derivatives volume
- Embedded finance is universal: every app is a financial app
- Stablecoins are dominant for cross-border payments
- CBDCs coexist but lag behind private innovation

**Winners:** Big Tech (Apple, Google), crypto-native protocols, API-first neobanks

**Losers:** Traditional banks that failed to transform, regulators scrambling to catch up

**Key risk:** Systemic fragility — no one understands the interconnections until a crash

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This scenario mirrors the “installation frenzy” phase in Perez’s framework.

## Scenario B: Regulated Renaissance (Rapid Tech + Restrictive Regulation)

### What this world looks like by 2032:

- Strong AI regulation (EU AI Act model) governs all financial ML
- CBDCs are the primary digital currency; stablecoins are tightly licensed
- Open banking is mandatory globally; data portability is a right
- RegTech is embedded in every financial product by design
- Incumbents transform successfully because regulation creates barriers to entry

**Winners:** Well-capitalized banks, RegTech vendors, public infrastructure (CBDCs)

**Losers:** Crypto-native firms, small FinTechs lacking compliance resources

**Key risk:** Innovation stifled — Europe-style regulation limits global competitiveness

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This scenario resembles the post-2008 regulatory tightening — but applied to digital finance.

## Scenario C: Slow Burn (Gradual Tech + Permissive Regulation)

### What this world looks like by 2032:

- Technology advances incrementally; no “iPhone moment” for finance
- Banks modernize core systems slowly; most still run COBOL
- FinTech firms find niches but do not displace incumbents
- Crypto remains a speculative asset class (<2% of global AUM)
- AI improves back-office efficiency but does not transform products

**Winners:** Incumbent banks (they keep their moats), consulting firms, middleware vendors

**Losers:** FinTech startups that burn cash waiting for adoption, VCs with long time horizons

**Key risk:** Opportunity cost — financial exclusion persists, costs remain high

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Many mature industries follow this path: gradual improvement without disruption.

## Scenario D: Digital Fortress (Gradual Tech + Restrictive Regulation)

### What this world looks like by 2032:

- Regulation is so strict that innovation moves offshore or underground
- Banks are safer but more expensive; compliance costs rise to 15% of revenue
- CBDCs are surveillance tools; privacy concerns drive adoption resistance
- AI in finance is restricted to approved use cases with human oversight
- Financial exclusion *worsens* as compliance costs are passed to consumers

**Winners:** Compliance departments, offshore financial centers, privacy-focused crypto

**Losers:** Consumers (higher costs), FinTechs (regulatory capture), innovation globally

**Key risk:** Regulatory overreach creates the problems it sought to prevent

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This scenario is the cautionary tale. Over-regulation can be as dangerous as under-regulation.

# Part III

## Cross-Module Synthesis

How all eight modules connect and reinforce each other

**M1L1 + M1L2.** Traditional finance vests trust in regulated intermediaries: card networks (Visa, Mastercard) certify the payment, banks settle the books, auditors confirm the books. The Merchant Discount Rate is the price of that trust.

- **M1L1 (anatomy of a payment):** five legal entities sit between buyer and seller; each is paid for a slice of trust
- **M1L2 (economics of intermediation):** two-sided market theory (Rochet & Tirole) frames why those intermediaries persist economically

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Trust here is institutional and priced via MDR. Subsequent modules reduce, relocate, or repurpose this trust.

**M2L2 + M2L4.** Inclusion programmes do not just lower fees; they shift trust toward algorithms. A thin-file borrower is now scored by a model, not by a loan officer.

- **M2L2 (credit scoring):** alternative-data models replace branch-relationship judgement
- **M2L4 (algorithmic fairness):** the question becomes “is the model's allocation fair?” rather than “is the bank biased?”

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**Algorithmic trust is auditable in a way human credit committees were not; but the audit itself requires new institutions (M7L3).**

**M3L2 + M3L3.** Public-key consensus and smart contracts attempt to remove the institution entirely. Trust is mathematical rather than institutional.

- **M3L2 (consensus mechanisms):** Proof-of-Work / Proof-of-Stake make finality a probabilistic property of the network, not a legal property of a registry
- **M3L3 (smart contracts):** the contract executes deterministically; the human enforcement step is gone

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The DAO 2016 and Terra-Luna 2022 show this trust is not absolute – it depends on code correctness and economic-incentive design.

**M4L3.** Even with cryptographic settlement, clearing and margining still rely on institutions. The Archegos 2021 collapse and the Credit Suisse March 2023 takeover both happened in the institution layer.

- **M4L3 (institutional risk):** Basel CET1, AT1, T2 stack assumes a regulated bank with a known balance sheet
- **M4L4 (new-risk landscape):** DeFi liquidations move the risk plumbing on-chain but reintroduce oracle + governance trust

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Pure-cryptographic trust shifts the failure mode; it does not abolish it. M4 catalogues where the failure mode emigrates to.

**M5L2 + M5L3.** Generative AI in finance creates outputs the institution cannot explain. Trust shifts from process to output, with the operator unable to defend either.

- **M5L2 (GenAI / LLMs):** a credit narrative drafted by an LLM is not auditable in the M2L4 sense; the institution adopts the output and inherits the responsibility
- **M5L3 (limits of prediction):** regime shift, Goodhart's law, and base-rate neglect each falsify the institution's confidence in its own model

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**This is the first thread inflection where M3's cryptographic trust does not help: a hash of a bad answer is still a bad answer.**

**M6L4 + M7L4 + M8L1.** The new trust primitives are operational not philosophical: on-chain verification + model-risk governance + portable identity.

- **M6L4 (next-gen infrastructure):** CBDC + tokenised deposits + SIX SDX wholesale DvP build verifiable settlement under regulator visibility
- **M7L4 (model risk governance):** SR 11-7 style lifecycle for the M5 models the bank now depends on
- **M8L1 (digital identity):** the Swiss e-ID 2026 rollout and the EU Digital Identity Wallet move authentication from credential to attribute
- Standalone reference: `lecture_cbdcs_money_reimagined.tex` extends this thread to public-trust + monetary mechanism

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Trust does not vanish in digital finance; it is unbundled into smaller, more verifiable pieces that are easier to audit individually but harder to audit jointly.

**Scenario.** A Swiss retail bank issues a tokenised savings product. Walk the lifecycle across the eight modules.

- **M1L4 (platform economics):** unit-economics design – LTV / CAC vs ETF / robo-advice competitors
- **M2L2 (credit scoring):** eligibility uses alternative data to include thin-file customers
- **M3L1 + M3L4 (cryptography + DeFi):** the savings token is a ledger-based security on a DLT; the yield mechanism mirrors a regulated stablecoin
- **M4L3 (institutional risk):** balance-sheet impact, capital treatment under Basel III.1 output floor
- **M5L4 (MLOps):** the eligibility model is monitored for drift and bias under model-risk governance
- **M6L4 (next-gen infrastructure):** settlement on SIX SDX with FINMA DLT Act civil-law title
- **M7L3 (regulating the new):** licensed under the DLT Act; FINMA supervision; cross-border via MiCA equivalence
- **M8L1 (digital identity):** customer onboarding via Swiss e-ID; portable KYC attribute

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Eight modules, one product. The course is not eight isolated topics; it is one operating system for finance.

**Honest acknowledgements.** The course closes by naming the questions that the field has not answered.

- **Quantum threat (M8L2):** when does Q-Day arrive, and is post-quantum migration cheap enough to complete in time across M3L1 + M6L4 infrastructure
- **AGI in finance:** M5L2 systems that pass narrow benchmarks today are not yet the autonomous credit officers M5L3 cautions against; the operational gap is closing faster than the regulatory gap
- **CBDC interoperability:** M6L4 promises a multilateral CBDC corridor (Project mBridge, Project Agora); the political question of who governs the bridge is unresolved
- **Climate / energy of consensus (M8L3):** Proof-of-Stake adoption resolved the worst of M3L2 energy debate, but climate-finance disclosure regimes are still mostly self-attested
- **Geopolitics of payment rails:** the SWIFT-vs-CIPS-vs-instant-payments fragmentation is reshaping M6L1 in ways the course material cannot yet anchor

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**Synthesis is not closure.** The course gives the vocabulary to formulate the next question; the answers belong to the next decade.

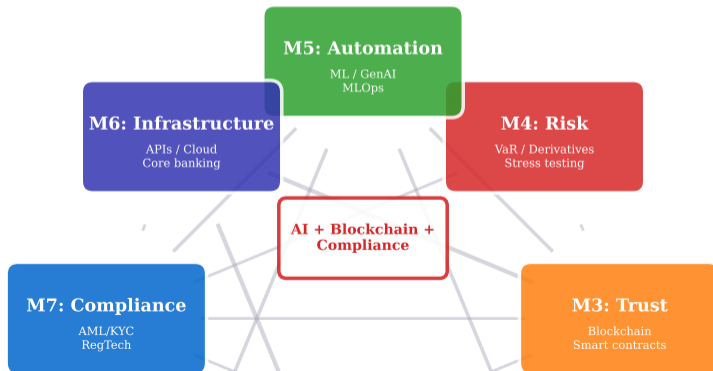
# The Digital Finance Course: 8 Problems, 1 System

## Digital Finance: 8 Modules, 32 Lessons, 1 System



- **What you see:** Eight modules arranged in two rows, each with core question and key insight; arrows connect sequential modules; central text emphasizes technology making finance work for everyone

## Technology Convergence Map: How All 8 Modules Connect



## AI + Blockchain + Compliance

- ML models detect suspicious transactions (Module 5)
- Smart contracts auto-freeze flagged wallets (Module 3)
- RegTech reports to regulators in real time (Module 7)
- Result: compliance cost drops 60%

## Open Banking + ML + Access

- APIs aggregate financial data (Module 6)
- ML builds alternative credit scores (Module 5)
- Underbanked populations gain access (Module 2)
- Result: 1.4 billion people can borrow

## DeFi + Risk + Infrastructure

- Smart contracts replace clearinghouses (Module 3)
- Real-time risk pricing via oracles (Module 4)
- Atomic settlement on-chain (Module 6)
- Result: T+0 settlement, no counterparty risk

*The future of finance is not a single technology — it is the convergence of many.*

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Module numbers in parentheses show which course modules contribute to each convergence pattern.

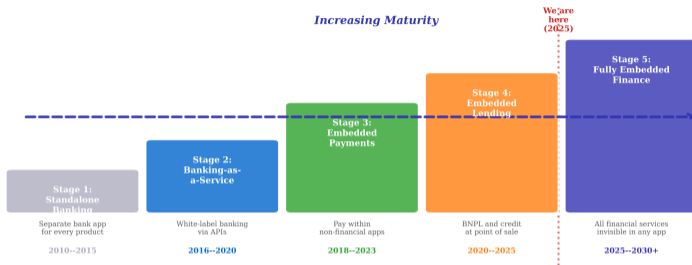
# Part IV

## Emerging Patterns

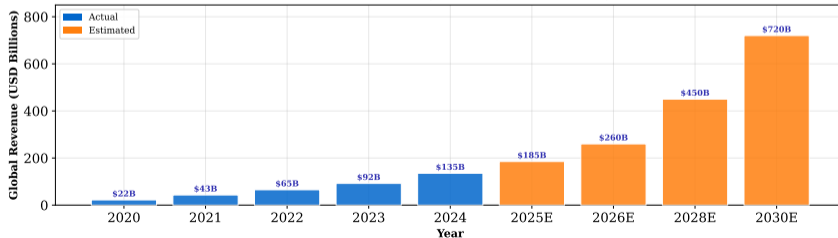
Four forces reshaping financial services by 2035

# Embedded Finance: Finance Disappears into Everything

## Embedded Finance: Maturity Model



## Embedded Finance Revenue Projection (Synthetic Industry Estimates)



**Definition:** Financial systems that sense, decide, and act *without* human intervention.

Level	Description	Example
Level 0	Fully manual	Paper-based lending
Level 1	Assisted	Robo-advisors with human approval
Level 2	Partial automation	Auto-rebalancing portfolios
Level 3	Conditional autonomy	AI approves loans under \$10K
Level 4	High autonomy	AI manages full portfolio, human oversight
Level 5	Full autonomy	AI-native institution, no human decisions

- Most retail banking is at Level 1–2 today
- DeFi protocols operate at Level 4–5 (Module 3) but with high risk
- Key challenge: accountability when an autonomous system causes harm (Modules 5, 7)

**Autonomous finance parallels autonomous driving levels. Most firms target Level 3 by 2030.**

# What If Your Money Knew Where It Should Go?

**Definition:** Digital currency that carries executable logic — money that “knows” how it should be spent.

## Three forms:

- 1 **Smart contract tokens** (Module 3): ERC-20 tokens with transfer conditions (e.g., vesting schedules)
- 2 **CBDCs with programmability** (Module 8): Central bank money with expiry dates or spending restrictions
- 3 **Tokenized deposits** (Module 6): Commercial bank money on blockchain rails with embedded compliance

## Use cases:

- Government stimulus that auto-expires if unspent (economic policy tool)
- Corporate treasury that auto-invests idle cash based on rules
- Supply chain payments that release automatically on delivery confirmation

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**Programmable money is powerful but raises concerns: should governments control how citizens spend?**

# Can a Bank Run With 50 Employees Instead of 10,000?

**Definition:** Organizations *designed from scratch* around AI capabilities, not legacy processes with AI bolted on.

## **Traditional bank + AI:**

- Legacy systems (COBOL) at core
- AI added to existing processes
- Human-centric workflows
- 10,000+ employees
- Cost-to-income ratio: 55–65%

## **AI-native institution:**

- Cloud-native, API-first (Module 6)
- AI *is* the process
- Machines as default, humans as exception
- 50–200 employees
- Cost-to-income ratio: 15–25%

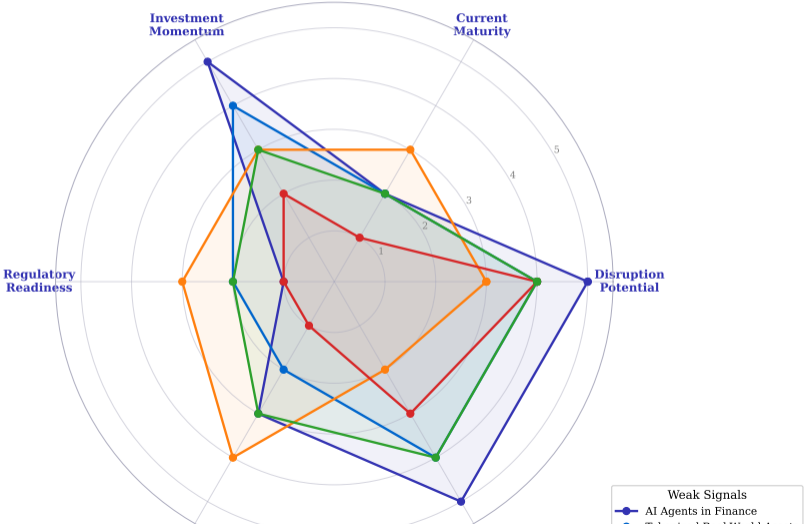
**Key question:** Can an AI-native institution earn a banking license? Regulators require human accountability (Module 7).

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The gap is not AI capability but regulatory acceptance. Human-in-the-loop remains a requirement in most jurisdictions.

# Weak Signals: Technologies to Watch (2025–2035)

Weak Signals Radar: Technologies to Watch (2025--2035)



# Part V

## The Future Financial Architecture

A stack-based view of how the pieces fit together

## The 2030 Financial Architecture Stack



Each layer maps to one or more course modules. The stack is modular: layers can be replaced independently.

## Enduring principles:

- Trust remains essential (Module 3)
- Risk must be measured and managed (Module 4)
- Regulation protects consumers (Module 7)
- Access is a moral imperative (Module 2)
- Cost efficiency drives competition (Module 1)

## What is changing:

- *Who* provides trust (algorithms > institutions)
- *How* risk is measured (real-time ML > quarterly models)
- *When* regulation acts (embedded > ex-post)
- *Where* access happens (phones > branches)
- *Why* costs fall (software > labor)

**The “what” of finance endures. The “how” is being reinvented.**

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This distinction separates lasting trends from temporary hype. Focus on what changes the “how,” not the “what.”

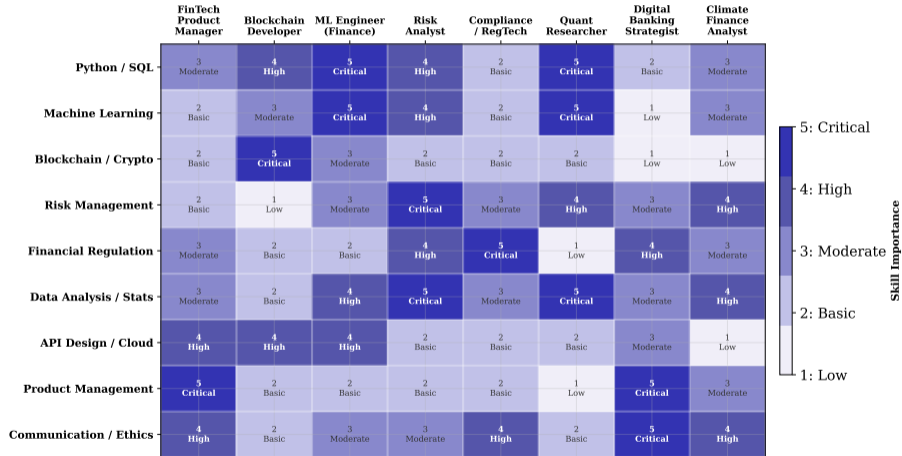
# Part VI

## Career Implications

What skills does the future financial system demand?

# The Digital Finance Skills Landscape

## Digital Finance Career Skills Landscape



Darker cells indicate higher demand. The intersection of technical and domain skills commands the highest premium.

Role	Key Modules	Core Skills
FinTech Product Manager	1, 2, 6	User research, API design, business model
Blockchain Developer	3, 6	Solidity, consensus, cryptography
ML Engineer (Finance)	4, 5	Python, model deployment, MLOps
Risk Analyst	4, 5, 7	VaR, stress testing, regulation
Compliance/RegTech	7, 2	AML/KYC, privacy tech, audit
Quantitative Researcher	4, 5	Statistics, backtesting, market data
Digital Banking Strategist	1, 2, 6, 8	Platform economics, competitive analysis
Climate Finance Analyst	4, 8	ESG scoring, carbon markets, TCFD

**The meta-skill:** ability to work across technical and business boundaries — “bilingual” professionals who speak both code and finance.

Roles are converging. A risk analyst who cannot code, or a developer who cannot explain VaR, will both struggle.

# Three Pieces of Advice for Your Career

## 1 Learn to code — even if you are “business side”

- Python + SQL cover 80% of financial data tasks
- You do not need to be a software engineer; you need to *think computationally*
- Every module in this course used Python for charts, models, or simulations

## 2 Understand regulation — even if you are “tech side”

- Every FinTech product operates within regulatory constraints (Module 7)
- The fastest growing FinTech sector is RegTech — compliance *is* the product
- Regulation determines what is possible, not just what is desirable

## 3 Stay curious — the field is moving faster than any textbook

- This course gives you frameworks, not final answers
- GenAI, DeFi, CBDCs, and quantum computing will evolve beyond what we covered
- The best professionals are lifelong learners who update their mental models

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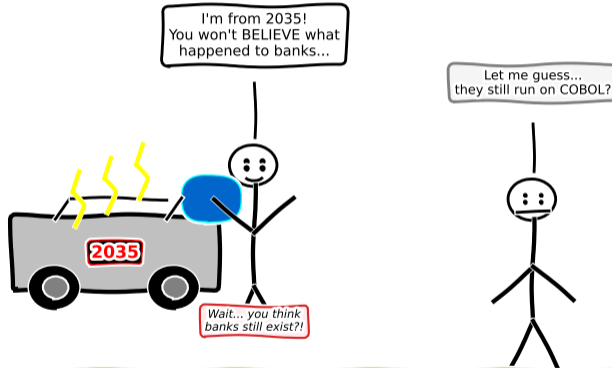
“The illiterate of the 21st century will not be those who cannot read and write, but those who cannot learn, unlearn, and relearn.” — Alvin Toffler

## Course Summary: 8 Modules, 32 Lessons, 1 System

#	Module	Core Question	Key Insight
1	The Cost Problem	Why is finance so expensive?	Software eliminates intermediaries
2	The Access Problem	Who is excluded and why?	Alternative data unlocks inclusion
3	The Trust Problem	Can we trust without institutions?	Cryptography replaces middlemen
4	The Risk Problem	How do we measure uncertainty?	Real-time ML redefines risk
5	The Automation Problem	What can machines decide?	AI augments, does not replace, judgment
6	The Infrastructure Problem	What runs beneath the surface?	APIs and cloud are the new rails
7	The Compliance Problem	How do we enforce the rules?	Regulation must be automated too
8	The Future Problem	What comes next?	Convergence, not single technologies

*Digital finance is not about technology replacing finance.  
It is about technology making finance work for everyone.*

Every module answered a “why” question. Together they describe a system in transformation.



**The future of finance: When a time traveler's punchline is "What's a bank?"**

Sometimes the best way to remember a concept is to laugh about it.

- 1 **Technology adoption follows predictable patterns** — S-curves, hype cycles, and Perez's installation-deployment framework apply to FinTech just as they applied to railways and the internet
- 2 **The future is not a single scenario** — scenario planning with regulation and technology axes yields four plausible futures; the actual outcome will blend elements of all four
- 3 **Convergence creates the real breakthroughs** — AI + blockchain + open banking + regulation combined is more powerful than any single technology alone
- 4 **Four emerging patterns define the next decade:** embedded finance (invisible banking), autonomous finance (machines decide), programmable money (smart currency), AI-native institutions (built on AI, not retrofitted)
- 5 **Careers demand “bilingual” skills** — the future belongs to professionals who combine deep technical ability with financial domain expertise and regulatory awareness

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These five takeaways synthesize 32 lessons into an actionable framework for thinking about the future of finance.

## End of Lesson 8.4 — and the Digital Finance Course

*“The future is already here — it is just not evenly distributed.”*

— William Gibson

**Prof. Dr. Joerg Osterrieder**  
Digital Finance — BSc Course

8 Modules · 32 Lessons · 1 Mission:  
*Understand the technology that is reshaping finance.*

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**The course is complete. The learning never stops.**

## What happened

- FTX was the second-largest crypto exchange by volume in 2022; valued at USD 32bn (*FTX Series C round Jan, 2022*)
- Alameda Research (sister hedge fund) held large FTT-token-collateralised positions on FTX
- CoinDesk balance-sheet leak (2 Nov 2022) showed FTT-concentration; Binance signalled FTT divestment
- Customer withdrawals spiked; FTX paused withdrawals 8 Nov 2022; bankruptcy 11 Nov 2022
- Sam Bankman-Fried convicted on seven counts 2 Nov 2023; 25-year sentence March 2024

## Why it matters here

- Concrete failure mode for the digital-finance future: same custody + leverage problems as 1990s prime brokers
- Worked example for M8L4 synthesis: M1 cost (FTX claimed cheaper rails), M3 trust (custody fiction), M4 risk (cross-firm leverage), M7 compliance (regulatory arbitrage), all in one event
- Direct catalyst for the EU MiCA fast-tracking and US stablecoin / market-structure proposals

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Full writeup: [v4/cases/case\\_m8\\_ftx.md](#). Host: M8 L4 Future Synthesis.

- Proof-of-reserves without proof-of-liabilities is theatre
- Cross-entity asset commingling: FTX customer funds were lent to Alameda; the contract structure permitted this
- Auditor signal: FTX used Armanino + Prager Metis, both small firms; chose to leave the Big-4 perimeter
- Regulatory geography: FTX was based in the Bahamas; the gap between Bahamas + US regulation was the arbitrage product

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See also: **M8 L4 Future Synthesis; full writeup at [v4/cases/case.M8.ftx.md](#).**

## Self-Check: Future Synthesis (Capstone)

**Draw on the entire course.**

- 1 [Understand] Name one technology from each of the 8 modules that you believe will be “mainstream” in 2030, and one that will remain niche.
- 2 [Apply] Design a 3-bullet career-path that uses skills from at least 3 different modules. Be specific (role title, skills, module-lessons).
- 3 [Evaluate] Of the four “problems” (cost, access, trust, risk), which has been most successfully addressed by digital finance so far, and which least? Argue with evidence.

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Solutions hidden unless `\solutionstrue` is set before compiling.