

# Brick and Mortar Banking is Dead! Long Live Digital Banking!

The journey in search of the goal

Alexander Lipton

Stronghold Labs, Numeraire Financial, MIT & EPFL

September 08, 2017

- **Introduction – Key Requirements for a Digital Bank – What is it all about?**
  - *First wave companies: the “incrementalists”*
  - *Second wave companies: digital hybrids*
  - *Third wave companies: digital natives*
- **Customers' Perspective, higher expectations and better experience**
  - *Holistic & Customizable Experience*
  - *End-to-End Digital*
  - *Mobile First*
  - *Foreign Exchange*
  - *Biometrics*
  - *E-Credit Card*

- **Investor Perspective, monetization and capturing value**
  - *Digital Payments*
  - *Digital wallet*
  - *Digital Sales & Banking Products*
  - *Multichanneling*
  - *Digital Financial Planner & Roboadvisory*
  - *Smart Big Data*
  - *SME Upside*
- **Bank's Perspective, new business model and new technology**
  - *Novel IT Infrastructure*
  - *Database Design*
  - *Advanced Data Analytics*
  - *Artificial Intelligence*
  - *Full-Stack Business Model*
  - *Security and Discretion*

- **Digital Customer Segmentation**
- **Unleashing Digital Currency**
  - *Non-Bank Digital Currencies*
  - *Central Bank Digital Currencies*
  - *Digital Sales & Banking Products*
  - *Private Bank Digital Currencies*
  - *Distributed Ledger*
- **Ecosystem**
- **Beyond Banks - Pros and Cons**

*"Banks are trying to be cool and hip and build super cool digital front ends... But it's like putting lipstick on a pig - ultimately it's still a pig and the new front end is still running into an awful digital back end."*

*"Banks are mired in the legacy of old IT systems that are bad... The first automated banking system was introduced by Coutts in 1967. The joke is that they are still running on it today."*  
*Mark Mullen, Chief Executive Atom, Durham, UK*

- The only saving grace is that banks are not unique in this respect.
- For instance, as was revealed by a recent government report, the US nuclear weapons force still relies on a 1970s-era computer system and 8-inch floppy disks.

# What is a bank?

- The art of banking is one of skillful record keeping in the double-entry general ledger.
- At micro level, banks can be thought of as dividend producing machines seeking deposits and issuing loans.
- At macro level, they are creators of credit money.
- The main determinants of their quality and reliability are the amount of capital and the level of liquidity (essentially central bank money) they keep.
- In general, a bank would like to maintain the right levels of both – if it has too little, it becomes fragile, if it has too much, it becomes unprofitable and hence unable to fulfill its purpose of paying dividends.

# What is a bank?

- Good bankers differ from bad ones by their ability to attract a large pool of reliable borrowers, so that default levels stay close to their expected values.
- At the same time, good bankers need to attract long-term depositors and serve them well, so that depositors do not suddenly withdraw their deposits.
- Banking activity is mostly technological and mathematical in nature.
- It is well suited to be digitized, yet the prevalence of legacy systems and legacy culture inhibits banks from embracing innovation as much as they should in order to survive and thrive in the digital economy of the 21 century.
- It happens because old-fashioned banks are far behind the latest technological breakthroughs; they also have a poor handle of the risks on their books.

# Three waves of innovation

- First wave companies - the “incrementalists”:
  - Digital technologies have been entering the banking industry for years;
  - They have been added incrementally to existing operations, either as an overlay or a minor extension;
  - Online banking, likewise, was piloted in the 1980s by Citi, Chemical Bank, through Minitel (France), and Prestel (UK);
  - Simple, browser-based tools gave consumers access to a number of key banking transactions such as money transfer, bank statements, and electronic bill payment;
  - The rise of the internet also saw the rise of the internet bank – most prominently NetBank in 1996.



# Three waves of innovation

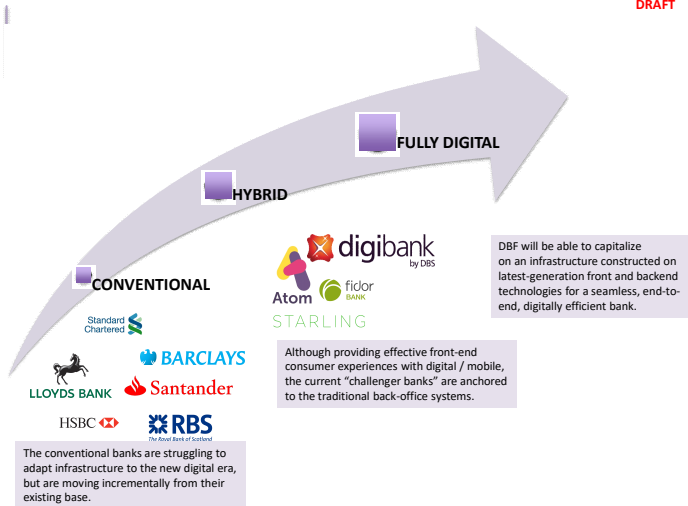
- Second wave companies - digital hybrids:
  - Frequently taking advantage of front end systems to better market and connect with consumers, they remain shackled by legacy back and middle office infrastructure, risk modeling systems, and sometimes labor models;
  - Often these hybrid banks will have an incumbent bank as their backend;
  - For example, Simple Bank was founded in 2009 with a number of innovations to streamline account management and costs, but uses The Bancorp as its backend.
  - Other emergent hybrid banks such as Fidor Bank (Germany), Atom Bank (UK), LHV Pank (Estonia), and DBS Digibank (Singapore) enjoy purpose-built IT infrastructure that is 60-80% less expensive to build, and 30-50% less expensive to maintain, than legacy banks.
  - Headcount is considerably lower, about 10-15% the levels of a traditional bank;
  - These “digital hybrids” still use centralized databases, cloud based storage and primitive user data protocols.

# Three waves of innovation

- Third wave companies - digital natives:
  - New set of technologies is emerging that permit close integration with consumers' lives, promise access to the 2.5 billion unbanked or underbanked consumers globally<sup>4</sup>, and greater financial flexibility to 45+ million underbanked Small & Medium-sized Enterprises (SMEs) around the world<sup>5</sup>;
  - DBF will take advantage of these technologies and be designed around the needs of digital natives;
  - For the millennials, a mobile-first strategy will drive ease of access and rapid adoption through seamless integration with their lives;
  - Taking a breakthrough approach to data security, DBF will eschew a central data repository, easily attacked, in favor of a secure, encrypted, distributed data system;
  - Personal data stores not only permit better digital walleting, but also greater security around personal biometric data which is integral to the digital bank's security protocols;
  - A new business model will arise.

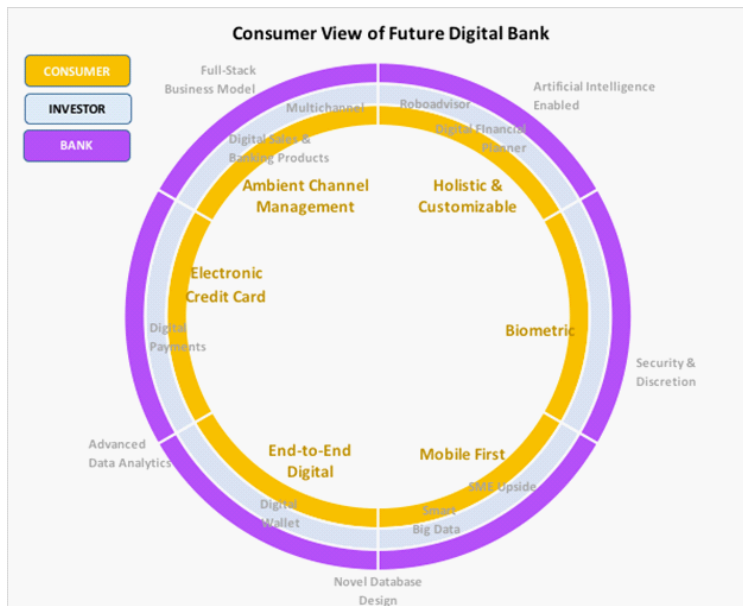
# Three waves of innovation

DRAFT



4

# Customers' Perspective



- **Credit Provision:**

- *Offer a trusted and relatively inexpensive source of credit.*

- **Holistic Experience:**

- *Provide a holistic, interactive, and intuitive overview of the customers' money and, more broadly, their financial life;*
- *End-to-End Digital:*
- *Provide a holistic fully digital experience for customers, including, paperless application and passing of the KYC (Know Your Client) process.*
- *Interactive and intuitive digital financial planner to organize customers' financial life and optimize their resources*
- *Robo-advisory with services previously accessible by high end investors only, investments, including tools for trading securities.*
- *Empower customers to electronically apply for mortgage or loan, insurance:*
- *Provide reporting documentation related to bank activity, including tax statements, etc.*
- *Provide access to Personal Data Store (PDS).*

- **Customizable Experience:**

- *Tailor services for different customer segments such as small and informal merchants, mass affluent, youth market, international travelers, or low-income customers.*

- **Mobile First:**

- *Enable natively driven mobile e-payment solutions, including domestic and international payments and remittances, automatic bill payments, and peer-to-peer (P2P) payments and money transfers;*
- *A comprehensive digital wallet and PDS, which includes, at the minimum, electronic ID, card for secure online purchases, and tools to view, pay, organize, analyze, archive e-bills, and generate relevant tax documents;*
- *Start with mobile and build out from there.*

## ● Foreign Exchange:

- *Deliver seamless and inexpensive foreign exchange services, including protection against exchange rate fluctuations by providing multi-currency accounts.*
- *Potentially, a full range of instruments for hedging against foreign exchange risk, including forward contracts, spot contracts, swaps, and exchange traded options can be offered;*

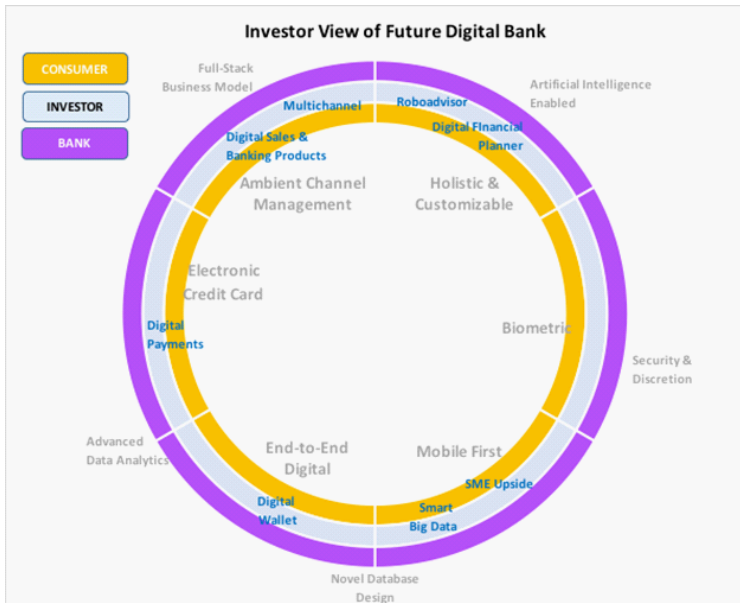
## ● Biometrics:

- *Offer biometric technology such as face and voice biometrics, already actively used at airports and international border controls, as core credentials for customers with preference for biometrics to PIN or password as a way of authentication for logging in;*
- *Behavioral biometric, which is being developed at the moment, is a promising venue for achieving an extra degree of protection.*

## ● E-Credit Card:

- *Implement bank e-credit card based on customer's own preferences with pre-set limits and permitted transactions, consumption-related patterns.*

# Investors' Perspective





- **Investment opportunity:**

- *Digital bank is an exciting and inevitable business step because legacy banks are no longer able to adequately service their customers' needs in the digital age.*
- *Customer requirements simply cannot be met by traditional banks unable to catch up with the digital revolution;*
- *With neither real estate overhead, nor massive maintenance spending on legacy IT systems, digital banks expect to grow multibillion dollar balance sheets in several years of operations with the fraction of full time staff compared to traditional banks;*
- *Atom Bank in the UK intends to grow into a £5 billion balance sheet business in five years with just 340 full time staff;*
- *Legacy bank Metro has that size balance sheet with 2,200 people;*
- *The majority of digital banks' staff will be engineers and data scientists, although, as always, the role of sales and marketing should not be underestimated.*

- **Digital Payments:**

- *Digital payments including mobile and online payments, both domestic and foreign, as well as mobile P2P interactions, form the core of monetization;*
- *They enable banks to boost fees and interest income and reach a broader set of customers with more diverse services;*
- *They are done more cost effectively than by incumbent banks, allowing market share gains through competitive pricing and/or accessing 2.5bn unbanked & underbanked.*

- **Digital wallet:**

- *Digital wallet is essential for digital commerce and ecosystems built on value-added services;*
- *It optimizes transaction costs for customers and funding costs for banking operations.*

## ● Digital Sales & Banking Products:

- *Artificial intelligence (AI) assisted sales of banking products, such as deposits, loans, and mortgages are conducted through direct channels, including social media;*
- *This approach is in line with shifting consumer preferences and behavior trends in e-commerce, especially directed at Generation Y and tech-savvy customers.*

## ● Multichanneling:

- *An integrated and seamless multichannel approach to sales increases the bank's share of customers' wallet, boosts customer loyalty, thereby making a significant difference in customer adoption rates.*

## ● Digital Financial Planner & Roboadvisory:

- *AI-based digital financial planner manages monthly income, recurring payments, savings and investments, increasing interaction between the digital bank and customers;*
- *Logical continuation of the circle of trust between the digital bank and customers, where customers rely on the Roboadvisory services to optimize investment portfolios based on individual goals and*

- **Smart Big Data:**

- *Advanced analytics allows the digital bank to transform its data into more personalized client service aimed at data monetization.*

- **SME Upside:**

- *AI- and big-data based credit models enabling risk-managed provisioning of credit access to SMEs, banking the 45 million underbanked SMEs globally;*
- *By 2018, banks in Scandinavia, the United Kingdom, and Western Europe are forecast to have half or more of new inflow revenue coming from digital related activities in most products, such as savings and term deposits, and bank services to SMEs.*

# Bank's Perspective



- **A digital bank has to be a cross between a Fintech company and a bank:**
  - *Such a digital bank can be organized into five divisions: Retail Banking, Private and Business Banking, Analytics and IT, Finance Management and Operations, and Risk Management;*
  - *The relative importance of these departments is not the same, with analytics and IT being the cornerstone of the digital banking edifice;*
  - *In general, success and failure of a bank is measurable by technologies and analytical methods adopted rather than by its product line.*
- **Novel IT Infrastructure:**
  - *Building a digital bank from scratch enables to create a flexible IT infrastructure, which provides state of the art risk management, helps to optimize the bank's balance sheet to achieve return on capital significantly higher than return of the incumbents, and guarantees compliance with constantly changing banking regulations in real time.*
- **Database Design:**
  - *The bank IT is based on the state-of-the-art database technology, including DLT, which can cope with the exponential growth in data*

## ● **Advanced Data Analytics:**

- *Banks own rich reserves of raw behavioral data, which can provide valuable insights into future customer choices;*
- *Following the example of Internet powerhouses, such as Google, Amazon, Alibaba, and Facebook, the bank should consolidate data across deposits, consumer finance, and other transaction accounts for a unified view of customer activities (to the extent allowed by law);*
- *For instance, customers' in-store payments are far more accurate than conventional profile data (for example, age, income, geography) in predicting their future financial activities and credit worthiness;*
- *Their geospatial mobility among stores providing extra improvements;*
- *Using customer data, digital banks can create offerings ranging from payment solutions to financing;*
- *It is imperative to be able to evaluate collected customer transactions in real time and connect them for prediction of future customer behavior using deep learning and other probabilistic algorithms;*
- *It is important to build in safeguards of customer privacy in accordance with their preferences and legal requirements;*
- *Fraud prevention can be massively improved.*

## ● **Artificial Intelligence:**

- *Autonomous selection of best methodology when presented with arbitrary data enables banks to dynamically adopt to novel information and build a full financial profile of its customers, including credit worthiness, debt capacity, and risk appetite for financial planning;*
- *AI can rapidly adapt to customer needs and present the best offers at the right time, changing dynamically as the customer evolves;*
- *A “smart bank” can more rapidly capitalize on shifts in a customer’s life cycle and assist them in achieving their financial goals.*

## ● **Full-Stack Business Model:**

- *The full-stack business model is crucial to the total client experience;*
- *Full-stack model facilitates the bank’s compliance with the regulatory framework, which enforces money laundering and fraud prevention and guarantees customers’ protection;*
- *Intelligent fraud detection and remediation systems can function in a far more superior fashion than conventional methods.*



- **Security and Discretion:**

- *Bulletproof security and customer protection is the area of a great competitive advantage for digital banks compared to other financial service providers;*
- *These features are embedded in a secure IT architecture from the onset and preclude both data misuse and data sales to third parties;*
- *They naturally include implementation of new cryptographically secured distributed data management.*

- **Digital banks have several natural constituencies in both developed and, especially, developing economies:**
  - *Professional consumers with at least an undergraduate college education;*
  - *Digitally educated middle upper-mass and mass-affluent professional and managerial consumers;*
  - *Digitally savvy Gen Y (students and young professionals in their 20s to 30s) digital-banking natives, who are exceedingly digitally savvy. They will form the foundation of the customer base for the digital bank;*
  - *In Asia alone the number of potential digital-banking consumers could be as high as 1.7 billion by 2020;*
  - *SMEs that go mainstream using a digital banking platform designed for their needs; potentially banking 45 million underbanked or unbanked SMEs globally.*

## ● **Non-Bank Digital Currencies:**

- *While the best known digital currency is Bitcoin, it's not suited for high volume transactions because of its low transactions per second (TPS) capacity;*
- *It is likely that other digital currencies based on consensus achievable by means other than proof-of-work will be used in digital banking;*
- *Bitcoin is not the first digital currency to emerge, nor is it going to be the last;*
- *It is likely that digital cash invented by David Chaum more than thirty years ago can see a comeback at the next level of efficiency.*

## ● **Central Bank Digital Currencies and Narrow Banking:**

- *Several central banks are investigating whether a state-backed digital currency could reduce capital outflow, money laundering and tax evasion, and make economic activity more transparent and efficient;*
- *For instance, PBOC, BoE and Bank of Russia are all actively looking in this direction;*
- *As a result, "free" (or very inexpensive) deposits that commercial banks have been benefiting from will evaporate.*

- **Private Bank Digital Currencies and Free Banking:**

- *The idea of banks issuing their own currency is very old;*
- *For instance, dozens of banks in the United States were doing so in the nineteenth century;*
- *Advances in digitization made this idea viable again.*

- **Distributed Ledger:**

- *Using distributed ledger reduces financial transaction costs, improves resilience of the system as a whole, and mitigates operational risks;*
- *Without doubt, distributed ledger will become intertwined with operational procedures of a digital bank and its interactions with other digital, legacy and central banks.*

- A well-designed digital bank will become the corner stone of a much bigger financial ecosystem.
- This ecosystem will include insurers, brokers, wealth managers, robo-advisors, credit card issuers, cross-border payment providers, currency exchanges, P2P lenders, etc.
- Efficiency of these companies will be greatly enhanced by their access to a wider financial system through the digital bank.
- The bank will benefit by getting additional information about their customers' demands and habits, thus closing the information feedback loop.
- Bank issued digital cash will serve as a lubricant allowing the wheels of commerce to spin faster and much more efficiently than is currently possible.
- A digital bank of the future will be the center of the internet of things (IoT), it can be thought of as the bank of things (BoT).

- The state of affairs with existing banks is unsatisfactory.
- It opens a unique opportunity for building a digital bank from scratch.
- Such a bank will utilize the most advanced technologies, including cryptography and distributed ledger techniques, artificial intelligence, big data, and deep learning.
- It will be based on balance sheet optimization, deployment of digital distributed ledger-inspired infrastructure, and comprehensive automation and digitization of the middle and back office.
- It will use a heightened security employing the most advanced cryptographic techniques throughout the entire organization.

- By design, this bank will be highly efficient, profitable and agile.
- Its infrastructure will be flexible enough to handle both private digital currencies (such as Bitcoin) and potential government issued currencies (such as Britcoin).
- This bank will be capable of issuing its own digital currency.
- It will create unparalleled customer experience, automating personal and SME credit issuance, and improving risk management.
- By design, such a bank will be valued by investors, customers, and regulators alike.

- By building a bank, are we trapped in the old paradigm?
- WeChat is redefining what financial services means in relation to the broader suite of consumer services individuals engage with.
- The key is having customer-centric data across all areas of life, held in standard format with standard APIs that work across all the entire digital ecosystem.
- Using this central, panoptic data, WeChat can integrate services from the whole range of life opportunities in a seamless and consistent manner.
- As a result, customers get fully integrated payments, credit and banking, unbelievable advising capability and amazing KYC and AML, all in a form that is completely transparent.



- Consumers don't need to know that payments are different from credit or from banking or from shopping in general.
- WeChat or Sesame is also integrating health, lifestyle and employment services with money services - completely transparently; no separate apps or web pages.
- However, this is conditional on consumers' ability to secure credit as necessary.
- Given the rather uncertain and limited capacity of P2P networks to provide credit, digital banks have to come to the rescue.
- A similar future is unfolding for SMEs: customers are shepherded to buy and money flow issues like credit, payments, KYC and AML go away virtually completely.

- Is there a future that is NO banking versus “digital banking”? Instead, banking functions are just integrated invisibly everywhere.
- Several immediate challenges come to mind with this model:
  - Due to the special and unique role of banks in credit money creation, non-bank actors simply do not have necessary capacity to satisfy the financial needs of their customers;
  - There are numerous constraints around offering banking services that may be too limiting for companies in western Europe and the US.
  - If China begins to adopt more restrictive financial regulations to better protect consumers, they too will create a less hospitable business environment for these kinds of services.
  - Will WeChat (or the next WeChat) want to take its high flying tech company stock market multiple, and burden it with a financial services discount?
  - If financialization of a tech company is done in a deliberate and measured way, it can actually increase the shareholder value.

- Despite these challenges, is there a model that we could call “invisible banking” that integrates into our daily lives without friction?
- The answer is yes and no – the legacy banking model will unquestionably disappear over time, but in the transition period, digital banks will have a role in daily life for the foreseeable future as transaction lubricants and enablers.

# Conclusions

- Legacy banking model is under assault from all sides.
- It is not sustainable in the long term.
- In order to survive, the industry needs to adapt and change.
- Digitization is a way to do it.
- There is no time to lose!
- Come join the party!

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Digital Banking Manifesto: The End of Banks?

Alex Lipton, David Shrier, Alex Pentland

Connection Science & Engineering

Massachusetts Institute of Technology

[connection.mit.edu](http://connection.mit.edu)



## Frontiers of Financial Technology

Expeditions in future commerce, from blockchain and digital banking to prediction markets and beyond

Edited by:

David Shrier (shrier@mit.edu) and Alex Pentland (pentland@mit.edu)

Publication Date: 08 September 2016

### Summary:

Financial technology innovation has exploded in the popular consciousness, and promises a radical transformation of the global financial services industry. Over \$20 billion is expected to be invested in fintech projects in 2016. How can executives, investors, and entrepreneurs make sense of the new inventions that are driving this change? MIT Professor Alex “Sandy” Pentland, called by *Forbes* one of the seven most powerful data scientists on the planet, is joined by fintech intrapreneur and educator David Shrier in curating an exploration of several major trends and technologies that are changing the face of financial services. Coauthors include Deven Sharma, the former President of S&P, and Alex Lipton, the former head of quantitative analytics for Bank of America Merrill Lynch. From blockchain to artificial intelligence, this series of articles helps the reader grapple with this exciting area of technology innovation.

### Outline:

- I. Introduction
- II. Blockchain & Financial Services
  - A. 5th Horizon of Networked Innovation
  - B. Transactions, Markets & Marketplaces
  - C. Infrastructure (Identity, Data Security)
- III. Mobile Money & Payments
- IV. Prediction Markets
- V. Digital Banking Manifesto
- VI. Regulation & Financial Technology
- VII. Future Directions



Alexander Lipton is Founder and CEO of StrongHold Labs, Partner at Numeraire Financial, Co-Founder of Distilled Analytics, Connection Science Fellow at MIT Media Lab and Visiting Professor of Financial Engineering at EPFL. He is an Advisory Board Member at UCL Centre for Blockchain Technologies, Clearmatics and Numerix.

In the end of May 2016, he left Bank of America Merrill Lynch where he served for ten years as a Managing Director. During this time, Alex worked in various senior managerial roles including Quantitative Solutions Executive and Co-Head of the Global Quantitative Group. Earlier, he was a Managing Director and Head of Capital Structure Quantitative Research at Citadel Investment Group in Chicago; he has also worked for Credit Suisse, Deutsche Bank and Bankers Trust.

While working full time as a banker, Alex held several prestigious academic appointments, including Visiting Professor of Quantitative Finance and Advisory Board Member at Oxford-Man Institute, and Visiting Professor of Mathematics at Imperial College London and the University of Illinois. Before switching to finance, Alex was a Full Professor of Mathematics at the University of Illinois and a Consultant at Los Alamos National Laboratory. He received his undergraduate and graduate degrees in pure mathematics from Moscow State University.

His current professional interests include digital banking, robo advisor investing, FinTech, applications of distributed ledger technology to banking, digital currencies, and payment systems, and industrial-strength risk management systems for large systemically important financial institutions. His scientific interests are centered on quantitative development of modern monetary circuit theory, mechanisms of money creation, interlinked banking networks, balance sheet optimization, and related topics.

In 2000 Alex was awarded the first Quant of the Year Award by Risk Magazine. Alex is the author of two books (“Magnetohydrodynamics and Spectral Theory” and “Mathematical Methods for Foreign Exchange”) and the editor of five more, including, most recently, “Quant of the Year 2000-2014, All Award-Winning Papers”. His next book “Financial Engineering - Selected Works of Alexander Lipton” will be published by WSPC in 2017. In addition, Alex has published more than a hundred papers on hydrodynamics, magnetohydrodynamics, astrophysics, chemical physics, and financial engineering.

Alex is a frequent keynote speaker at Quantitative Finance and FinTech conferences and forums worldwide.