Artificial Intelligence for Investment Analysis

AI 金融科技: 金融服务創新應用
(AI in FinTech: Financial Services Innovation and Application)

Min-Yuh Day
Assistant Professor
Dept. of Information Management, Tamkang University

http://mail.tku.edu.tw/myday/
2018-09-20
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(Course Orientation on Artificial Intelligence for Investment Analysis) |
| 2 2018/09/20 | AI 金融科技: 金融服務創新應用  
(AI in FinTech: Financial Services Innovation and Application) |
| 3 2018/09/27 | 機器人理財顧問與AI交談機器人  
(Robo-Advisors and AI Chatbots) |
| 4 2018/10/04 | 投資心理學與行為財務學  
(Investing Psychology and Behavioral Finance) |
| 5 2018/10/11 | 財務金融事件研究法 (Event Studies in Finance) |
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| 18          | 2019/01/10  | 期末報告 II (Final Project Presentation II) |
AI in FinTech: Financial Services Innovation and Application
Paolo Sironi (2016)

**FinTech Innovation:**
From Robo-Advisors to Goal Based Investing and Gamification,
Wiley

John M. Jordan (2012),
*Information, Technology, and Innovation: Resources for Growth in a Connected World,* Wiley

Source: https://www.amazon.com/Information-Technology-Innovation-Resources-Connected/dp/1118155785
Brett King (2012),

**Bank 3.0**

Why banking is no longer somewhere you go, but something you do,

Marshall Cavendish International Asia Pte Ltd
Brett King (2014),

**Breaking Banks:**

The Innovators, Rogues, and Strategists Rebooting Banking

*Wiley*

Source: https://www.amazon.com/Breaking-Banks-Innovators-Strategists-Rebooting/dp/1118900146
Chris Skinner (2014),

**Digital Bank:**
Strategies to Launch or Become a Digital Bank,
Marshall Cavendish International Asia Pte Ltd

Everett M. Rogers (2003),
Diffusion of Innovations,


Joseph A. Schumpeter,
The Theory of Economic Development:
An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle,
Transaction Publishers, 1982

(Schumpeter, 1912)
Evolution of Decision Support, Business Intelligence, and Analytics

The timeline in Figure 1.8 shows the terminology used to describe analytics since the 1970s. During the 1970s, the primary focus of information systems support for decision making focused on providing structured, periodic reports that a manager could use for decision making (or ignore them). Businesses began to create routine reports to inform decision makers (managers) about what had happened in the previous period (e.g., day, week, month, quarter). Although it was useful to know what had happened in the past, managers needed more than this: They needed a variety of reports at different levels of granularity to better understand and address changing needs and challenges of the business. These were usually called management information systems (MIS). In the early 1970s, Scott-Morton first articulated the major concepts of DSS. He defined DSSs as “interactive computer-based systems, which help decision makers utilize data and models to solve unstructured problems” (Gorry and Scott-Morton, 1971).

Keen and Scott-Morton (1978) provided another classic DSS definition:

Decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision makers who deal with semistructured problems.

Note that the term decision support system, like management information system and several other terms in the field of IT, is a content-free expression (i.e., it means different things to different people). Therefore, there is no universally accepted definition of DSS.

During the early days of analytics, data was often obtained from the domain experts using manual processes (i.e., interviews and surveys) to build mathematical or knowledge-based models to solve constrained optimization problems. The idea was to do the best with limited resources. Such decision support models were typically called operations research (OR). The problems that were too complex to solve optimally (using linear or nonlinear mathematical programming techniques) were tackled using heuristic methods such as simulation models. (We will introduce these as prescriptive analytics later in this chapter and in a bit more detail in Chapter 6.)

In the late 1970s and early 1980s, in addition to the mature OR models that were being used in many industries and government systems, a new and exciting line of models had emerged: rule-based expert systems. These systems promised to capture experts’ knowledge in a format that computers could process (via a collection of if–then–else rules or heuristics) so that these could be used for consultation much the same way that one would use a traditional expert system.
Definition of Artificial Intelligence (A.I.)
Artificial Intelligence

“... the science and engineering of making intelligent machines”

(John McCarthy, 1955)
Artificial Intelligence

“... technology that thinks and acts like humans”
Artificial Intelligence

“... intelligence exhibited by machines or software”
### 4 Approaches of AI

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<th>Thinking Humanly</th>
<th>Thinking Rationally</th>
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<td>Acting Humanly</td>
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# 4 Approaches of AI

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<td>3.Thinking Rationally: The “Laws of Thought” Approach</td>
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<td>4. Acting Rationally: The Rational Agent Approach</td>
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AI Acting Humanly: The Turing Test Approach
(Alan Turing, 1950)

- Natural Language Processing (NLP)
- Knowledge Representation
- Automated Reasoning
- Machine Learning (ML)
- Computer Vision
- Robotics

Boston Dynamics: Atlas

#13 ON TRENDING
What's new, Atlas?

https://www.youtube.com/watch?v=fRj34o4hN4I
Humanoid Robot: Sophia

https://www.youtube.com/watch?v=S5t6K9iwcdu
Can a robot pass a university entrance exam?

Noriko Arai at TED2017

https://www.ted.com/talks/noriko_arai_can_a_robot_pass_a_university_entrance_exam
https://www.youtube.com/watch?v=XQZjkPyJ8KU
Artificial Intelligence (A.I.) Timeline

1950
TURING TEST
Computer scientist Alan Turing proposes a test for machine intelligence. If a machine can trick humans into thinking it is human, then it has intelligence.

1955
A.I. BORN
Term ‘artificial intelligence’ is coined by computer scientist John McCarthy to describe “the science and engineering of making intelligent machines.”

1961
UNIMATE
First industrial robot, Unimate, goes to work at GM replacing humans on the assembly line.

1964
ELIZA
Pioneering chatbot, developed by Joseph Weizenbaum at MIT, holds conversations with humans.

1966
SHAKEY
The ‘first electronic person’ from Stanford, Shakey is a general-purpose mobile robot that reasons about its own actions.

1997
DEEP BLUE
Deep Blue, a chess-playing computer from IBM defeats world chess champion Garry Kasparov.

1998
KISMET
Cynthia Breazeal at MIT introduces Kismet, an emotionally intelligent robot as far as it detects and responds to people’s feelings.

1999
AIBO
Sony launches first consumer robot pet dog AIBO (AI robot) with skills and personality that develop over time.

2002
ROOMBA
First mass-produced autonomous robotic vacuum cleaner from iRobot learns to navigate and clean homes.

2011
SIRI
Apple integrates Siri, an intelligent virtual assistant with a voice interface, into the iPhone 4S.

2011
WATSON
IBM’s question answering computer Watson wins first place on popular $1M prize television quiz show Jeopardy.

2014
EUGENE
Eugene Goostman, a chatbot, passes the Turing Test with a third of judges believing Eugene is human.

2014
ALEXA
Amazon launches Alexa, an intelligent virtual assistant with a voice interface that completes shopping tasks.

2016
TAY
Microsoft’s chatbot Tay goes rogue on social media making inflammatory and offensive racist comments.

2017
ALPHA GO
Google’s A.I. AlphaGo beats world champion Ke Jie in the complex board game of Go, notable for its vast number of possible positions.

Since an early flush of optimism in the 1950s, smaller subsets of artificial intelligence – first machine learning, then deep learning, a subset of machine learning – have created ever larger disruptions.

Artificial Intelligence techniques in optical networks

Knowledge-based, reasoning and planning methods
[13], [14], [15], [16], [17], [18] [94], [97], [99], [100], [101]

Search methods and optimization theory

Local search algorithms and metaheuristics
- Tabu search [86], [87]
- Genetic Algorithms (GA) [6], [8], [48], [69], [70], [71], [72], [77], [78], [79], [80], [80], [91], [92], [93], [94], [110], [111], [112], [113], [114], [115], [116], [119]
- Simulated Annealing [47], [84], [85]
- Teaching-learning based optimization [119]
- Ant Colony Optimization (ACO) [71], [91], [74], [81], [82], [90], [109]
- Artificial bee colony algorithm [78]
- Gravitational search algorithm [76]
- Fire-fly algorithm [74]
- Particle Swarm Optimization [73]
- Mathematical formulations (e.g., Mixed Integer Linear Programming) e.g., [2], [3]
- Breadth-first search [2], [3]

Statistical models
- Bayesian networks [19], [46], [56], [96], [106]
- Hidden Markov model [20], [23]
- Kalman filtering [21], [22]

Game theory
[10], [11], [12]

Decision-making algorithms
- Markov decision processes [24], [25], [26], [122]

Learning methods
- Learning probabilistic methods
- Expectation-maximization (EM)
- Maximum a Posteriori (MAP) learning [23], [30], [32], [46], [55]
- Maximum-likelihood learning [23], [31], [32], [46], [54], [55]
- Neural networks [33], [39], [51], [52], [53], [64], [65], [88], [89], [95], [102], [107], [108], [117], [121]
- Support Vector Machines (SVM) [53], [56], [68], [68]
- Linear regression [38], [49], [50]
- Logistic regression [60]
- Random Forests (RF) [37]
- Instance-based learning (e.g., K-nearest neighbors/Case-Based Reasoning) [34], [35], [36], [48], [57], [83]
- Principal Component Analysis (PCA) [41], [89]
- Clustering K-means [40], [42], [75], [96]
- Unsupervised learning
- Reinforcement learning
- Q-learning [45], [104], [105]
- Supervised learning

FinTech
Financial Technology
FinTech
Financial Technology

FinTech

“providing financial services by making use of software and modern technology”

Source: https://www.fintechweekly.com/fintech-definition
Frederic S. Mishkin (2015),
The Economics of Money, Banking and Financial Markets,

Mike Thornton (2016),
History of Money: Financial History:
From Barter to Bitcoin - An Overview of Our Economic History, Monetary System & Currency Crisis, CreateSpace Independent Publishing Platform

Money and Financial History

• Why is a printed piece of paper worth anything?
• How can a coin be worth more or even less than the number stamped on it?
• Why is digital money real money?
• How can money be worth more or less than it was yesterday?
Money
Exchange
Barter
Barter
Barter
Bills
Gold Bullion Coin

Source: http://www.wpclipart.com/money/coins/American_buffalo_gold_bullion_coin_front.jpg.html
Gold Bullion Coin

Source: http://www.wpclipart.com/money/coins/American_buffalo_gold_bullion_coin_back.jpg.html
Coin US Penny

Source: http://www.wpclipart.com/money/coins/coin_US_penny_2.png.html
Gold Bricks

Financial Services
Financial Services
Safe

Source: http://www.wpclipart.com/money/safe/steel_safe.png.html
Currency Exchange

Source: http://www.wpclipart.com/signs_symbol/BW/travel_symbols/currency_exchange.png.html
Market
Financial Services
Financial Services

Source: http://www.crackitt.com/7-reasons-why-your-fintech-startup-needs-visual-marketing/
Financial Revolution with Fintech

A financial services revolution
Consumer Trends

1. Simplification
2. Transparency
3. Analytics
4. Reduced Friction

Source: http://www.hedgethink.com/fintech/european-fintech-top-100/
FinTech: Financial Services Innovation

1. Payments
2. Insurance
3. Deposits & Lending
4. Capital Raising
5. Investment Management
6. Market Provisioning

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Financial Services Innovation

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<th>創新項目</th>
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<td>無現金世界 (Cashless World)</td>
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<td>新興支付 (Emerging Payment Rails)</td>
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<td>保險 (Insurance)</td>
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<td>存貨 (Deposit &amp; Lending)</td>
<td>替代管道 (Alternative Lending)</td>
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<td>通路偏好移轉 (Shifting Customer Preferences)</td>
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<td>筹資 (Capital Raising)</td>
<td>群眾募資 (Crowdfunding)</td>
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<td>投資管理 (Investment Management)</td>
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<td>市場資訊供應 (Market Provisioning)</td>
<td>機器革命 (Smarter, Faster Machines)</td>
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<td>新興平台 (New Market Platforms)</td>
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Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/
FinTech: Payment
Cashless World
Emerging Payment Rails
FinTech: Insurance

Insurance Disaggregation

Connected Insurance

Sharing Economy
Autonomous Vehicles
Digital Distribution
Securitization and Hedge Funds
Internet of Things
Advanced Sensors
Wearable Computers

P2P Lending
Virtual Technologies
Mobile

Niche, Specialized Products

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Insurance Disaggregation
Connected Insurance

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/
FinTech: Deposits & Lending

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
3

FinTech: Deposits & Lending

Alternative Lending

Shifting Customer Preferences

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務
FinTech: Capital Raising

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
4 FinTech: Capital Raising
Crowdfunding

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/
FinTech: Investment Management

- Market Information Platforms
  - New Market Platforms
    - Automated Data Collection & Analysis
- Automation of High-Value Activities
- Empowered Investors
  - Process Externalisation
    - Advanced Algorithms
    - Cloud-Computing
    - Capability Sharing
  - Open Source IT
  - Social Trading
  - Retail Algorithmic Trading

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
5 FinTech: Investment Management
Empowered Investors
Process Externalization

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/
FinTech: Market Provisioning

- Cashless World
  - Mobile Payments
  - Integrated Billing
  - Streamlined Payments

- Smarter, Faster Machines
  - Machine Readable News
  - Social Sentiment
  - Big Data

- Market Information Platforms
  - Automated Data Collection & Analysis

- Market Provisioning
  - Streamlined Infrastructure
  - Automation of High-Value Activities

- Advanced Algorithms
  - Cloud-Computing
  - Capability Sharing

- Process Externalisation

Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf
FinTech: Market Provisioning
Smarter, Faster Machines
New Market Platforms

Source: https://www.stockfeel.com.tw/2015年世界經濟論壇－未來的金融服務/
The Economics of Money, Banking and Financial Markets

Frederic S. Mishkin (2015),
The Economics of Money, Banking and Financial Markets,

Economics of Money, Banking and Financial Markets

1. Money, Banking, and Financial System
2. Financial Markets
3. Financial Institutions
4. Central Banking and the Conduct of Monetary Policy
5. International Finance and Monetary Policy
6. Monetary Theory
7. Financial Services Industry

INTRODUCTION

1. Why Study Money, Banking, and Financial Markets?
2. An Overview of the Financial System
3. What Is Money?

4. Understanding Interest Rates
5. The Behavior of Interest Rates
6. The Risk and Term Structure of Interest Rates
7. The Stock Market, the Theory of Rational Expectations, and the Efficient Market Hypothesis

FINANCIAL INSTITUTIONS

8. An Economic Analysis of Financial Structure
10. Economic Analysis of Financial Regulation
11. Banking Industry: Structure and Competition
12. Financial Crises

CENTRAL BANKING AND THE CONDUCT OF MONETARY POLICY

13. Central Banks and the Federal Reserve System
14. The Money Supply Process
15. The Tools of Monetary Policy
16. The Conduct of Monetary Policy: Strategy and Tactics

MONETARY THEORY

19. Quantity Theory, Inflation, and the Demand for Money
20. The IS Curve
21. The Monetary Policy and Aggregate Demand Curves
22. Aggregate Demand and Supply Analysis
23. Monetary Policy Theory
24. The Role of Expectations in Monetary Policy
25. Transmission Mechanisms of Monetary Policy
26. Financial Crises in Emerging Market Economies
27. The ISLM Model
28. Nonbank Finance
29. Financial Derivatives
30. Conflicts of Interest in the Financial Services Industry

Why Study Money, Banking, and Financial Markets?

Why Study Money, Banking, and Financial Markets?

• To examine how financial markets such as bond, stock and foreign exchange markets work

• To examine how financial institutions such as banks and insurance companies work

• To examine the role of money in the economy

Financial Markets

• Markets in which funds are transferred from people who have an excess of available funds to people who have a shortage of funds
  – Bond market
  – Stock market
  – Foreign exchange market

Financial Institutions

• Financial Intermediaries: institutions that borrow funds from people who have saved and make loans to other people:
  – **Banks**: accept deposits and make loans
  – Other Financial Institutions: **insurance companies, finance companies, pension funds, mutual funds and investment banks**

• **Financial Innovation**: the advent of the information age and e-finance

Money and Business Cycles

• Money plays an important role in generating business cycles
• Recessions (unemployment) and expansions affect all of us
• Monetary Theory ties changes in the money supply to changes in aggregate economic activity and the price level

Overview of the Financial System

Indirect Finance

Financial Intermediaries

Funds

Funds

Financial Markets

Funds

Funds

Lender-Savers
1. Households
2. Business firms
3. Government
4. Foreigners

Borrower-Senders
1. Business firms
2. Government
3. Households
4. Foreigners

What is Money?
Meaning of Money

- **Money (=money supply)** any vehicle used as a means of **exchange** to pay for goods, services or debts.

- In today’s society, any **asset** that can quickly be transferred into cash is considered money.

- The more **liquid** an asset is, the closer it is to money.

- In economics, **money** does not mean **wealth** nor does it mean **income**.

Functions of Money

• Medium of Exchange
• Unit of Account
• Store of Value
Medium of Exchange

• By eliminating barter, this function of money increases efficiency in a society.
• As human societies started to engage in exchange money had to be invented.
• Any technological change that reduces transaction costs increases the wealth of the society.
• Any technological change that allows people to specialize also increases wealth.

Unit of Account

• We use money to measure the value of goods and services.

• Suppose we had 4 goods and no money. How do we measure the price of each good?
  – A in terms of B
  – B in terms of C
  – C in terms of D
  – A in terms of C
  – A in terms of D
  – B in terms of D

• Money allows to quote prices in terms of currency only.

Store of Value

- All assets are stored value.
- Money, although without any return, is still desirable to hold because it allows purchases immediately.
- Other assets take time (transaction costs) to use as a payment for purchases.
- The more liquid an asset is, the less transaction cost it carries.
- Inflation erodes the value of money.

Evolution of the Payments System

• Commodity Money:
  — valuable, easily standardized and divisible commodities
    (e.g. precious metals, cigarettes).

• Fiat Money:
  — paper money decreed by governments as legal tender.

Electronic Money

• Debit Cards
  – Instant transfer from your checking account to merchant’s checking account.

• Stored Value Card
  – Gift cards.

• Electronic Cash
  – Account set up on a person’s PC from her bank whereby she can buy products over the Internet.

• Electronic Checks
  – Checks written on PC and sent through the Internet.
Benefits of Paper Checks

• Cheaper than telecommunications network.
• Provide receipts.
• Allow float.
• May be more secure; avoid hacker problems.
• Do not leave a wealth of information trail.

Measuring Money

• M1:
  – Currency, demand deposits, travelers checks.

• M2:
  – M1, saving deposits, small time deposits, retail MMMF.

• M3:
  – M2, large time deposits, repos, Eurodollar deposits, institutional MMMF.

• MZM:
  – M2, institutional MMMF minus small time deposits.

• Growth rates of these aggregates do not always go hand in hand, making monetary policy difficult since signals are conflicting.

The IS Curve

The IS (Investment/Saving) Curve

The IS (Investment/Saving) Curve

Goods Markets

Interest rate, $i$

Output (Income), $Y$

Demand

Demand

Price (p)

Quantity (q)

Q*

P*

D

The ISLM Model
Goods and Financial Markets:

The ISLM Model

(Investment Saving – Liquidity Preference Money Supply) model

The ISLM Model
(Investment Saving – Liquidity Preference Money Supply) model

Supply and Demand

Quantity \( (q) \)

Price \( (p) \)

\[ Q^* \quad P^* \]

Demand

Supply

Equilibrium

Artificial Intelligence and Deep Learning for Fintech
From Algorithmic Trading to Personal Finance Bots: 41 Startups Bringing AI to Fintech

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
From Algorithmic Trading To Personal Finance Bots: 41 Startups Bringing AI To Fintech

AI in Fintech

41 Startups Bringing Artificial Intelligence To Fintech

- **General Purpose/Predictive Analytics**
  - AYASDI
  - KENS
  - cortical.io
  - Numenta
  - DataRobot
  - nervana systems
  - H2O
  - Digital Reasoning
  - context relevant

- **Quantitative Trading**
  - sentient technologies
  - CLONE ALGO
  - Alpaca
  - W AL N U T A L G O R I T H M S

- **AI Assistants/Bots**
  - KASIST
  - TRIM
  - Penny
  - INSURIFY
  - SURE.

- **Blockchain**
  - Skry
  - EUKLID

- **Credit Scoring**
  - TypeScore
  - aire
  - creditvidya
  - zest finance
  - ADF
  - Applied Data Finance

- **Fraud Detection**
  - feedzai
  - BIO CATCH
  - Less Friction. Less Fraud.

- **Debt Collection**
  - TrueAccord

- **Personal Banking**
  - personometrics
  - CREAM FINANCE

- **Market Research & Sentiment Analysis**
  - indico
  - acuity research
  - Lucena Quantitative Analytics
  - Numerai
  - Dataminr

- **Search Engine**
  - alphasense

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Artificial Intelligence (AI) in Fintech

General Purpose/ Predictive Analytics

- AYASDI
- Digital Reasoning
- context relevant
- H2O
- KENSHEC
- cortical.io
- Numenta
- DataRobot
- Nervana Systems

Market Research & Sentiment Analysis

- indico
- Acuity Trading
- Lucena Quantitative Analytics
- Numerai
- Dataminr

Search Engine

- alphasense

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Artificial Intelligence (AI) in Fintech

Quantitative Trading
- sentient technologies
- CLONE ALGO
- Alpaca
- WALNUT ALGORITHMS

AI Assistants/Bots
- KASIST
- TRIM
- Penny
- INSURIFY
- SURE.

Credit Scoring
- TypeScore
- aire
- creditvidya
- zest finance
- ADF
- APPLIED DATA FINANCE
- Wecash
- CREAM FINANCE

Blockchain
- Skry
- EUKLID

Debt Collection
- TrueAccord

Fraud Detection
- feedzai
- BIOLCATCH

Personal Banking
- personetics
- SBDA group

Source: https://www.cbinsights.com/blog/artificial-intelligence-fintech-market-map-company-list/
Wealthfront Robo Advisor
Financial Services
Technology
Innovation
Innovation

Source: https://www.merriam-webster.com/dictionary/innovation
Innovation: a new idea, method, or device

Source: https://www.merriam-webster.com/dictionary/innovation
Innovation: something new

Source: https://www.merriam-webster.com/dictionary/innovation
Novelty:
something new or unusual

the novelty of a self-driving car

Source: https://www.merriam-webster.com/dictionary/novelty
Creativity is not a new idea.

Creativity is an old belief you leave behind
FinTechs as Service Innovators: Analysing Components of Innovation

Innovation

“a process of searching and recombining existing knowledge elements”

Search and recombination process to innovate: A review of the empirical evidence and a research agenda

Innovation Research in Economics, Sociology and Technology Management

Innovation Research in Economics, Sociology and Technology Management

<table>
<thead>
<tr>
<th>Stage of process</th>
<th>Level of study</th>
<th>Type of innovation</th>
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Business, Innovation, and Knowledge Ecosystems

Business, Innovation, and Knowledge Ecosystems

Innovation Ecosystems
integrate exploration (knowledge) and exploitation (business) ecosystems

Knowledge Ecosystems
focus on generating new knowledge and technologies

Business Ecosystems
focus on creating customer value

## Innovation Ecosystems

### Characteristics

<table>
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<tr>
<th></th>
<th>Business Ecosystems</th>
<th>Innovation Ecosystems</th>
<th>Knowledge Ecosystems</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Baseline of Ecosystem</strong></td>
<td>Resource exploitation for customer value</td>
<td><strong>Co-creation of innovation</strong></td>
<td>Knowledge exploration</td>
</tr>
<tr>
<td><strong>Relationships and Connectivity</strong></td>
<td>Global business relationships both competitive and co-operative</td>
<td>Geographically clustered actors, different levels of collaboration and openness</td>
<td>Decentralized and disturbed knowledge nodes, synergies through knowledge exchange</td>
</tr>
<tr>
<td><strong>Actors and Roles</strong></td>
<td>Suppliers, customers, and focal companies as a core, other actors more loosely involved</td>
<td><strong>Innovation policymakers, local intermediators, innovation brokers, and funding organizations</strong></td>
<td>Research institutes, innovators, and technology entrepreneurs serve as knowledge nodes</td>
</tr>
<tr>
<td><strong>Logic of Action</strong></td>
<td>A main actor that operates as a platform sharing resources, assets, and benefits or aggregates other actors together in the networked business operations</td>
<td>Geographically proximate actors interacting around hubs facilitated by intermediating actors</td>
<td>A large number of actors that are grouped around knowledge exchange or a central non-proprietary resource for the benefit of all actors</td>
</tr>
</tbody>
</table>

Diffusion of Innovation Theory (DOI)

Innovation

(Diffusion of Innovation)

1. Relative advantage
2. Compatibility
3. Complexity
4. Trialability
5. Observability

Diffusion of Innovation

Innovation Adoption Process

Initiation → Adoption Decision → Implementation

Innovation Adoption Process

Initiation → Adoption Decision → Implementation

- Environmental Characteristics
- Organizational Characteristics
- Top Managers Characteristics
- Innovation Characteristics
- User Acceptance Attributes

RBV = Resource-Based View

DOI = Diffusion of Innovation Theory

TAM = Technology Acceptance Model

Innovation Adoption Process

Environment Characteristics:
- Dynamism
- Hostility
- Complexity

Organizational Characteristics:
- Specialization
- Horizontal differentiation
- Vertical differentiation
- Centralization
- Formalization
- Human resources
- Financial resources

Top Managers Characteristics:
- Attitudes toward innovation
- Demographic characteristics

Innovation Characteristics:
- Relative advantage
- Compatibility
- Complexity
- Trialability
- Observability

DOI = Diffusion of Innovation Theory

RBV = Resource-Based View

TAM = Technology Acceptance Model

Source: Pichlak, Magdalena.
# Innovation Adoption Process

## Table

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<thead>
<tr>
<th>Factors</th>
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<th>Adoption decision</th>
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Note.
Me = median; Q = quartile; QD = quartile deviation.

Source: Pichlak, Magdalena.
# Innovation Adoption Process

<table>
<thead>
<tr>
<th>Initiation</th>
<th>Round 1</th>
<th>Round 2</th>
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FinTech Innovation

FinTech high-level classification

- Lending
- Payments
- Robo Advisors
- Analytics
- Others

Profile
Advice
Re-Balance
Indexing

Brett King (2014),
Breaking Banks:
The Innovators, Rogues, and Strategists Rebooting Banking
Wiley

Source: https://www.amazon.com/Breaking-Banks-Innovators-Strategists-Rebooting/dp/1118900146
“In the next 10 years, we'll see more disruption and changes to the banking and financial industry than we've seen in the preceding 100 years.”

(Brett King, 2014)
Disrupting Banking: The Fintech Startups That Are Unbundling Wells Fargo, Citi and Bank of America

Source: https://www.cbinsights.com/blog/industry-market-map-landscape/
Fintech: Unbundling the Bank

Source: https://www.cbinsights.com/blog/disrupting-banking-fintech-startups-2016/
Fintech: Unbundling the Bank

Wealth Management: Wealthfront

Source: https://www.cbinsights.com/blog/disrupting-banking-fintech-startups-2016/
Disrupting European Banking: The FinTech Startups That Are Unbundling HSBC, Santander, and BNP

Source: https://www.cbinsights.com/blog/industry-market-map-landscape/
Financial Technology (Fintech) Categories

1. Banking Infrastructure
2. Business Lending
3. Consumer and Commercial Banking
4. Consumer Lending
5. Consumer Payments
6. Crowdfunding
7. Equity Financing
8. Financial Research and Data
9. Financial Transaction Security
10. Institutional Investing
11. International Money Transfer
12. Payments Backend and Infrastructure
13. Personal Finance
14. Point of Sale Payments
15. Retail Investing
16. Small and Medium Business Tools

Source: http://www.venturescanner.com/financial-technology
References

• Brett King (2012), “Bank 3.0: Why banking is no longer somewhere you go, but something you do”, John Wiley & Sons