



AI in Fintech, Green Finance, and Sustainability

(人工智慧金融科技、綠色金融與永續)

時間：2022/12/01 (四) 10:20-12:10

地點：國立臺灣大學國家發展研究所 3F 300教室

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中央研究院 資訊科學研究所 訪問學人
國立臺灣大學 資訊管理 博士

Publications Co-Chairs, IEEE/ACM International Conference on
Advances in Social Networks Analysis and Mining (ASONAM 2013-)

Program Co-Chair, IEEE International Workshop on
Empirical Methods for Recognizing Inference in Text (IEEE EM-RITE 2012-)

Publications Chair, The IEEE International Conference on
Information Reuse and Integration for Data Science (IEEE IRI)



Outline

- **AI in FinTech**
 - **Metaverse, Web3, DeFi, NFT**
 - **Financial Services Innovation and Applications**
 - **Technology-driven Financial Industry Development**
- **Green Finance and Sustainability**
 - **SDGs: Sustainable Development Goals**
 - **ESG: Environmental, Social, and Governance**
 - **CSR: Corporate Social Responsibility**

臺北大學 國際發光

【記者王志誠、周貞伶／新北報導】

2022年7月9日 週六 下午8:33

由臺北大學資管所戴敏育副教授領軍的「IMNTPU」跨國團隊，在第十六屆NTCIR國際資訊存取技術評估研討會上榮獲多項大獎。其中在**投資者與管理者的細粒度聲明檢測的中文分析報告分項與對話系統評測（DialEval-2）**的英文金塊偵測分項EnglishNuggetDetection（ND）子任務，**兩項子任務皆拿下第一名的優秀成績。**

國立臺北大學資管所在戴敏育副教授帶領IMNTPU跨國團隊，其成員包括資管所碩士班研究生鄧詠薇、邱沛慈與蕭婷云，以及與日本東京Zeals公司AI自然語言科學家姜天戡共同合作，參與**2022 NTCIR-16**研討會榮獲許多獎項，為臺北大學資管所在NTCIR研討會上，建立良好的國際聲譽。

臺北大學資管所IMNTPU團隊在投資者與管理者的細粒度聲明檢測任務（FinNUM3）中，最終在七支隊伍中脫穎而出，除了在任務中取的平均效能為所有隊伍中最佳**榮獲第一名**，還囊括多項大獎，包含「**口頭報告獎**」與「**海報展示獎**」。不僅在FinNUM3口頭報告中以優秀的國際簡報與問答獲得主辦單位的高度賞識與重視；在海報展示期間，以精美海報展示與生動活潑的解說，吸引大批與會人員前來駐足交流與提問，獲得超高人氣。

戴敏育表示，希望藉由此次在國際研討會的優良成果，鼓勵學生積極參與相關國際競賽，讓學生能與國際接軌。IMNTPU隊長鄧詠薇認為，整個NTCIR-16比賽從拿到資料集、模型建置到最後預測結果，花了近半年的時間，突破重重關卡，到最後甚至能順利的在研討會中發表，這一過程受益良多。從主辦方提供的專業財務分析報告資料集，進一步針對聲明內容作細粒度分析，判斷聲明內容中的數字是否為其中重要資訊，以利相關利益者更能了解數字對於專業財務報告的重要性。

副隊長邱沛慈更談到，能夠在NTCIR-16 FinNUM中文財務分析報告中獲得第一名的績效，除了團隊共同努力外，也非常感謝戴老師與姜天戡博士在過程中給予很多建議與幫助。「經過約半年的努力，**IMNTPU團隊在NTCIR-16 Dial-Eval-2對話系統評測任務英文金塊偵測分項能獲得第一名**，真的很高興。」副隊長蕭婷云認為，從參與國際資訊競賽的過程中，可學習到許多寶貴經驗。

校方表示，在此次競賽中，透過與來自世界各地的高手較量，展現北大資管所的研究成果，不僅能開闊國際視野，也同時能讓世界各國看到臺灣隊伍的實力。

IMNTPU at the NTCIR-16 FinNum-3 Task: Data Augmentation for Financial Numclaim Classification

¹ Information Management, National Taipei University, New Taipei City, Taiwan

² Zeals Co., Ltd. Tokyo, Japan



Yung-Wei Teng¹



Pei-Tz Chiu¹



Ting-Yun Hsiao¹



Mike Tian-Jian Jiang²



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IMNTPU Dialogue System Evaluation at the NTCIR-16 DialEval-2 Dialogue Quality and Nugget Detection

¹ Information Management, National Taipei University, New Taipei City, Taiwan

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**AI in FinTech:
Metaverse,
Web3, DeFi, NFT,
Financial Services
Innovation and Applications**

AI in FinTech

FinTech ABCD

AI

Block Chain

Cloud Computing

Big **D**ata

Decentralized Finance (DeFi)

Block Chain Financial Technology

**Block Chain & Bitcoin
(BTC)**

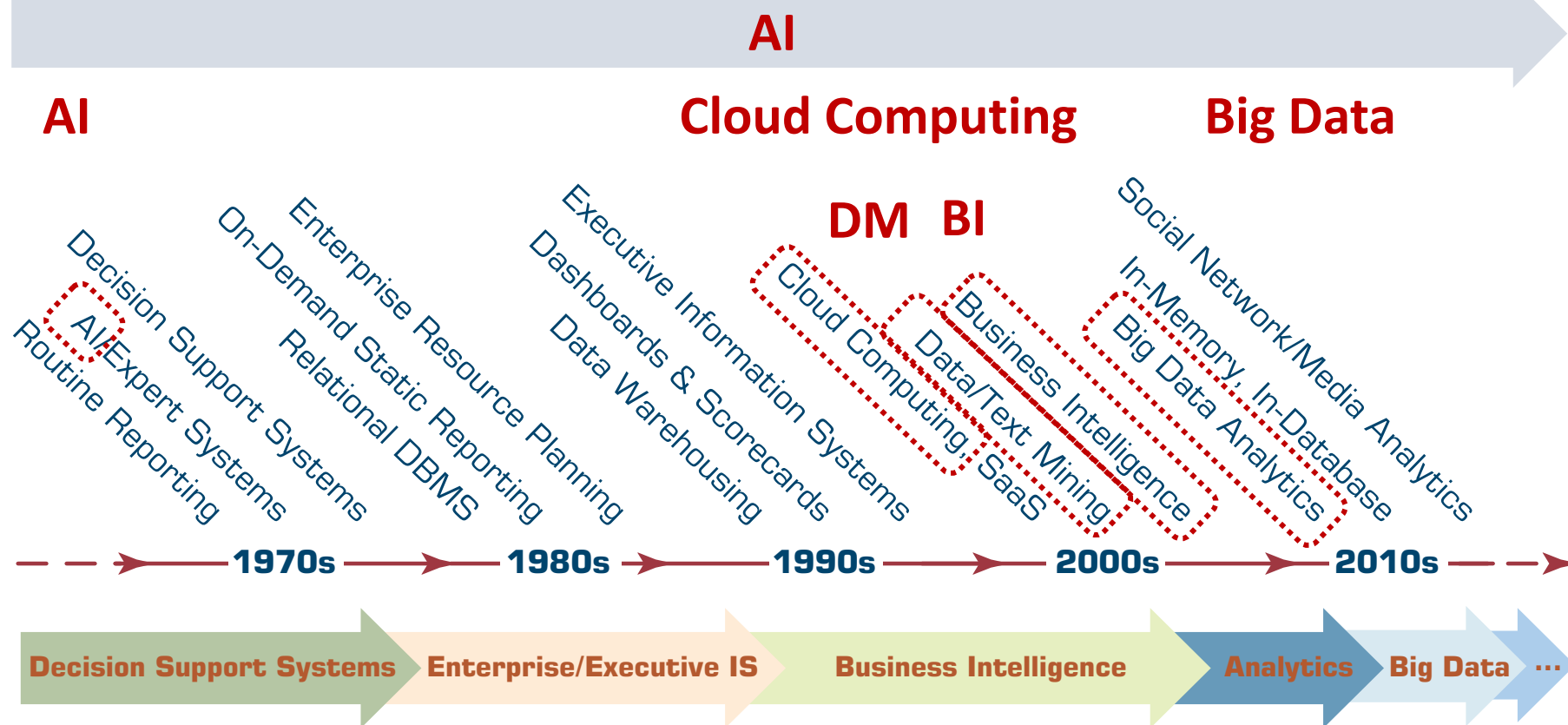
**Smart Contract & Ethereum
(ETH)**

**Decentralized Application
(DApp)**

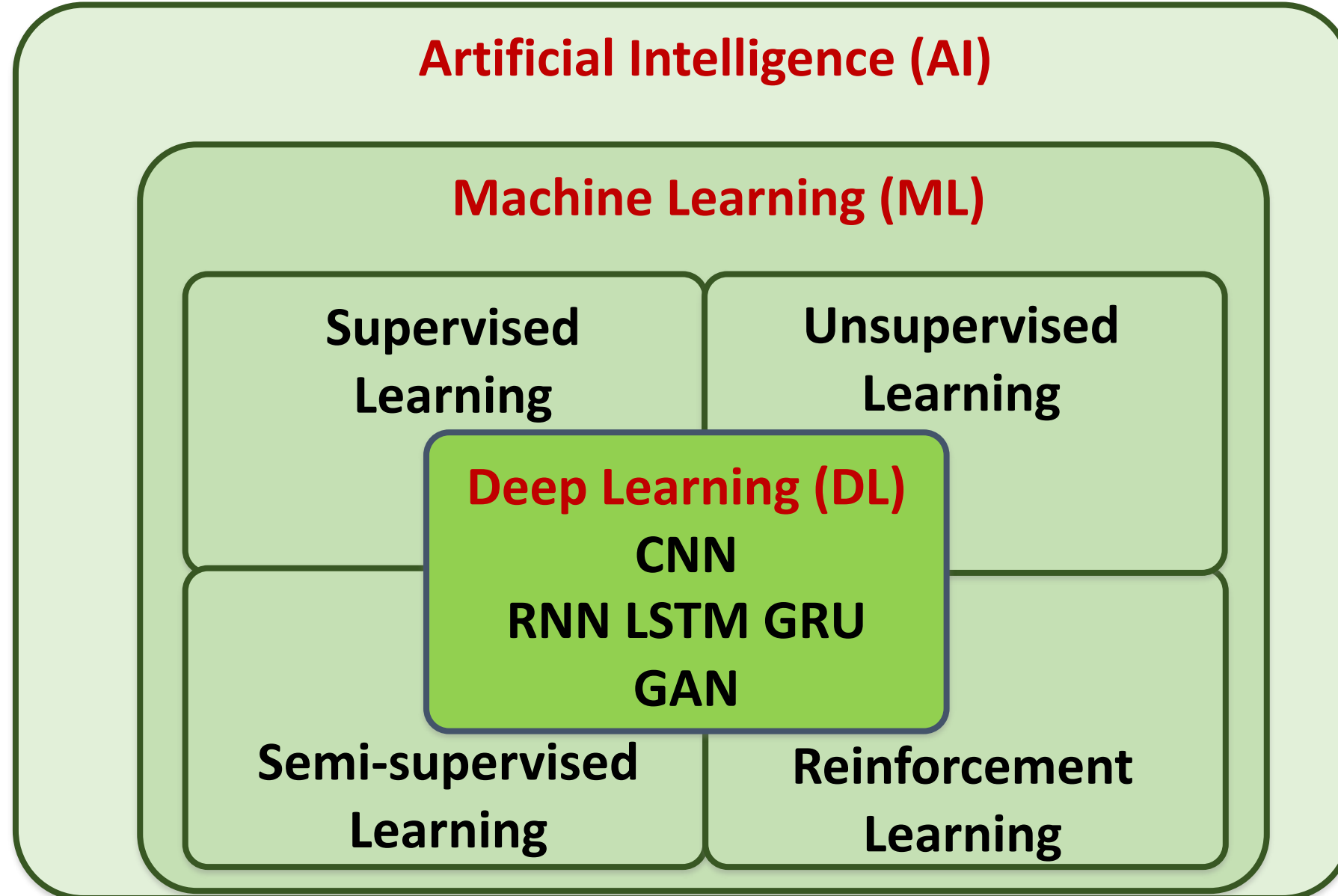
Artificial Intelligence (AI)

AI, Big Data, Cloud Computing

Evolution of Decision Support, Business Intelligence, and Analytics



AI, ML, DL



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

Thinking Humanly	Thinking Rationally
Acting Humanly	Acting Rationally

4 Approaches of AI

<p>2.</p> <p>Thinking Humanly: The Cognitive Modeling Approach</p>	<p>3.</p> <p>Thinking Rationally: The “Laws of Thought” Approach</p>
<p>1.</p> <p>Acting Humanly: The Turing Test Approach (1950)</p>	<p>4.</p> <p>Acting Rationally: The Rational Agent Approach</p>

AI Acting Humanly: The Turing Test Approach

(Alan Turing, 1950)

- Knowledge Representation
- Automated Reasoning
- Machine Learning (ML)
 - Deep Learning (DL)
- Computer Vision (Image, Video)
- Natural Language Processing (NLP)
- Robotics

FinTech

Financial Technology

FinTech

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

Financial Technology

Financial Services

FinTech: Financial Services Innovation



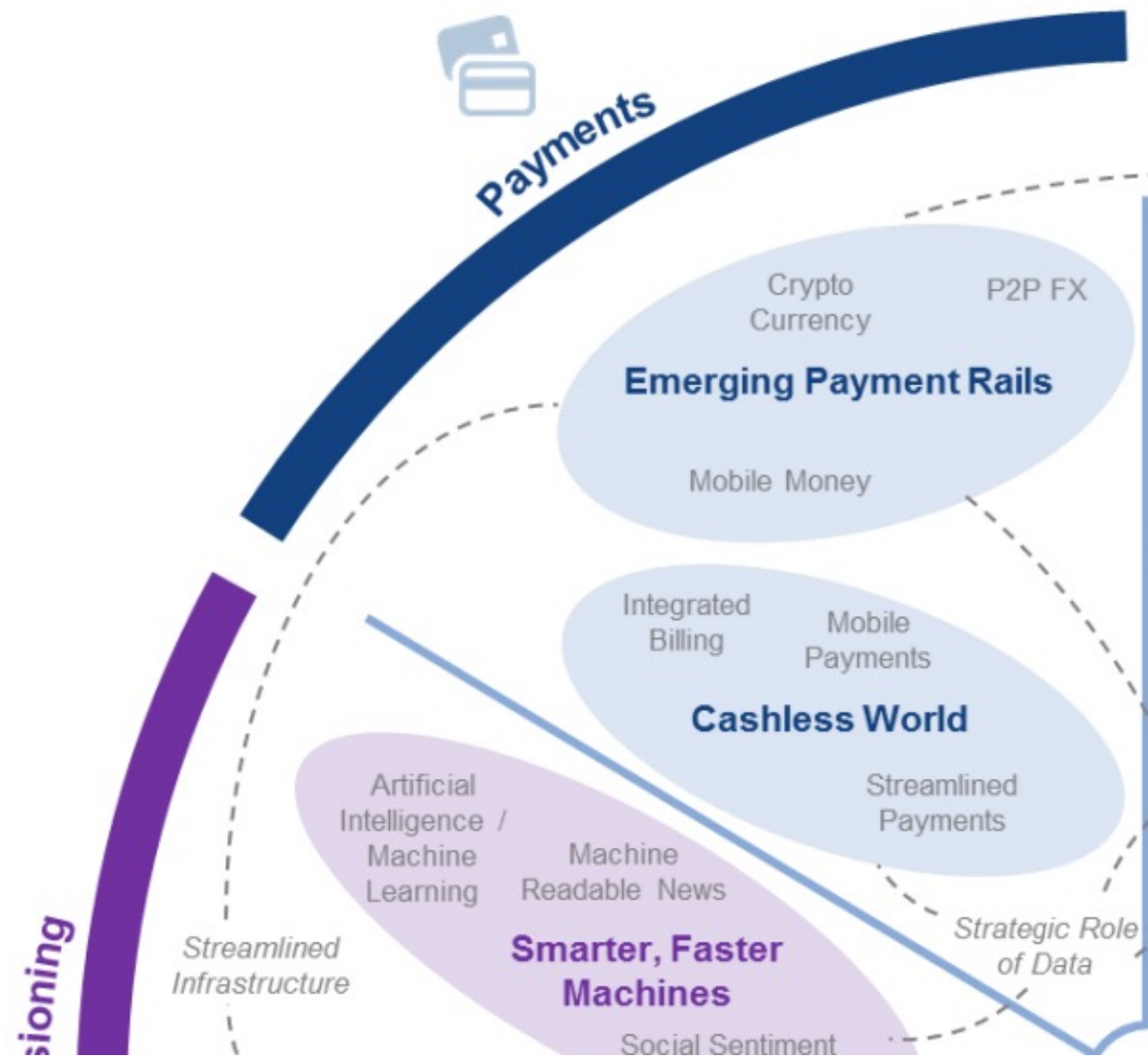
FinTech:

Financial Services Innovation

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

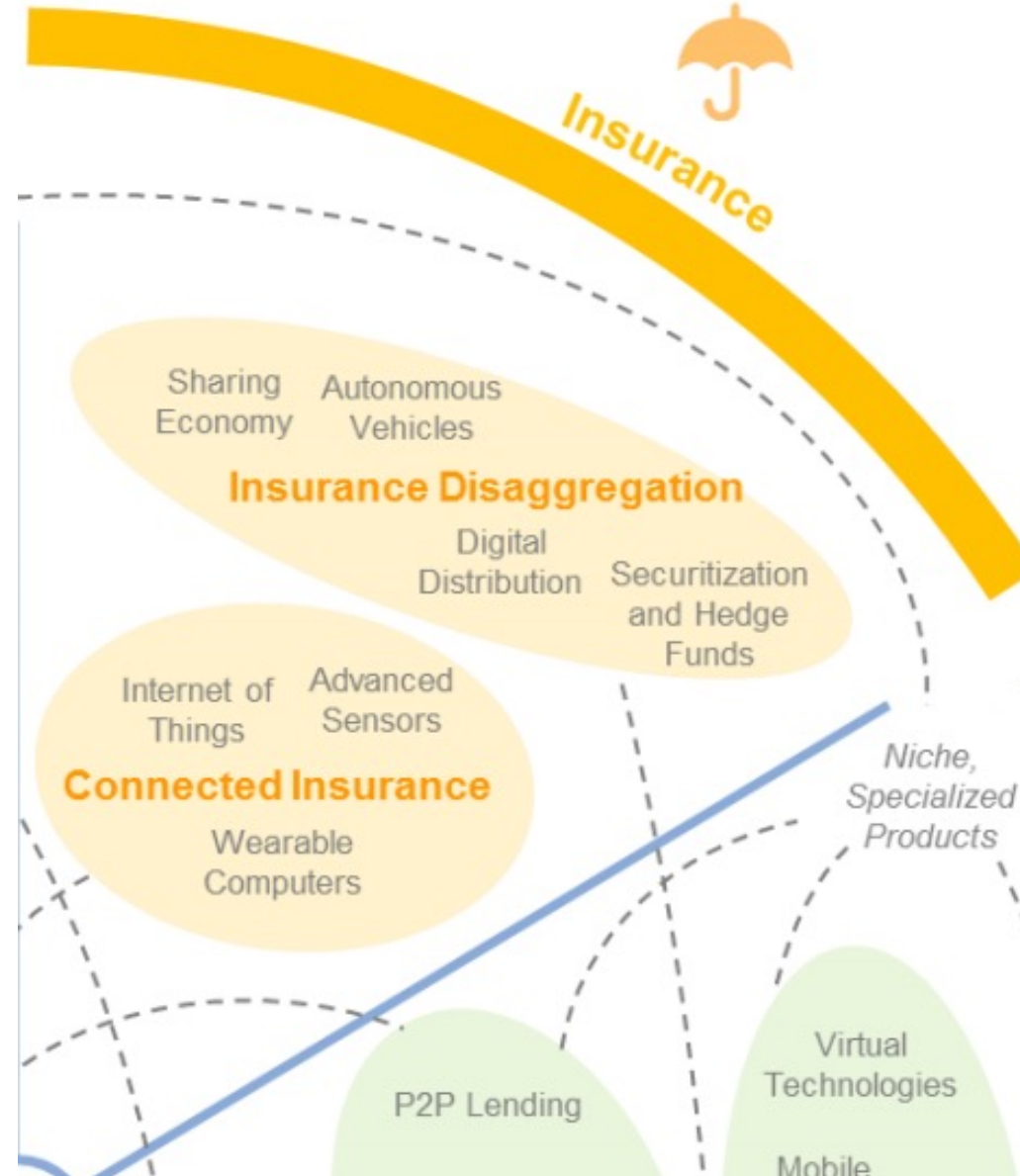
1

FinTech: Payment



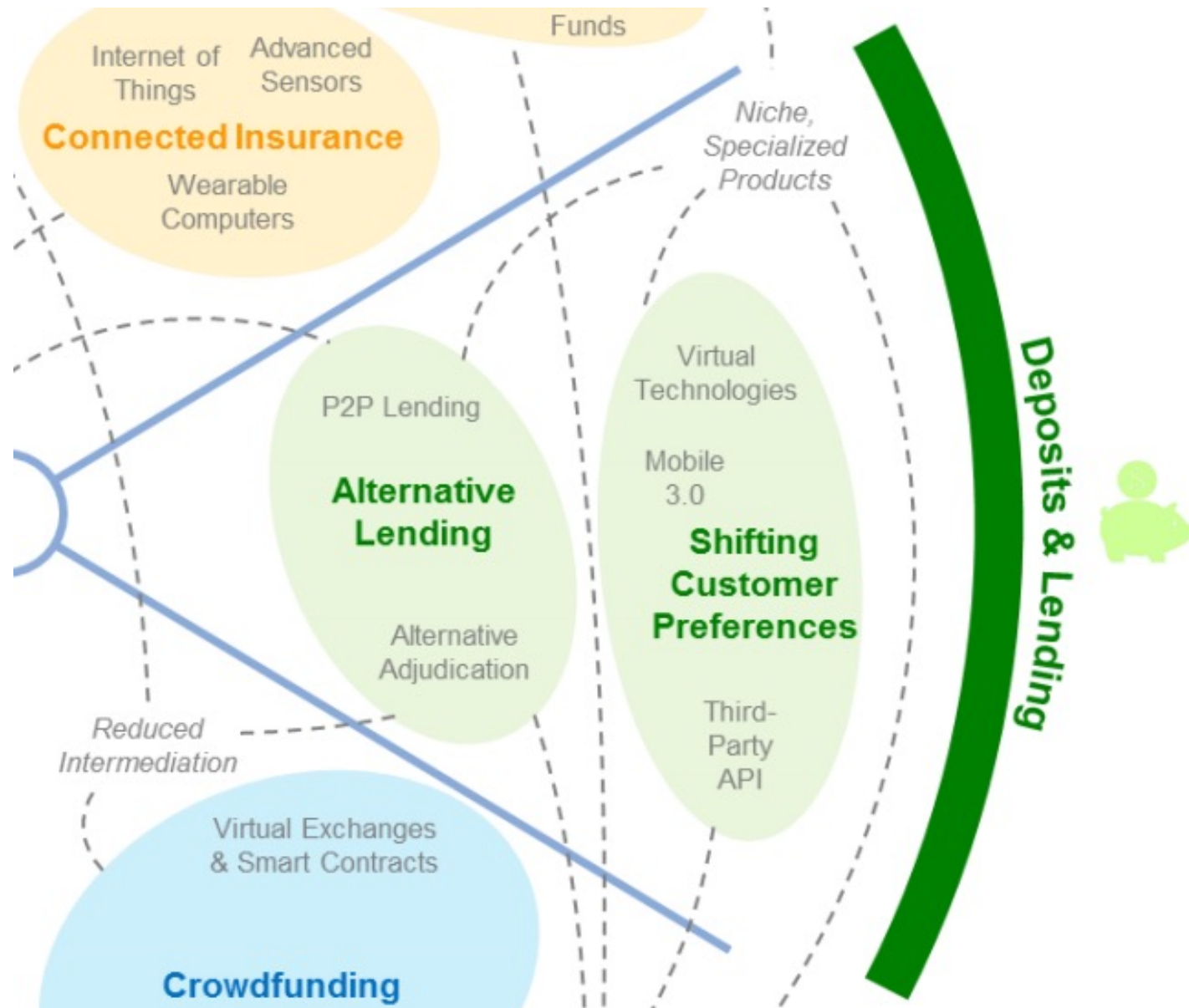
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FinTech: Insurance



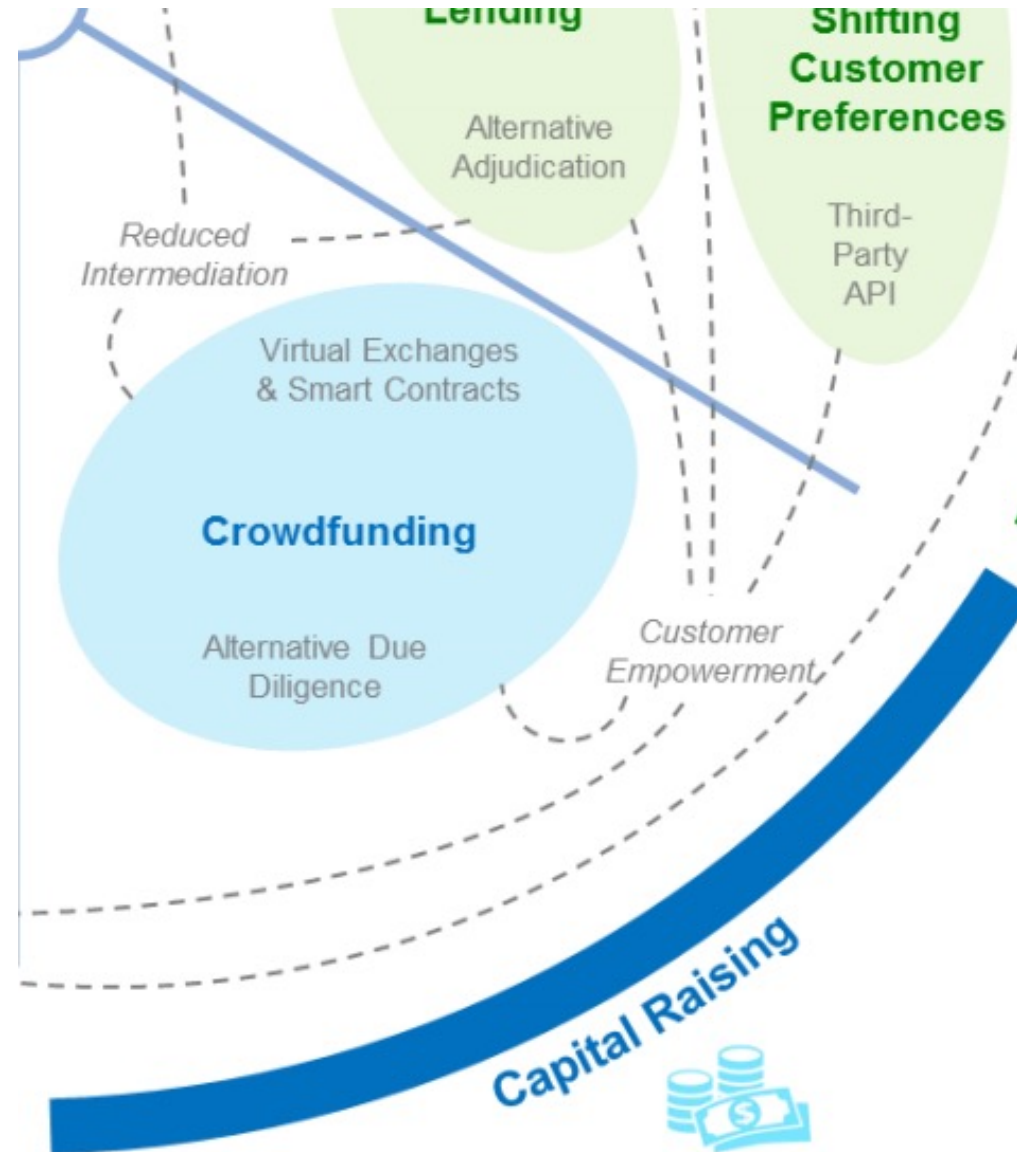
3

FinTech: Deposits & Lending

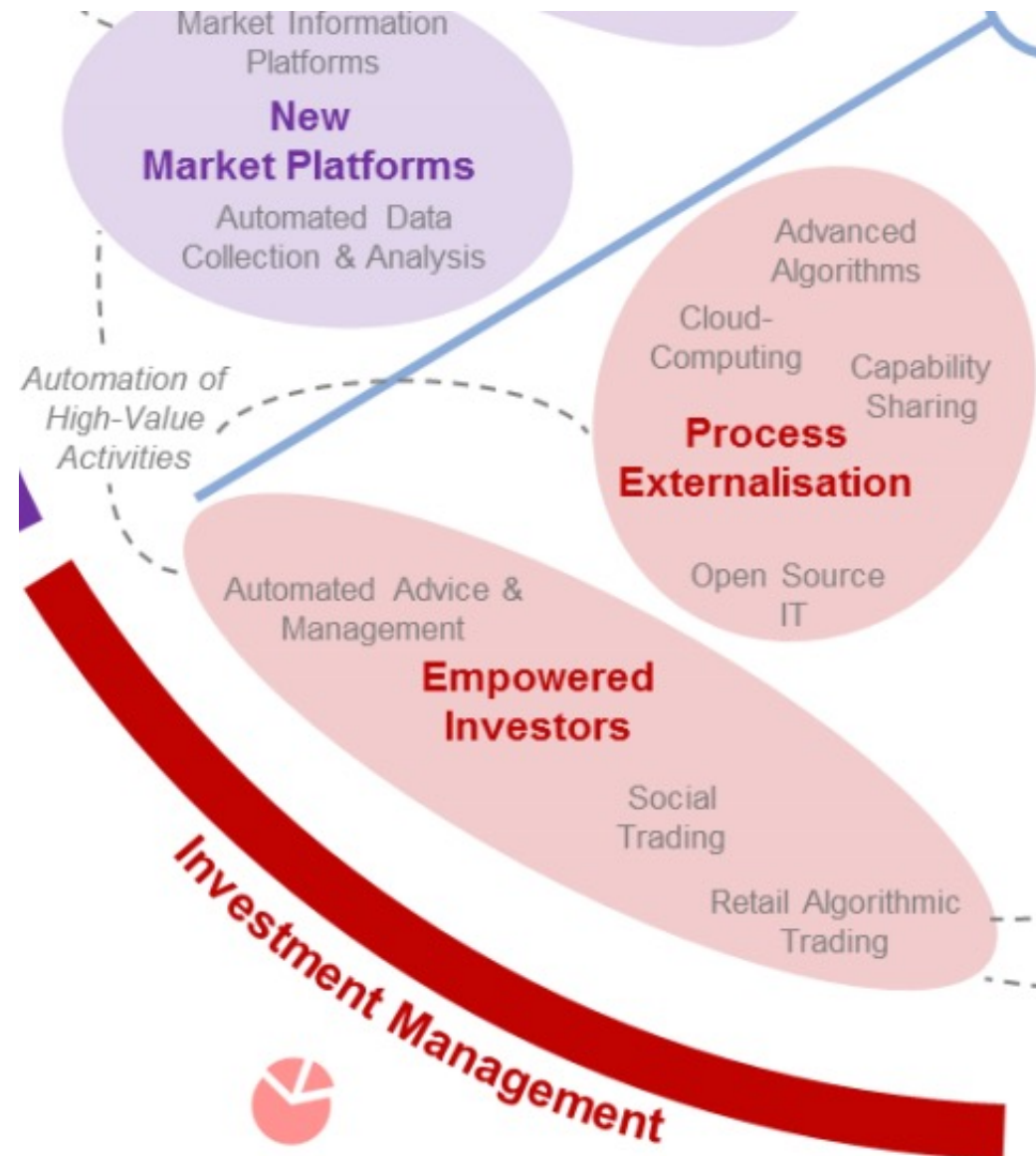


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FinTech: Capital Raising

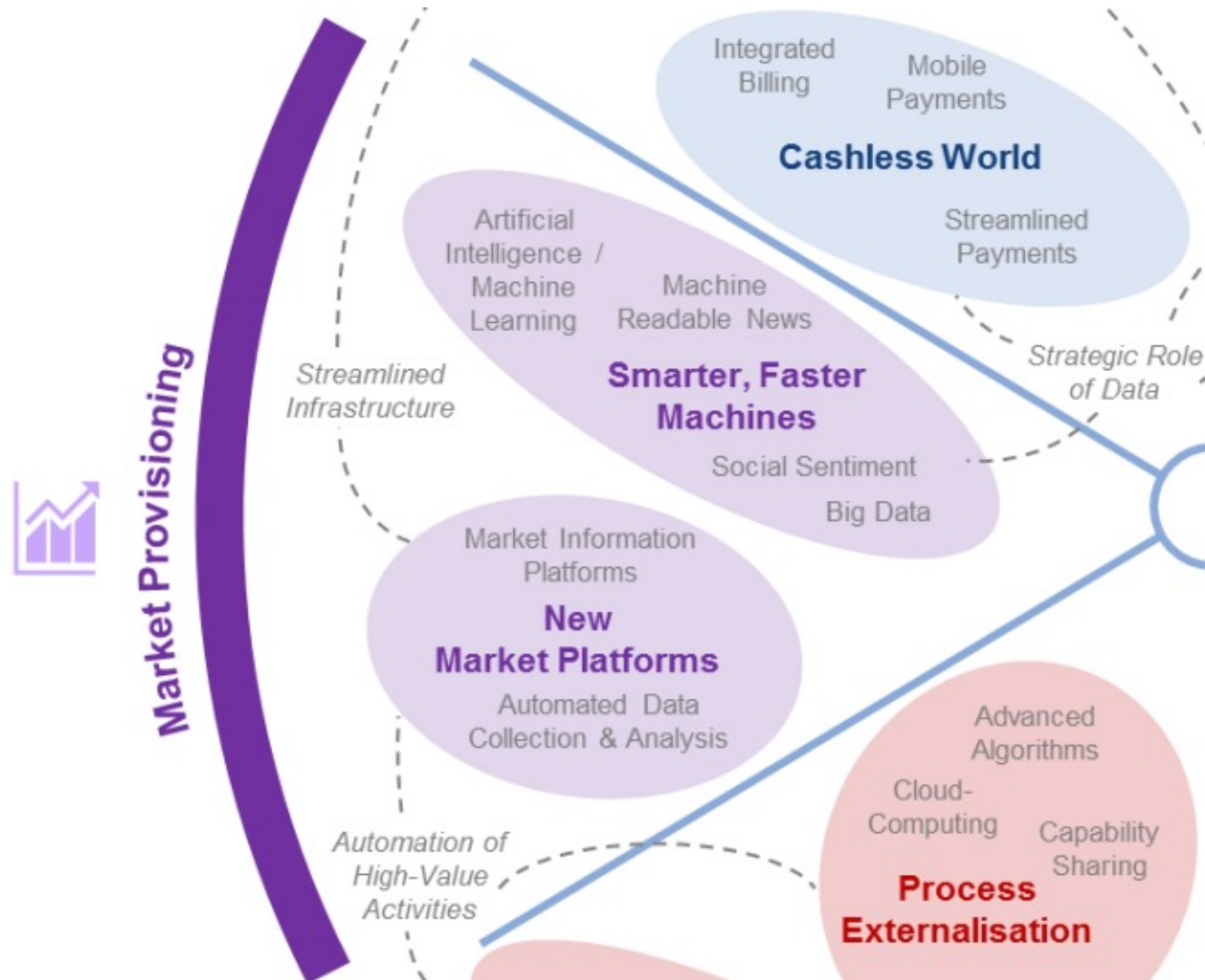


5 FinTech: Investment Management



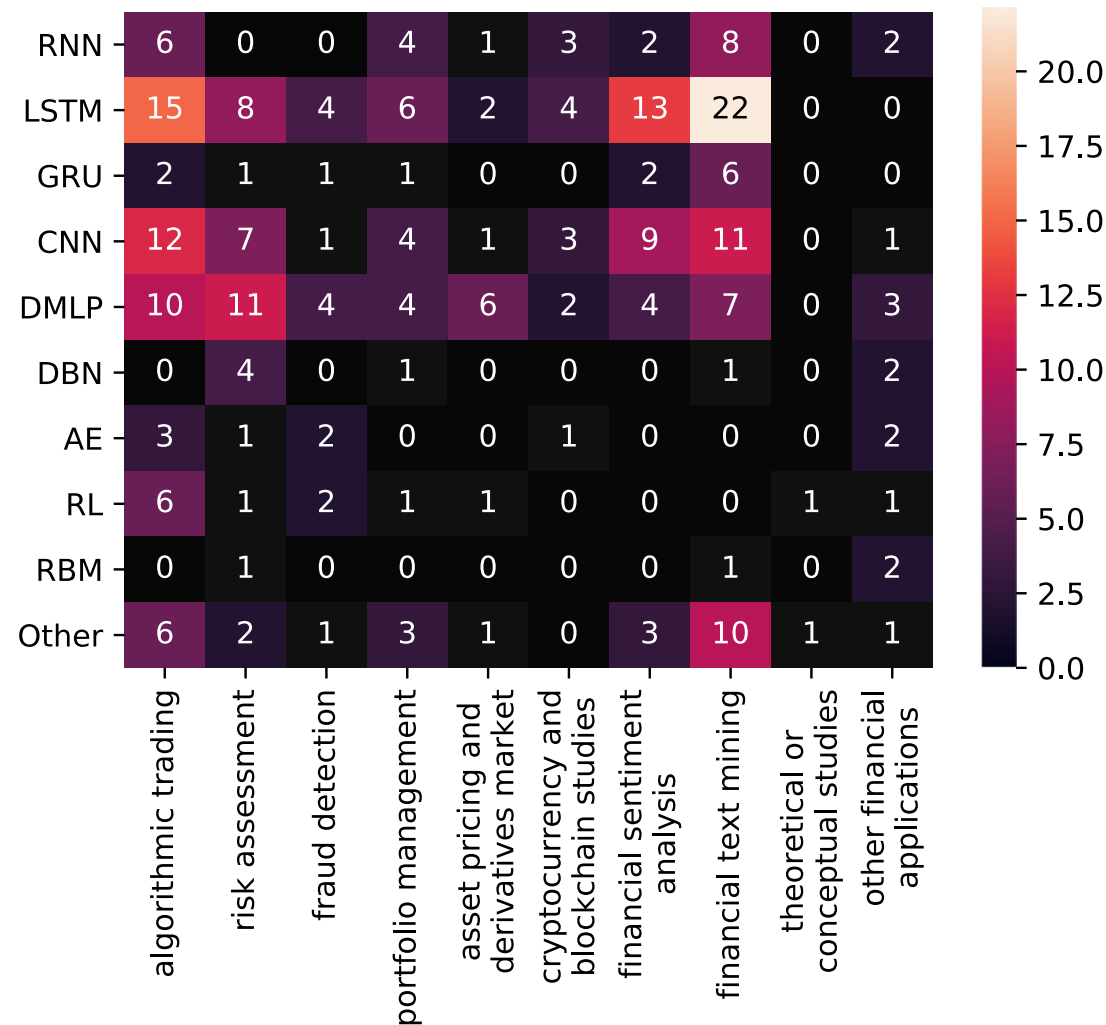
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FinTech: Market Provisioning



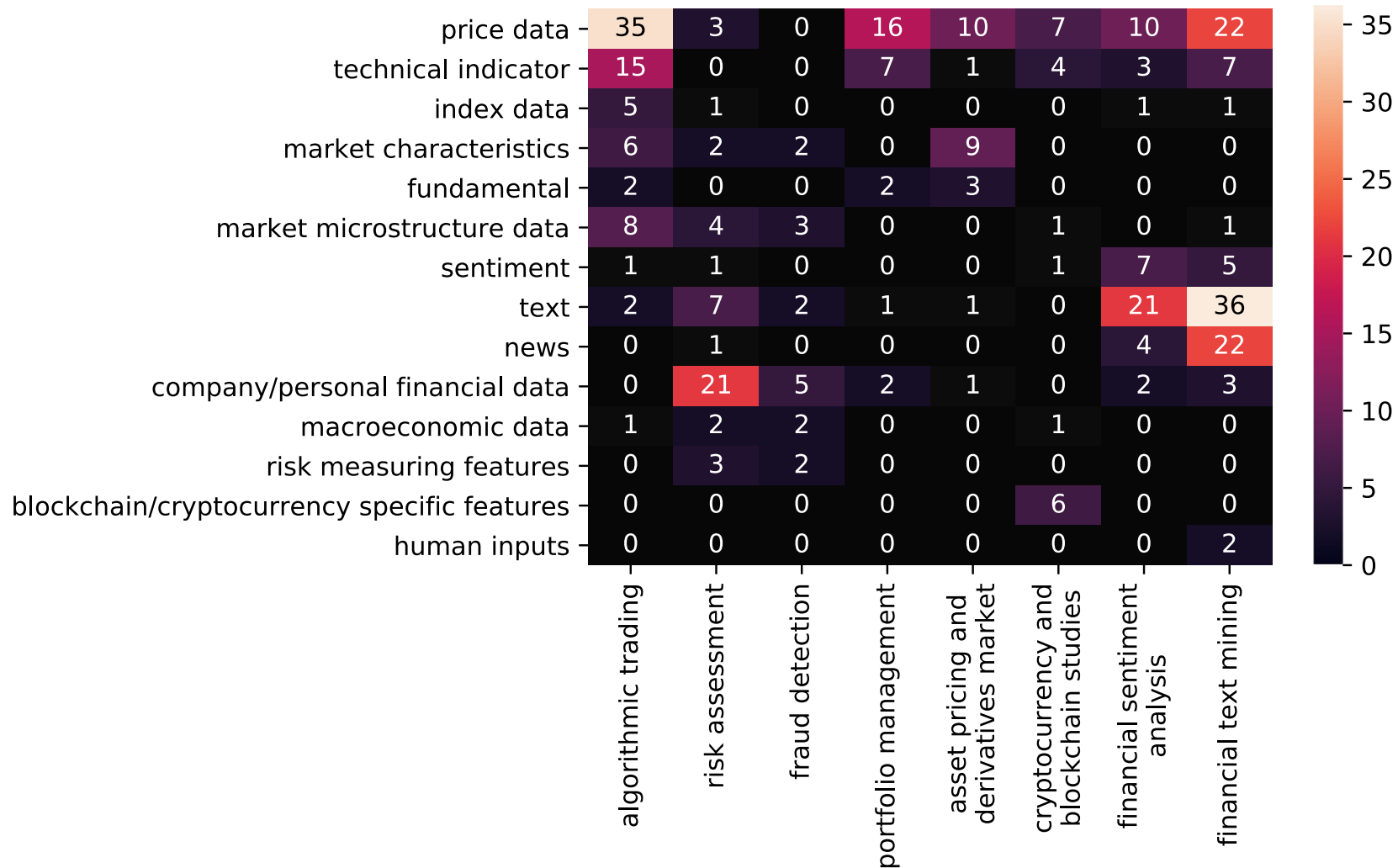
Deep learning for financial applications:

Topic-Model Heatmap



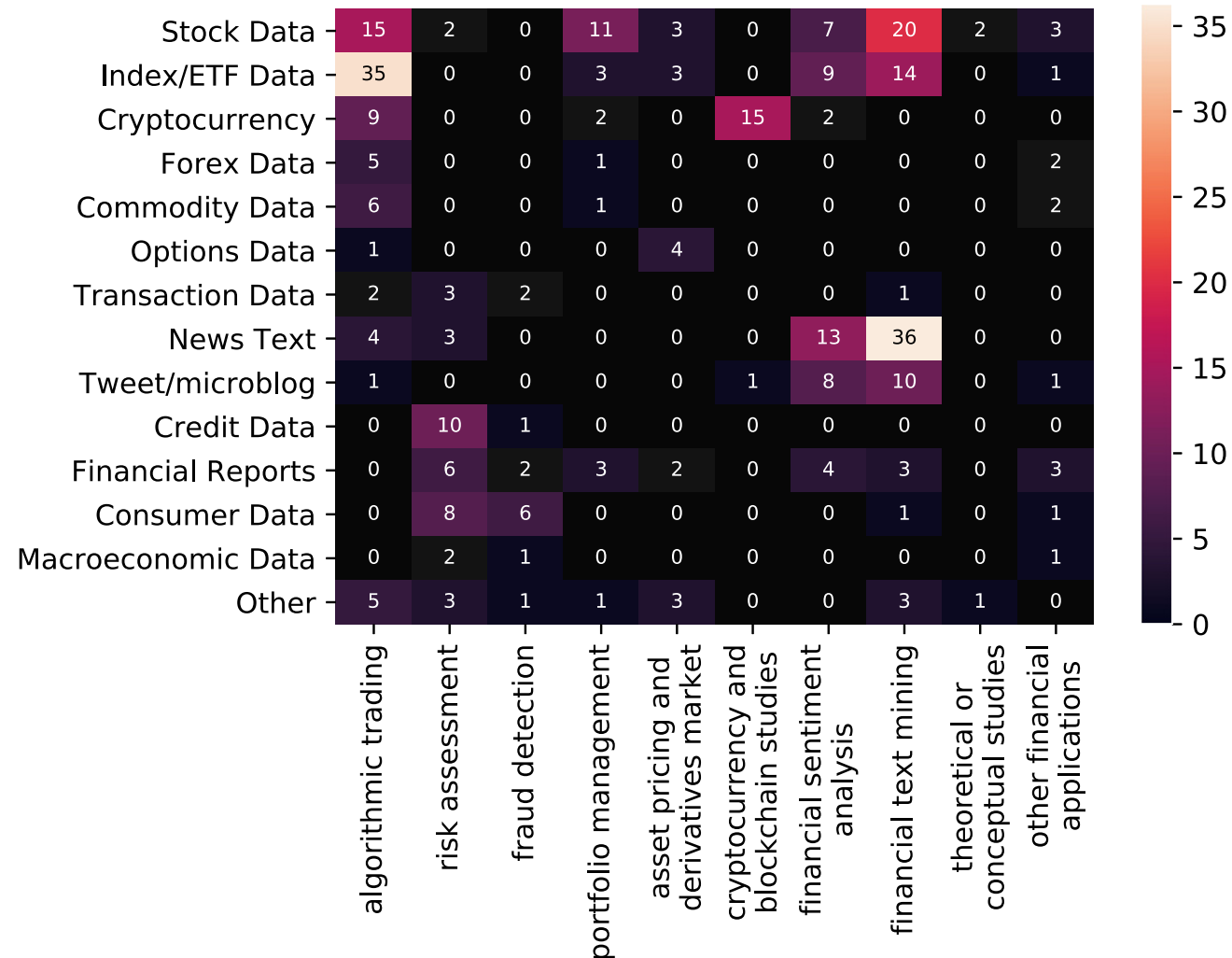
Deep learning for financial applications:

Topic-Feature Heatmap



Deep learning for financial applications:

Topic-Dataset Heatmap



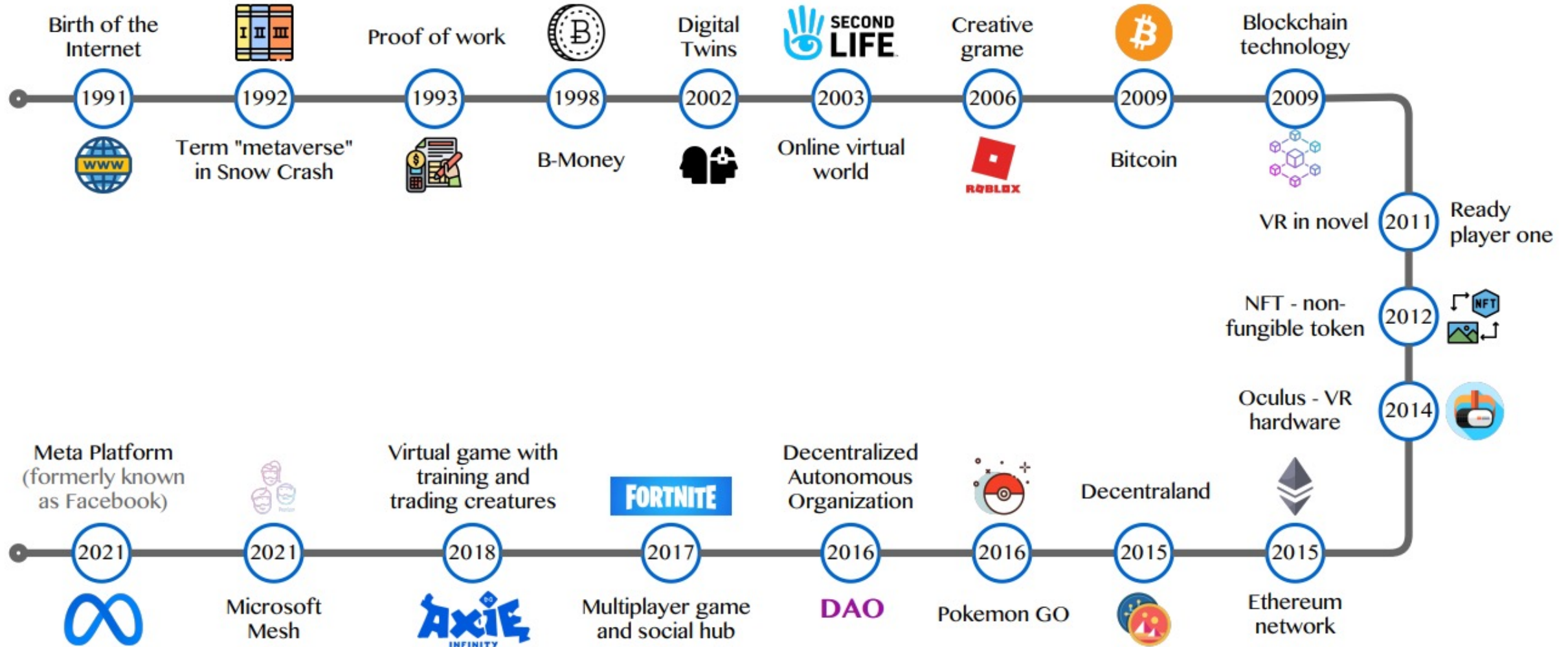
Metaverse

Web3

DeFi

NFT

Metaverse Development from 1991 to 2021

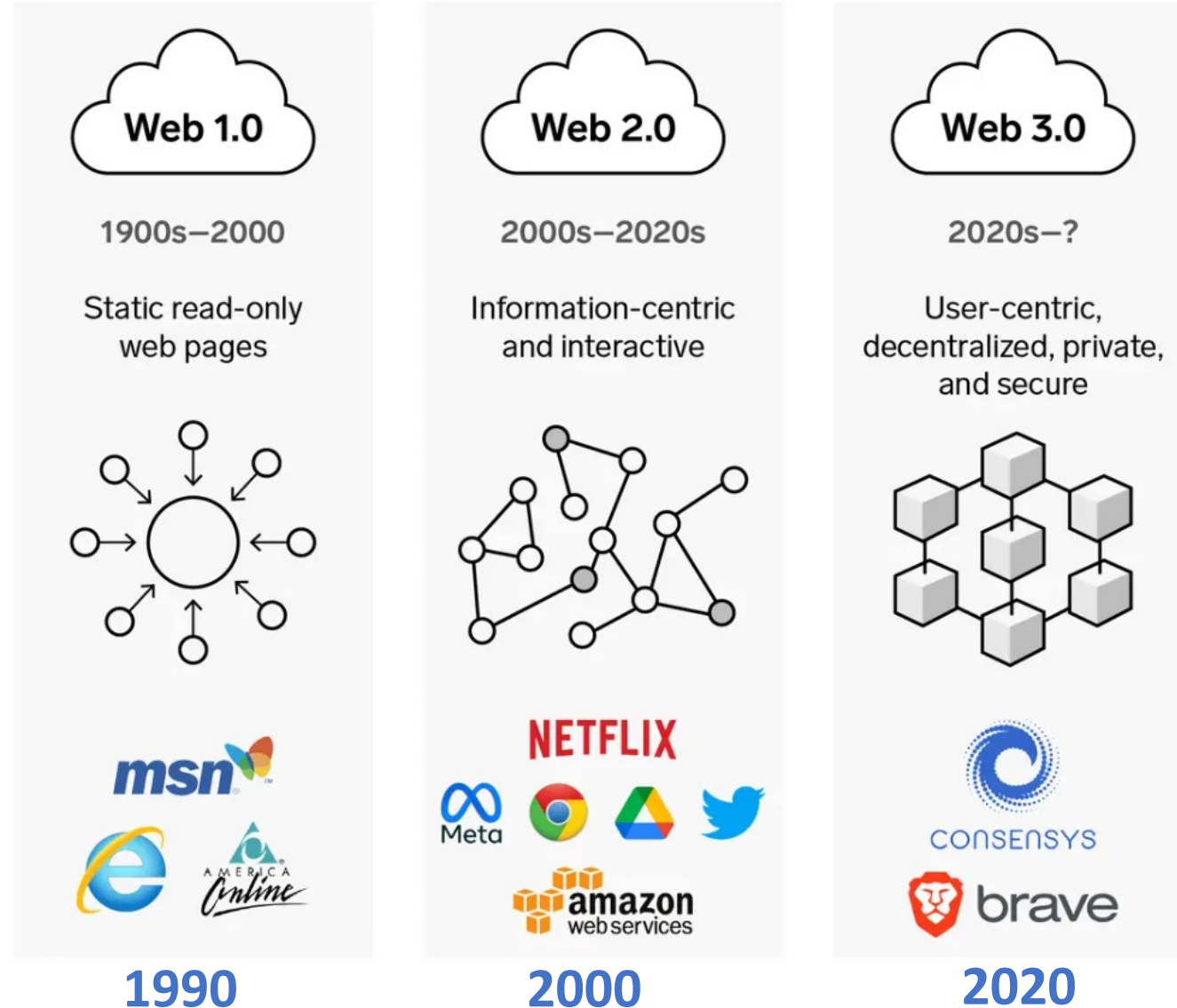


Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

"Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

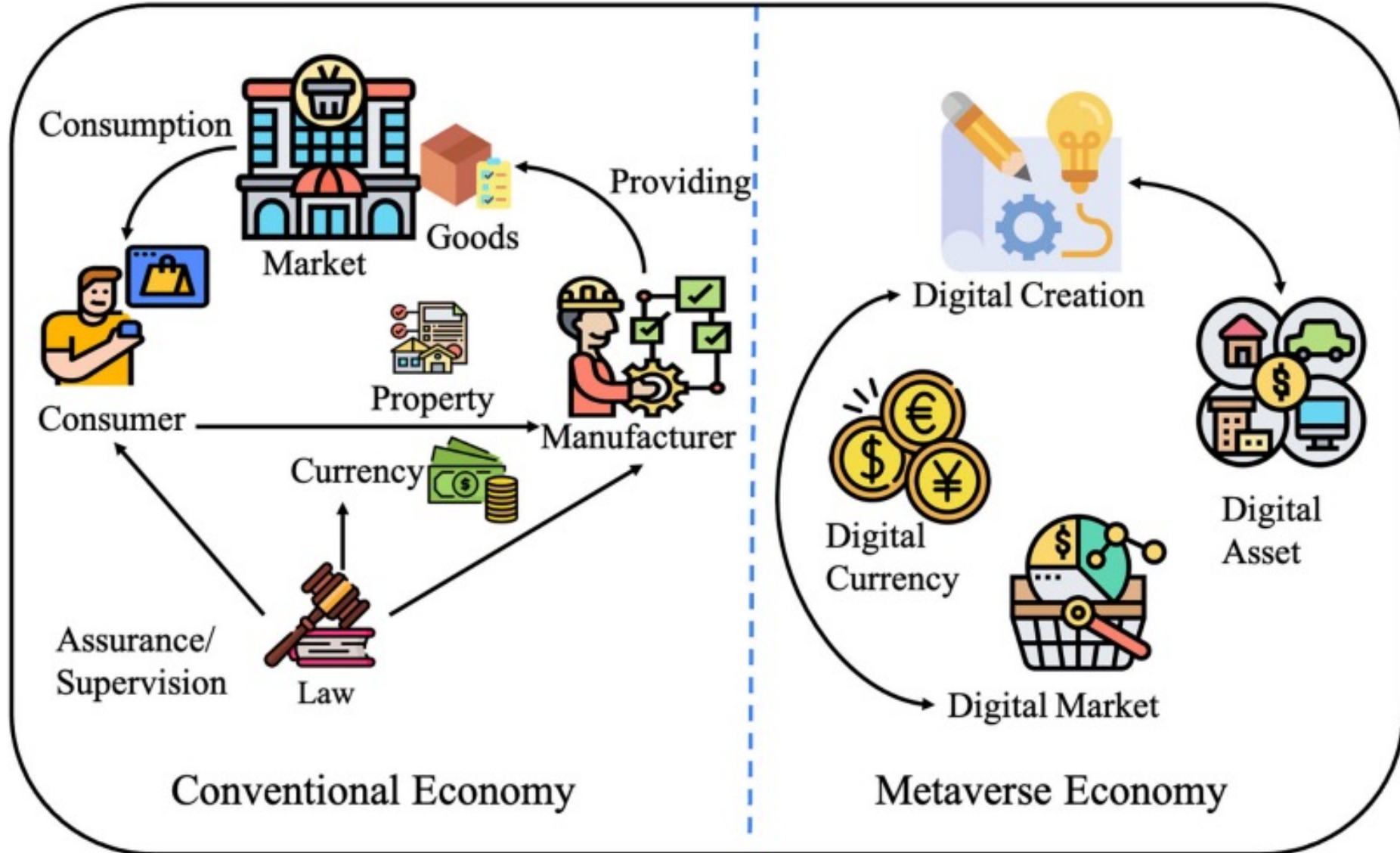
Web3: Decentralized Web

Internet Evolution

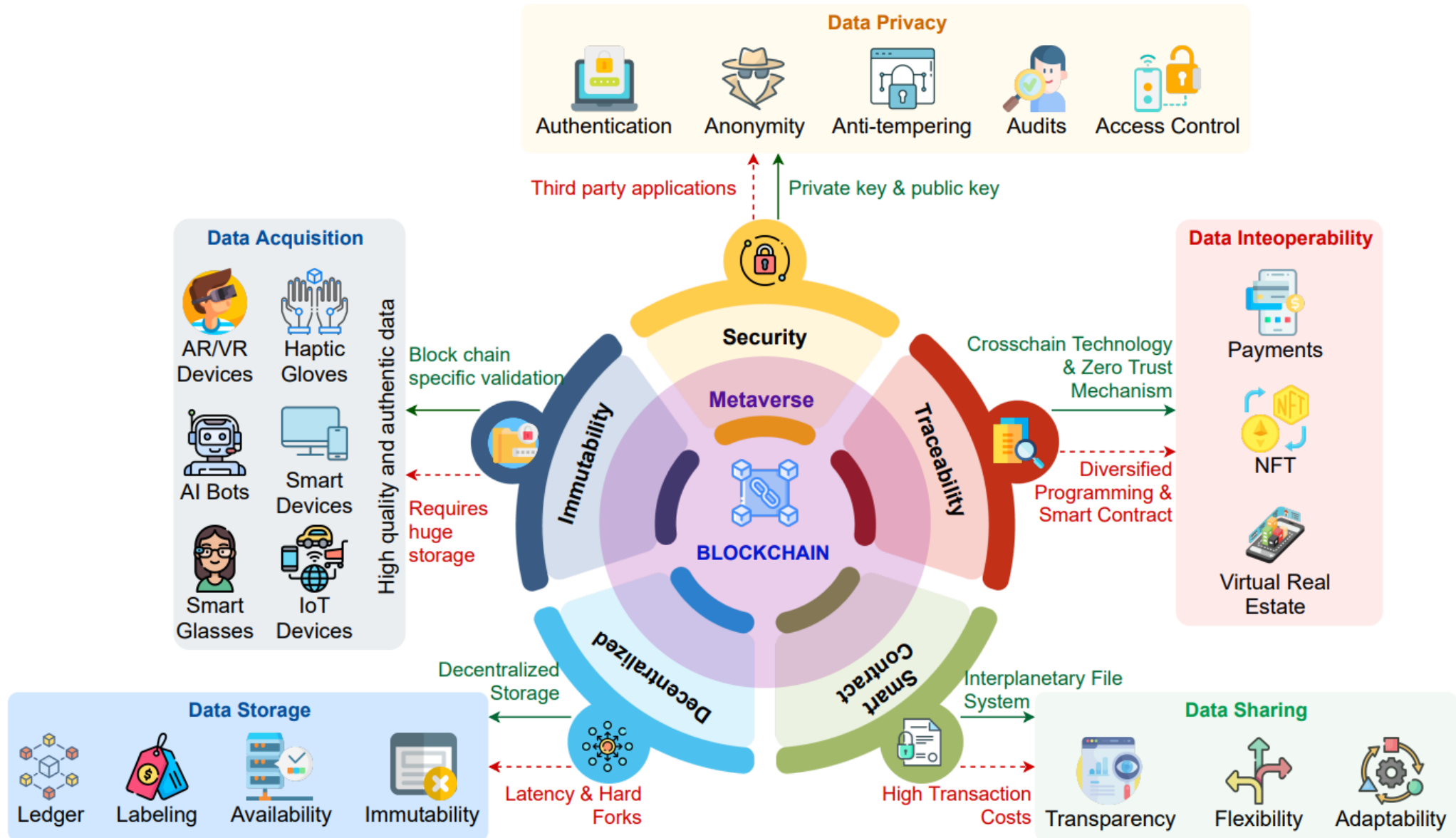


Source: <https://www.businessinsider.com/personal-finance/what-is-web3>

Metaverse Economy

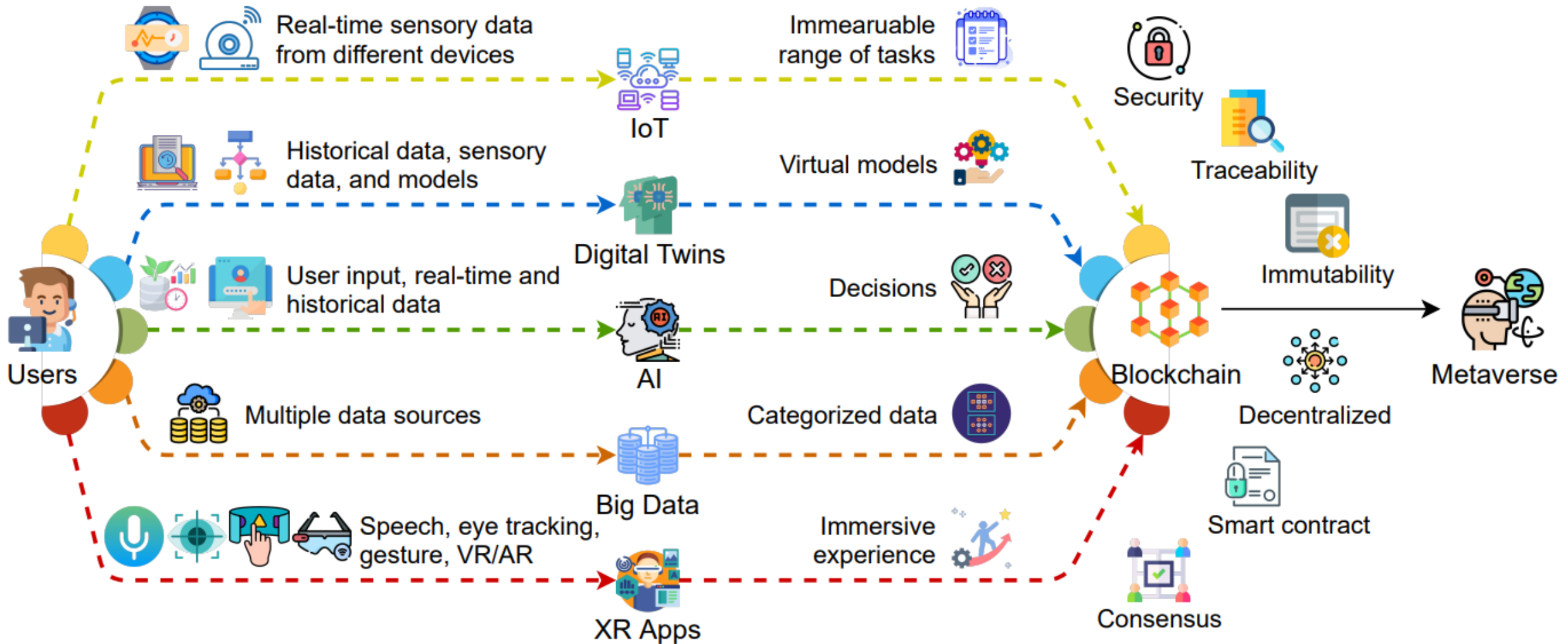


Blockchain in the Metaverse

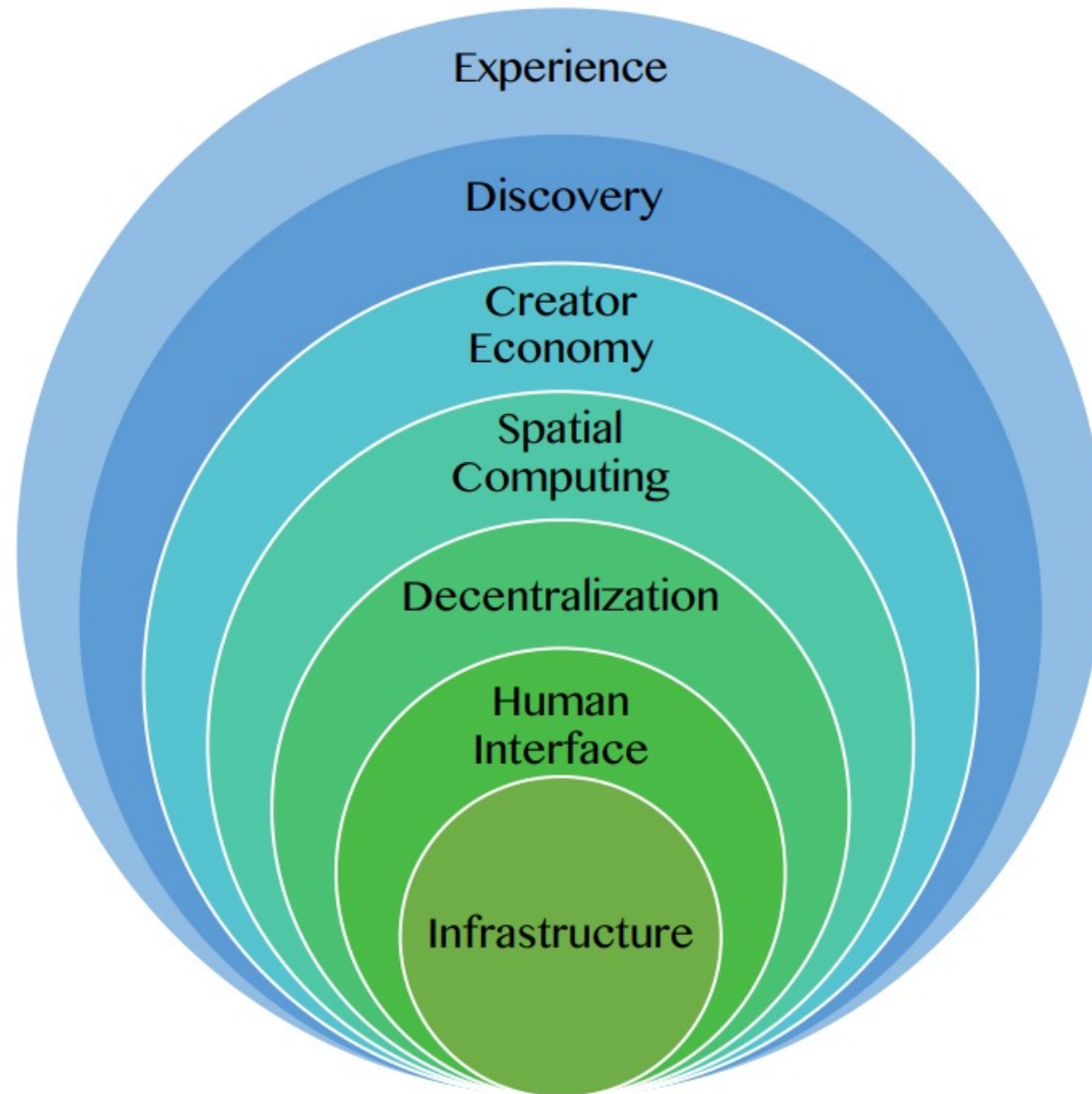


Blockchain

for Key Enabling Technologies of the Metaverse

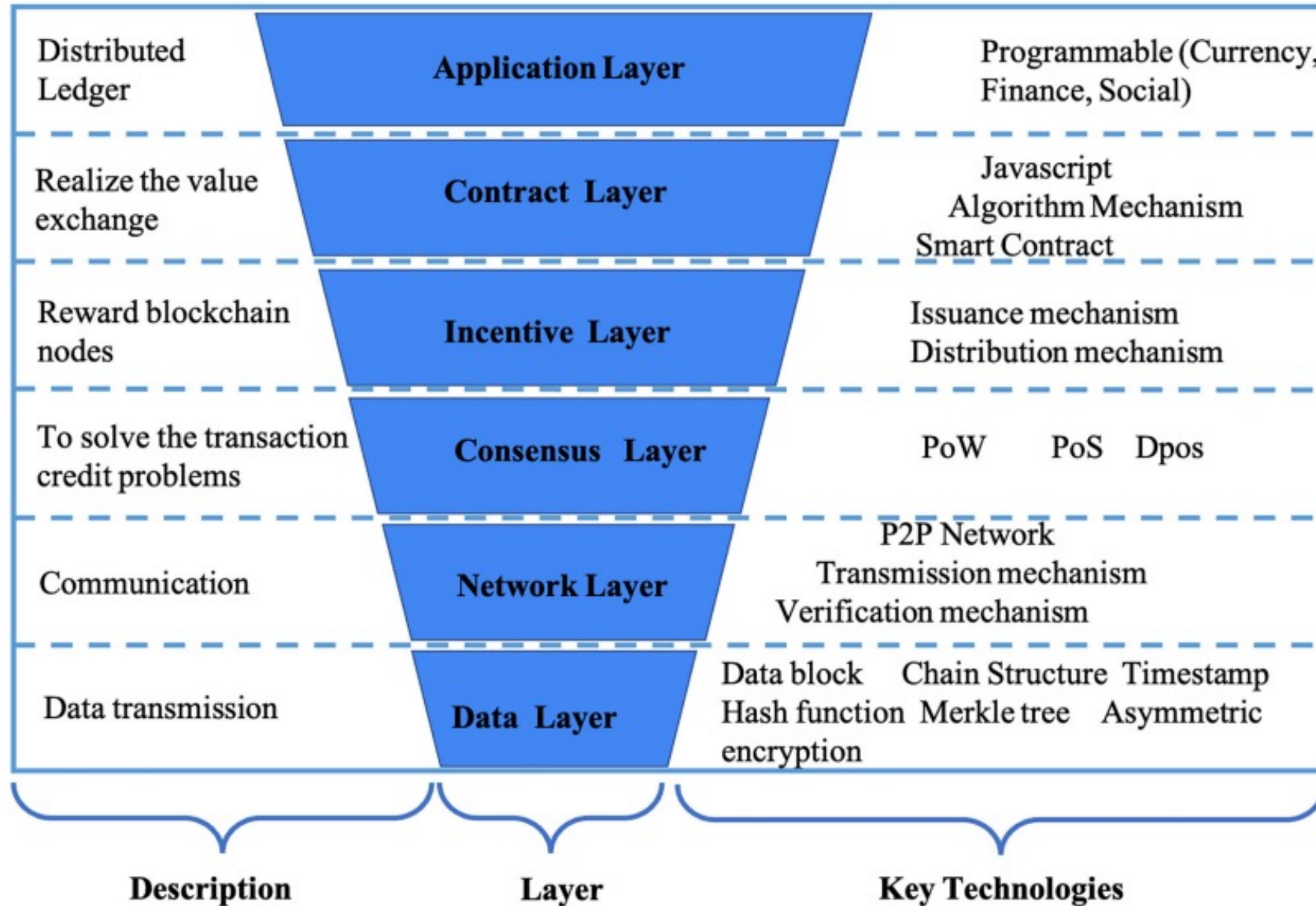


Seven Layers of a Metaverse Platform



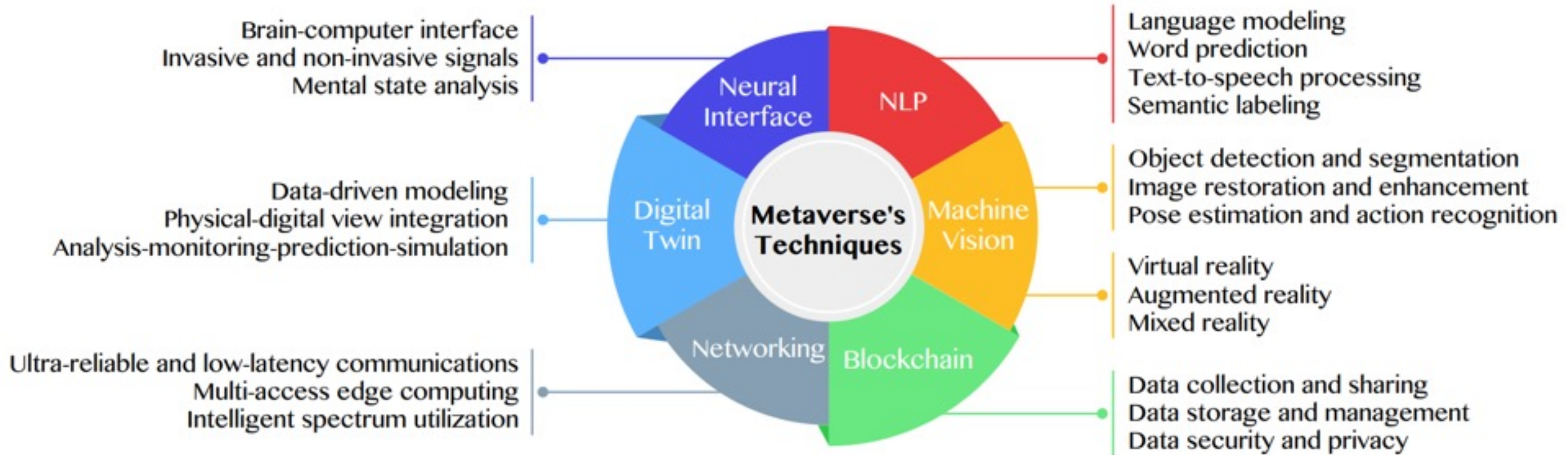
Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).
"Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

Layered Architecture of Blockchain



Primary Technical Aspects in the Metaverse

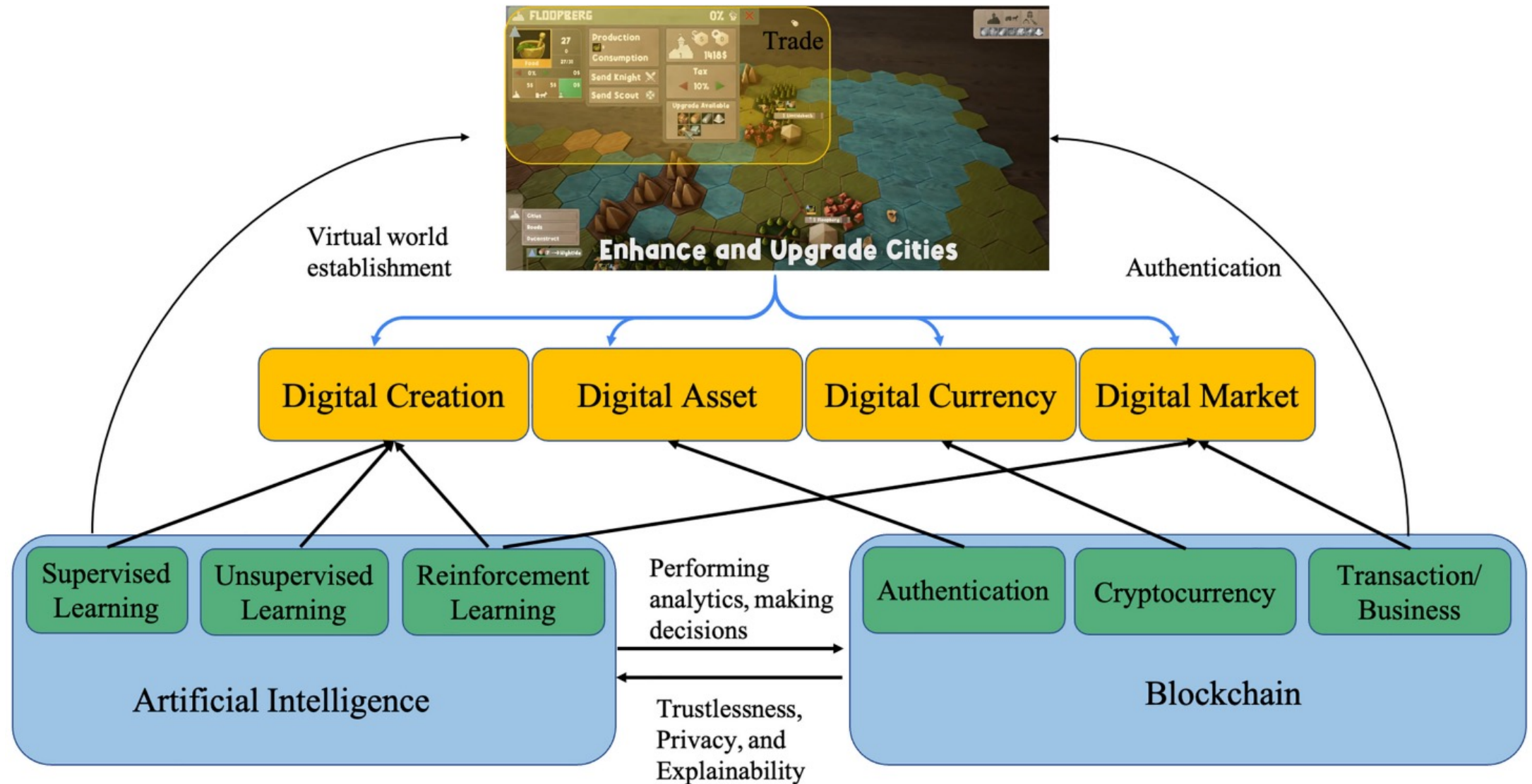
AI with ML algorithms and DL architectures
is advancing the user experience in the virtual world



Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

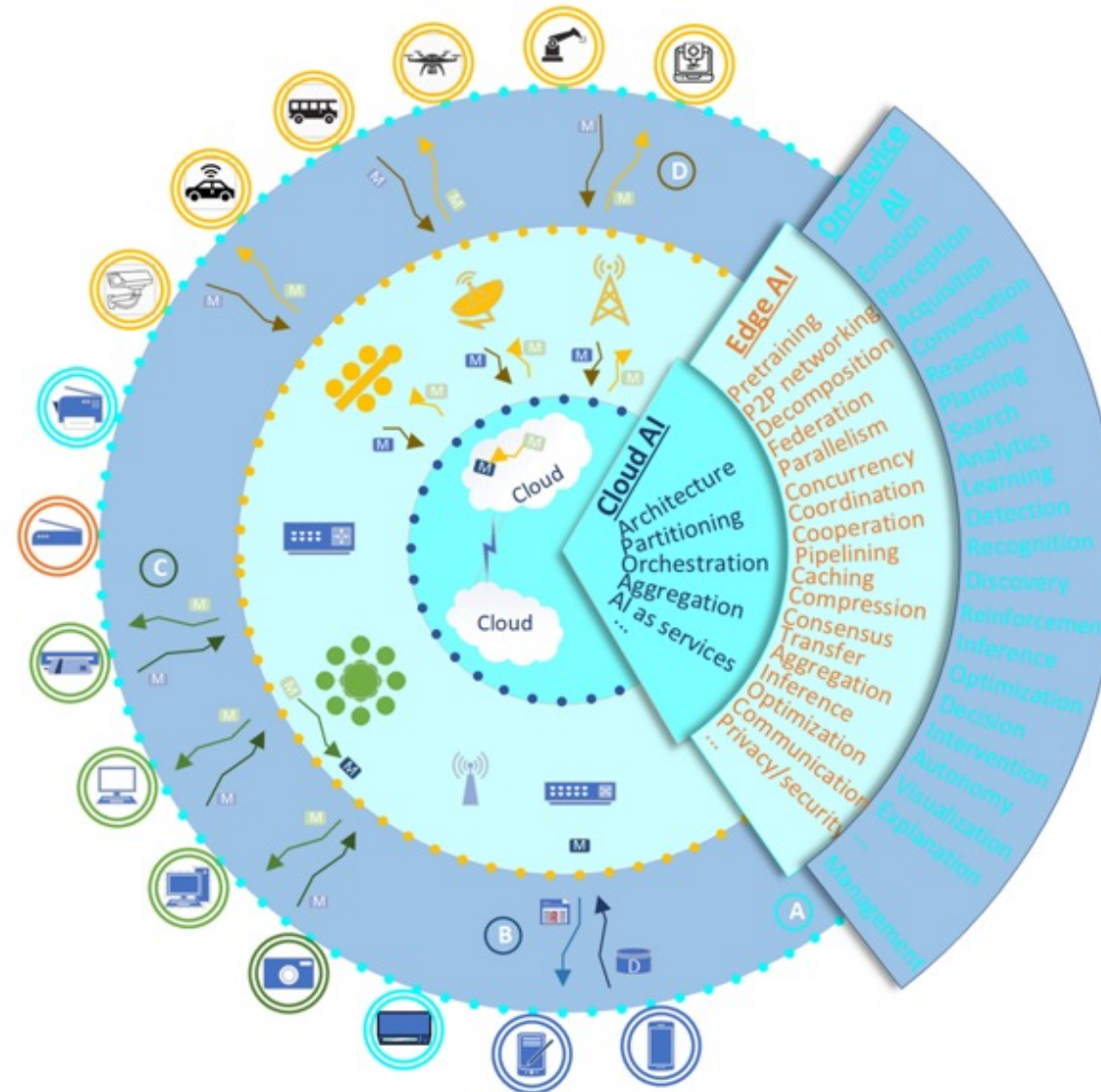
"Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

Fusion of AI and Blockchain in Metaverse



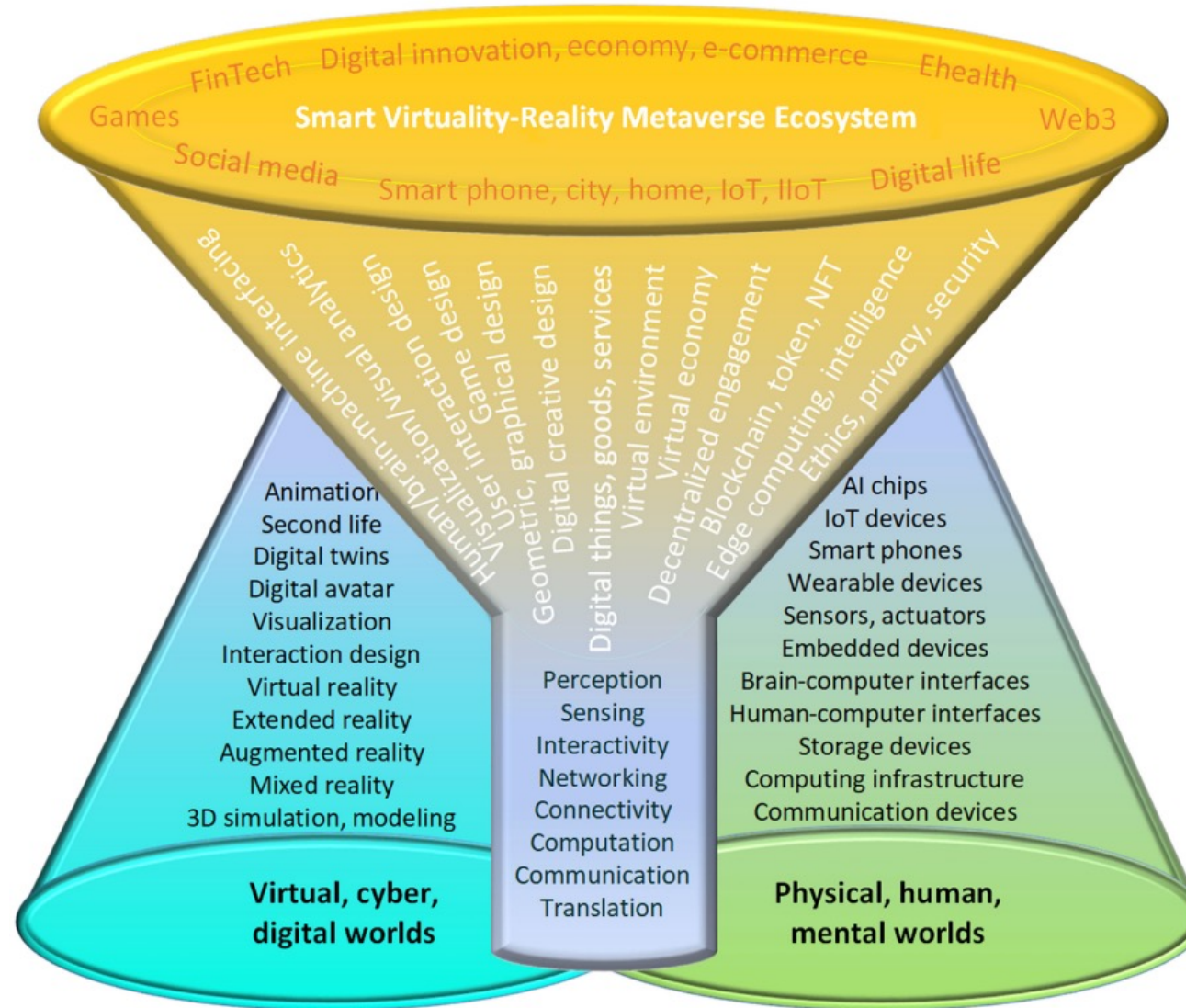
DeAI:

Synthesizing On-device AI, Edge AI, and Cloud AI



Smart Virtuality-Reality Metaverse Ecosystem:

Metasynthesizing DeAI, Metaverse, Blockchain, Web3



The difference between AR, MR, and VR under the umbrella of XR

XR

VR

MR

AR

Extended Reality

Entire experience spectrum from fully virtual to fully real



Virtual Reality

User is completely immersed into a virtual world



Mixed Reality

Environment aware
2D/3D content is overlaid onto the physical space



Augmented Reality

Non-environment aware
2D/3D content is overlaid onto the physical space

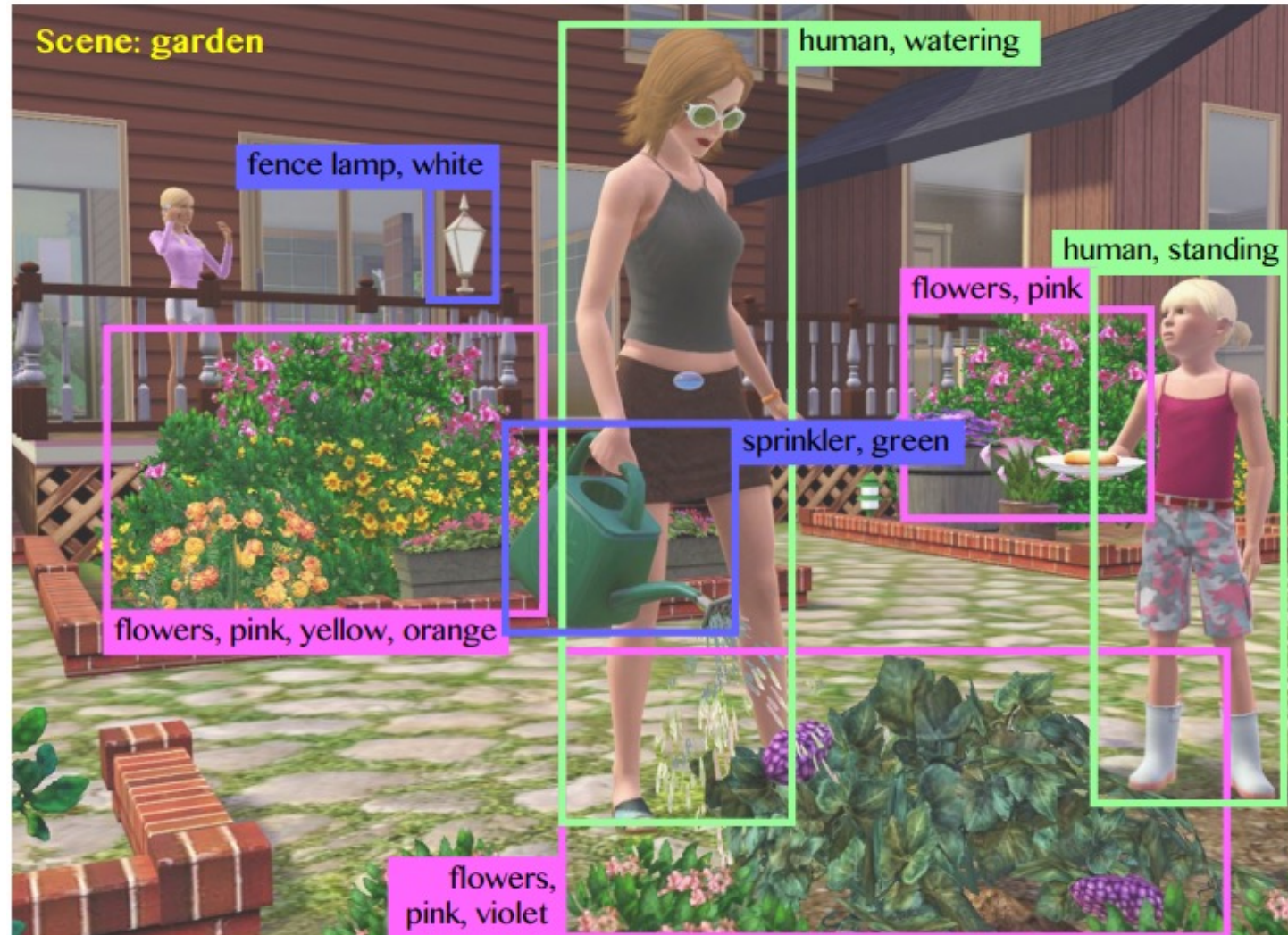


Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

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Computer vision in the metaverse

with scene understanding, object detection, and human action/activity recognition

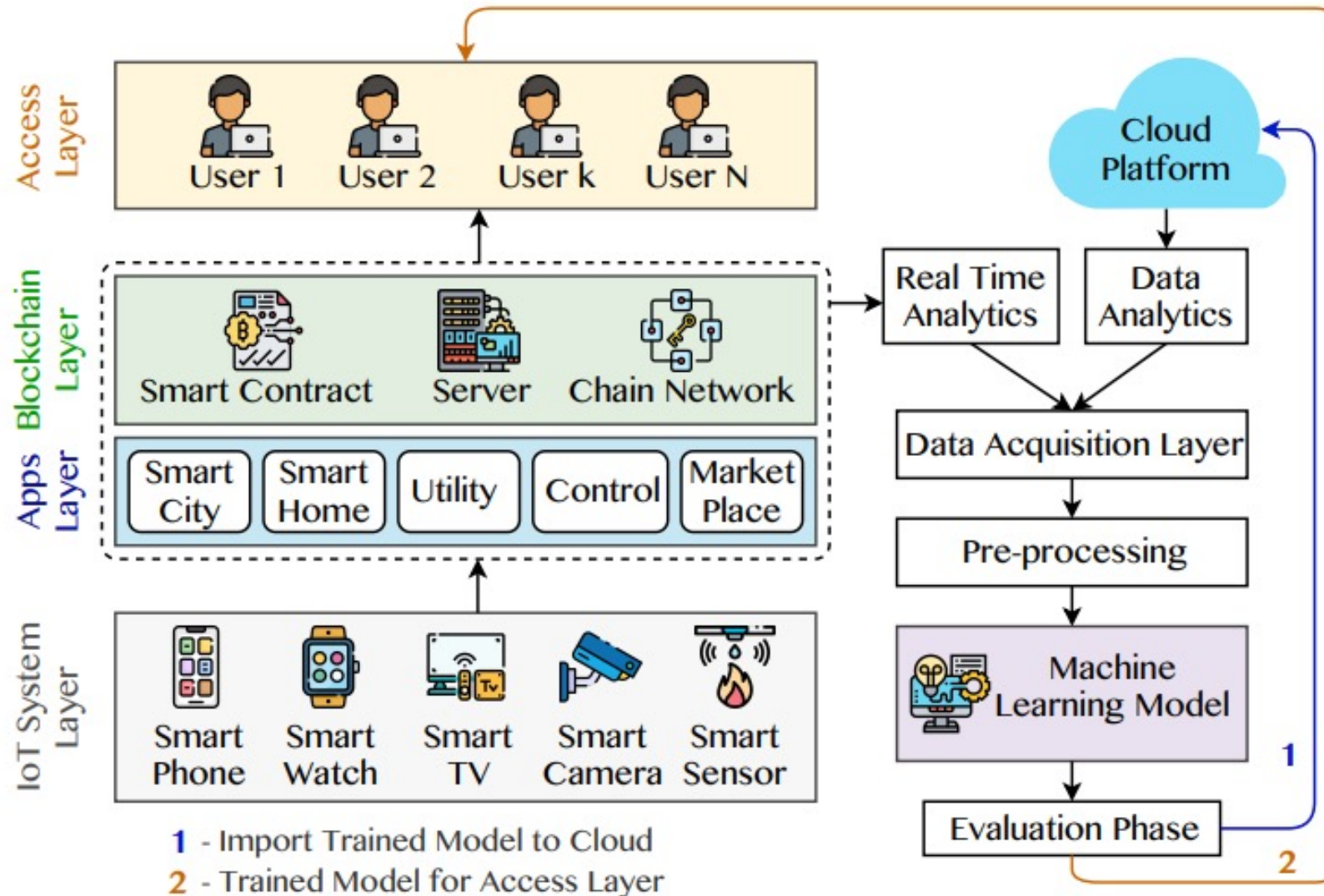


Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

"Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

A Blockchain-based IoT Framework

with ML to enhance security and privacy

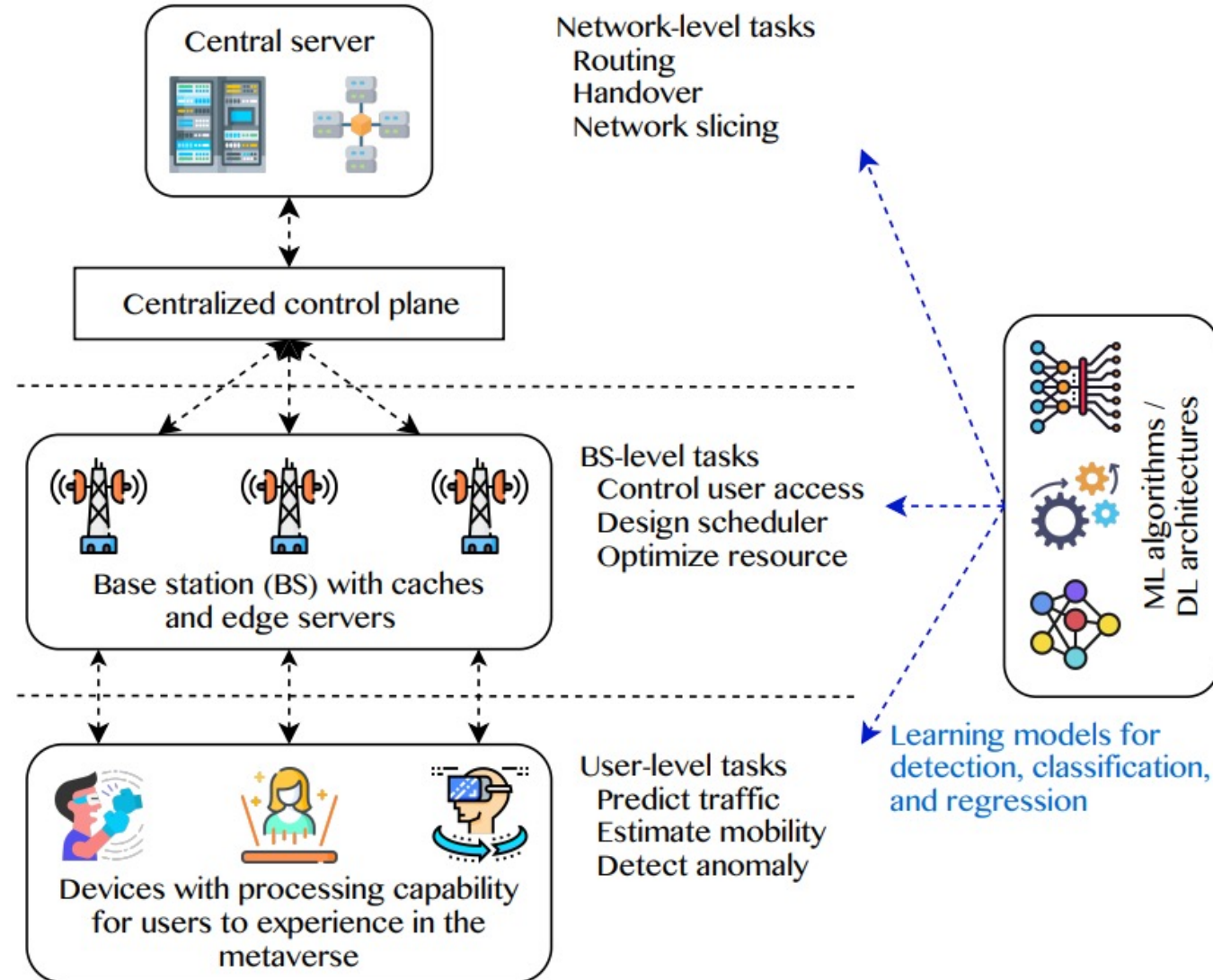


Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Qui Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

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5G and beyond for Metaverse Services

AI with ML algorithms and DL models contribute in multi-level tasks

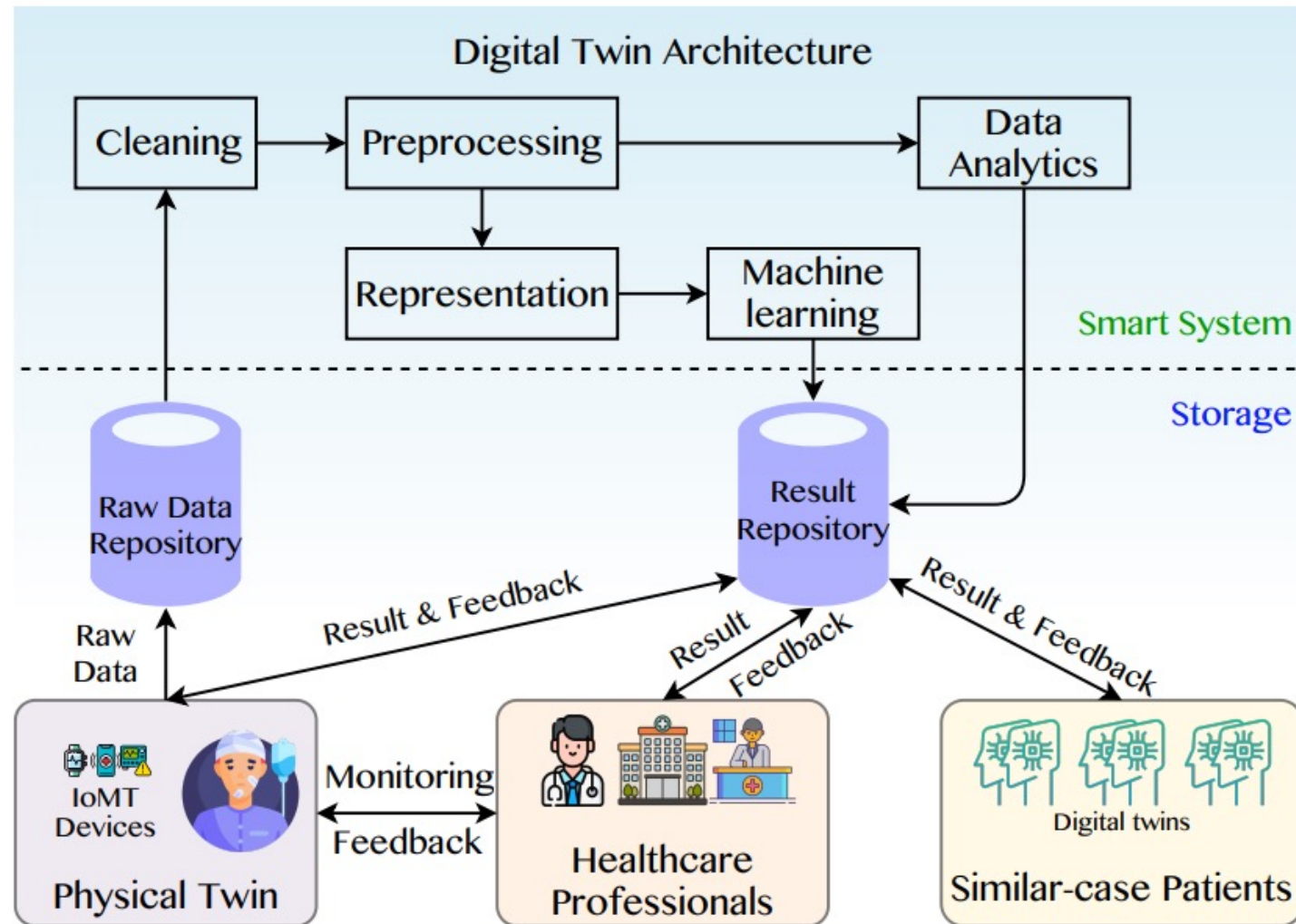


Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

"Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

A Data-Driven Digital Twin Architecture

for intelligent healthcare systems using ML to process raw data of IoMedicalThings devices

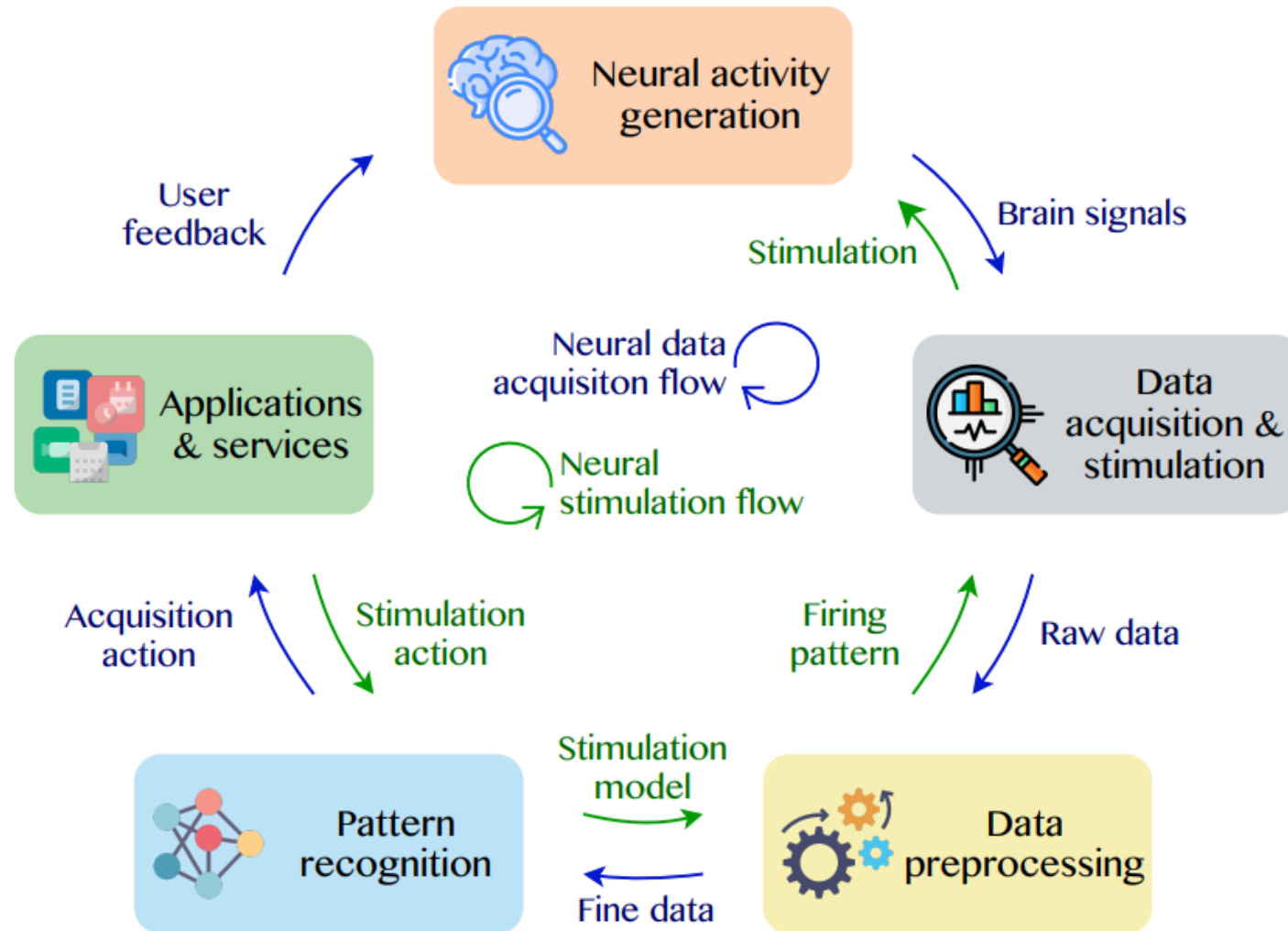


Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

"Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

Brain-Machine Interfaces (BMIs)

for processing neural signals and responding neural stimulations



Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

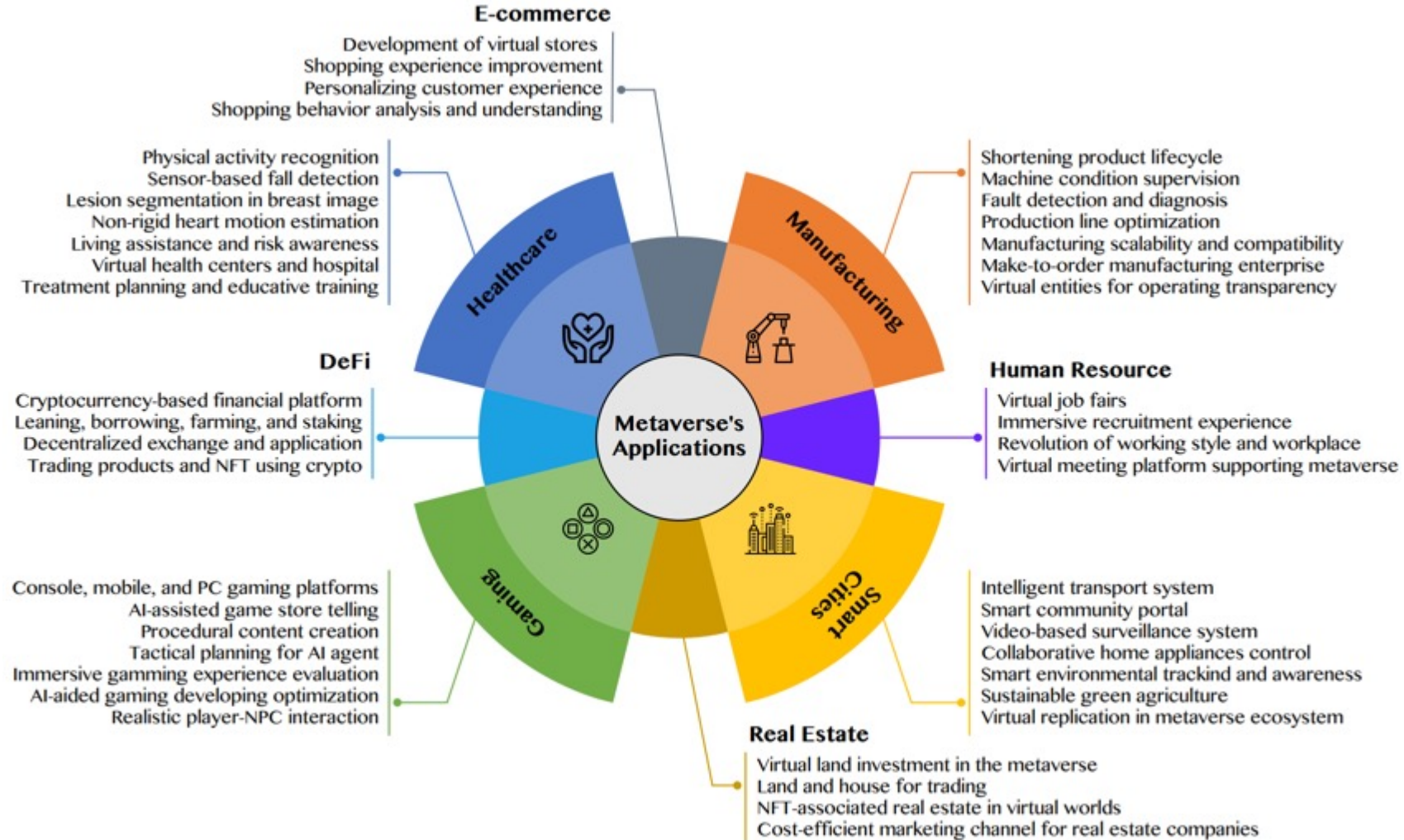
"Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

AI for the Metaverse

Technical Aspect	Ref	Task	AI Technique
NLP	[20]	Word and linguistic prediction for language modeling.	RNNs and LSTM networks with the attention mechanisms.
	[21]		Advanced memory network with residual connection.
	[24]		Deep networks with gated connection and bi-directional structure.
	[25]	Analyzing and understand the representation of words from characters	General deep networks with CNN and LSTM architectures.
	[27]	Identifying prefixes and suffixes and detecting misspelled words	DL framework with CNN, Bi-LSTM, and conditional random field.
	[29]	Sentiment prediction and question type classification.	Various CNNs and LSTM networks with simple structures and advanced-designed architectures.
	[31]	Generate short text in image captioning and long text in virtual question answer.	DL framework with single RNN/LSTM and mixture LSTM-CNN models.
	[32]	Semantic labeling, context retrieval, and language interpretation.	Unsupervised and reinforcement learning with common RNN/LSTM and CNN models.

AI for the Metaverse in the Application Aspects

healthcare, manufacturing, smart cities, gaming
E-commerce, human resources, real estate, and DeFi

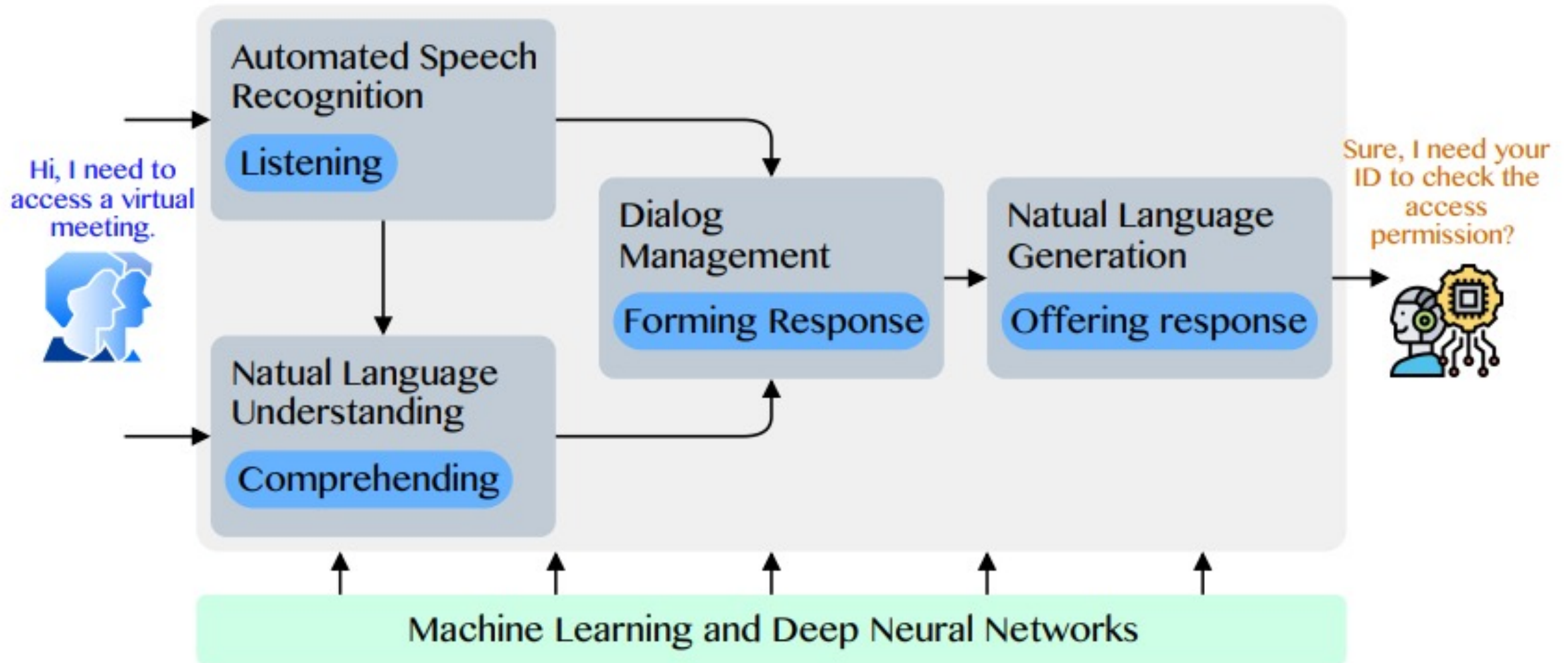


Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

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Conversational AI

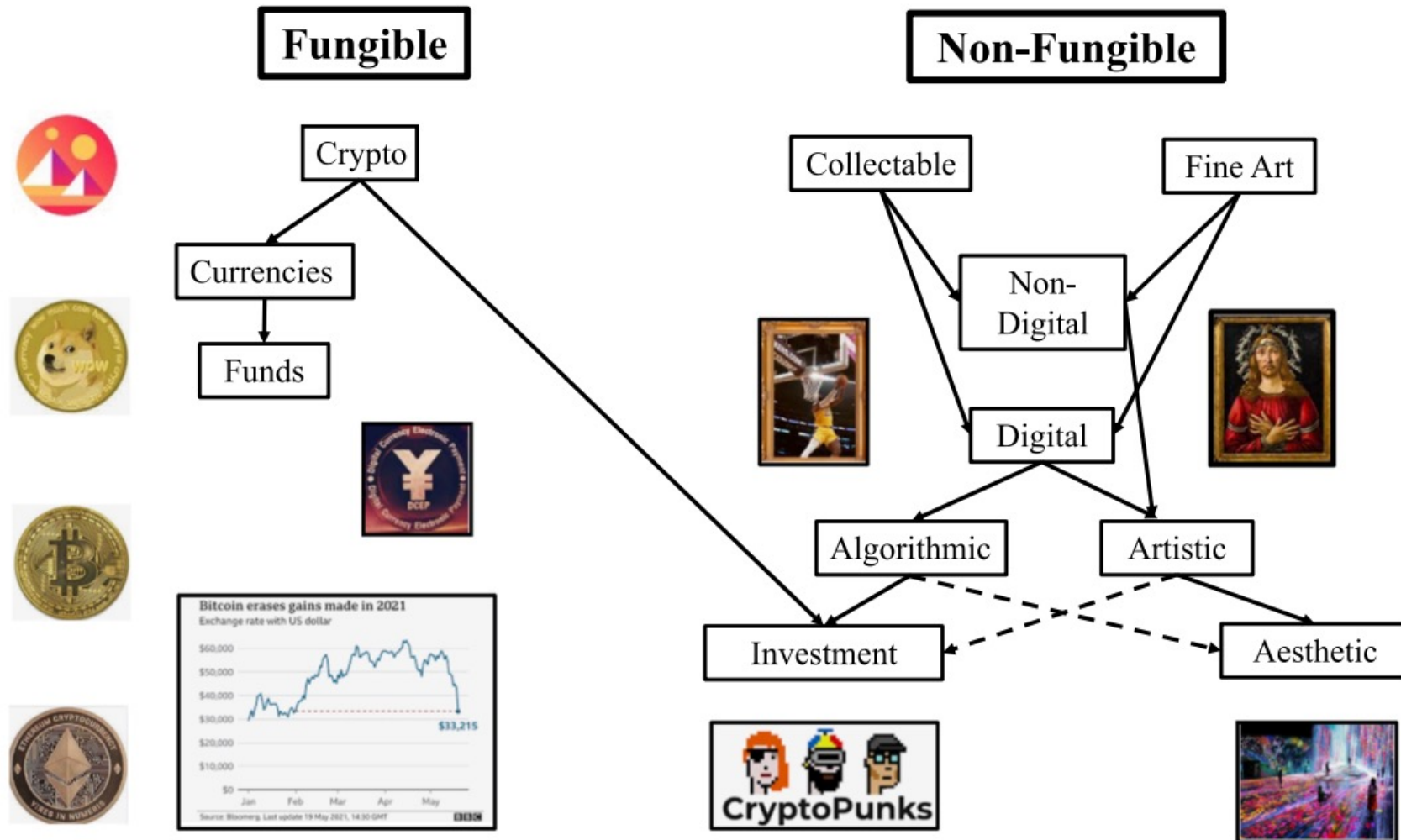
to deliver contextual and personal experience to users



Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Quy Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022).

"Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

Blockchain-Registered: Crypto, Collectables, and Art.



Source: Belk, Russell, Mariam Humayun, and Myriam Brouard. (2022)

"Money, possessions, and ownership in the Metaverse: NFTs, cryptocurrencies, Web3 and Wild Markets." Journal of Business Research 153: 198-205.

Full Versus Fractional [NFT]

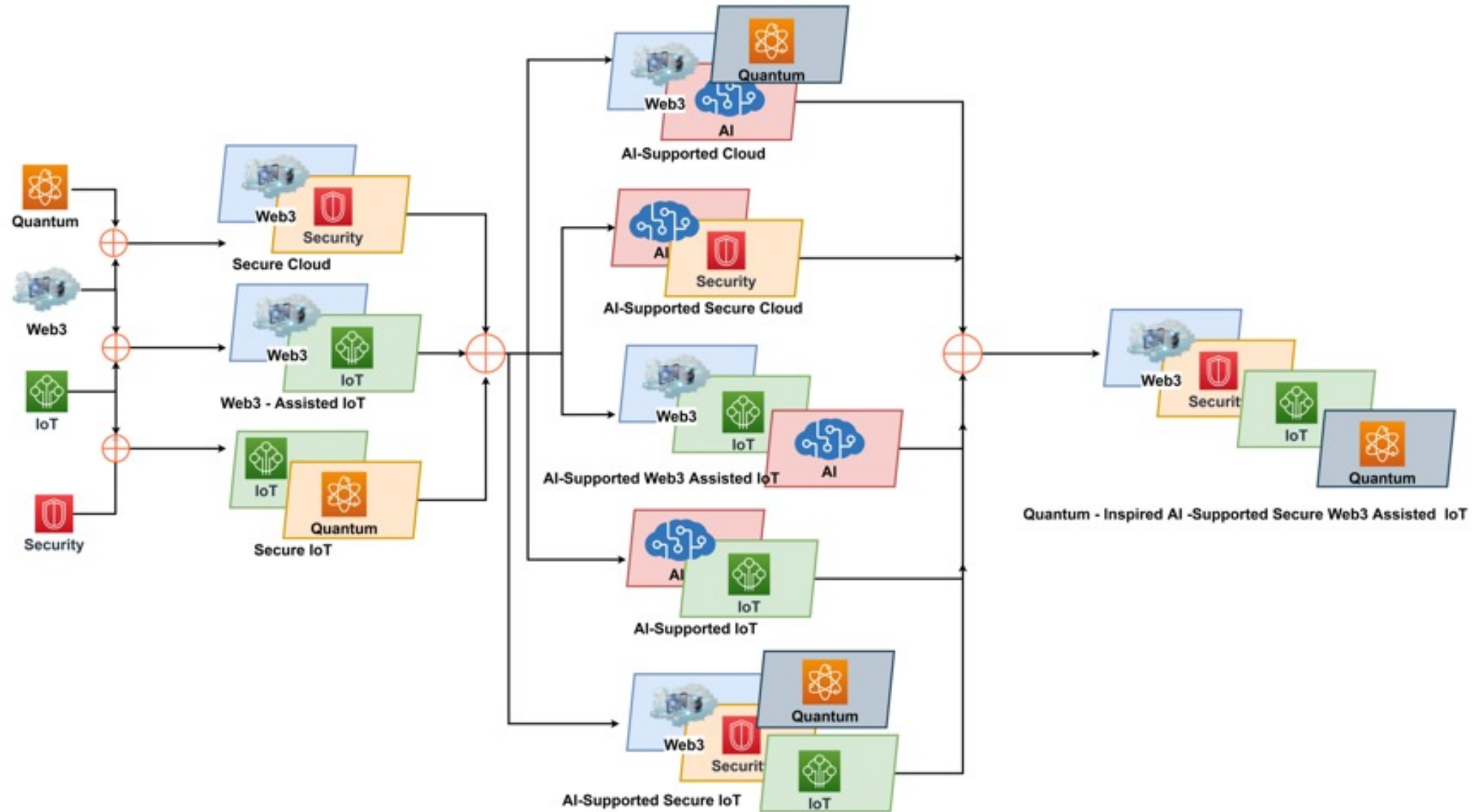
Property Ownership Rights for an Artwork

RIGHTS	Full Ownership	NFT (Fractional Ownership)
Use	Yes	Yes
Sell or dispose of	Yes	Yes
Manipulate or modify	Yes	No
Exclude Others	Yes	No
Copyright	No	No
Intellectual property	No	Possibly with some NFTs
Income from	Yes	Mostly no
Artist Resale (% for artist)	No	Possibly yes

Source: Belk, Russell, Mariam Humayun, and Myriam Brouard. (2022)

"Money, possessions, and ownership in the Metaverse: NFTs, cryptocurrencies, Web3 and Wild Markets." Journal of Business Research 153: 198-205.

Combination of Web3 with other Technologies



Source: Sheridan, Dan, James Harris, Frank Wear, Jerry Cowell Jr, Easton Wong, and Abbas Yazdinejad. (2022)

"Web3 Challenges and Opportunities for the Market." arXiv preprint arXiv:2209.02446.

Decentralized Finance (DeFi)

Block Chain FinTech

Decentralized Finance (DeFi)

- A **global, open alternative** to the current **financial system**.
- Products that let you **borrow, save, invest, trade**, and more.
- Based on **open-source technology** that anyone can program with.

Traditional Finance

Centralized Finance (CeFi)

- **Some people aren't granted access to set up a bank account or use financial services.**
- **Lack of access to financial services can prevent people from being employable.**
- **Financial services can block you from getting paid.**
- **A hidden charge of financial services is your personal data.**
- **Governments and centralized institutions can close down markets at will.**
- **Trading hours often limited to business hours of specific time zone.**
- **Money transfers can take days due to internal human processes.**
- **There's a premium to financial services because intermediary institutions need their cut.**

DeFi vs. CeFi

Decentralized Finance (DeFi)

You hold your money.

You control where your money goes and how it's spent.

Transfers of funds happen in minutes.

Transaction activity is pseudonymous.

DeFi is open to anyone.

The markets are always open.

It's built on transparency – anyone can look at a product's data and inspect how the system works.

Traditional Finance (Centralized Finance; CeFi)

Your money is held by companies.

You have to trust companies not to mismanage your money, like lend to risky borrowers.

Payments can take days due to manual processes.

Financial activity is tightly coupled with your identity.

You must apply to use financial services.

Markets close because employees need breaks.

Financial institutions are closed books: you can't ask to see their loan history, a record of their managed assets, and so on.

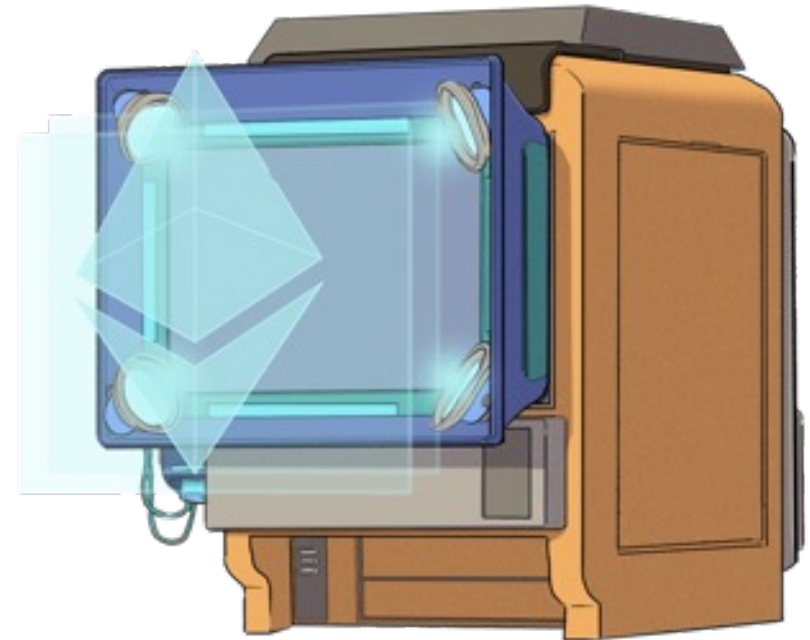
(DeFi)

Decentralized Applications (Dapps)

- **Ethereum-powered tools and services**
- **Dapps are a growing movement of applications that use Ethereum to disrupt business models or invent new ones**

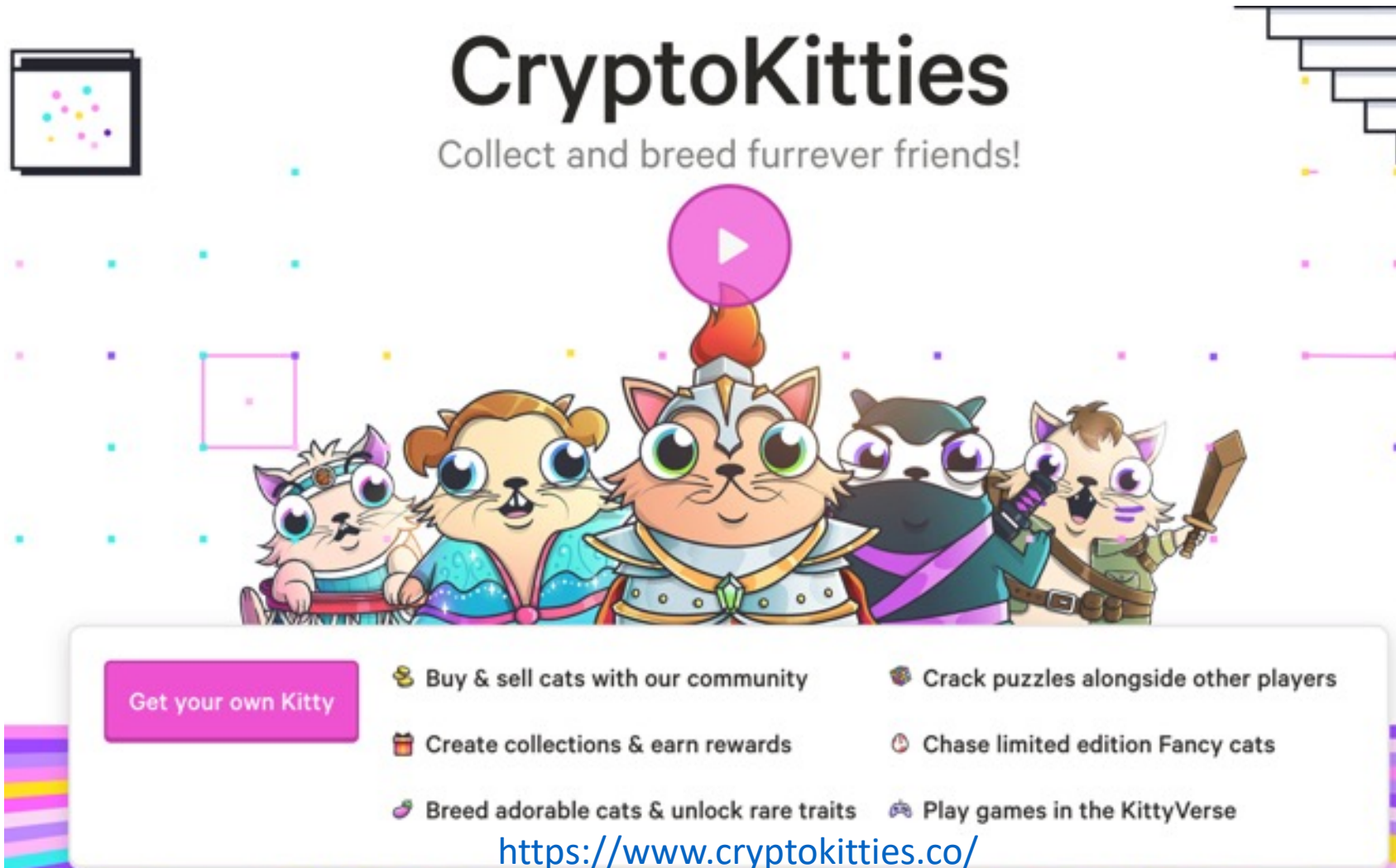
The Internet of Assets

- **Ethereum** isn't just for **digital money**.
- Anything you can own can be **represented, traded and put to use** as **non-fungible tokens (NFTs)**.



Non-Fungible Tokens (NFT)

CryptoKitties



Source: Matt Fortnow and QuHarrison Terry (2021), The NFT Handbook - How to Create, Sell and Buy Non-Fungible Tokens, Wiley

Financial Stability Challenges

Crypto Ecosystem

- **Operational, cyber, and governance risks**
- **Integrity (market and AML/CFT)**
(Anti-Money Laundering / Combating the Financing of Terrorism)
- **Data availability / reliability**
- **Challenges from cross-border activities**

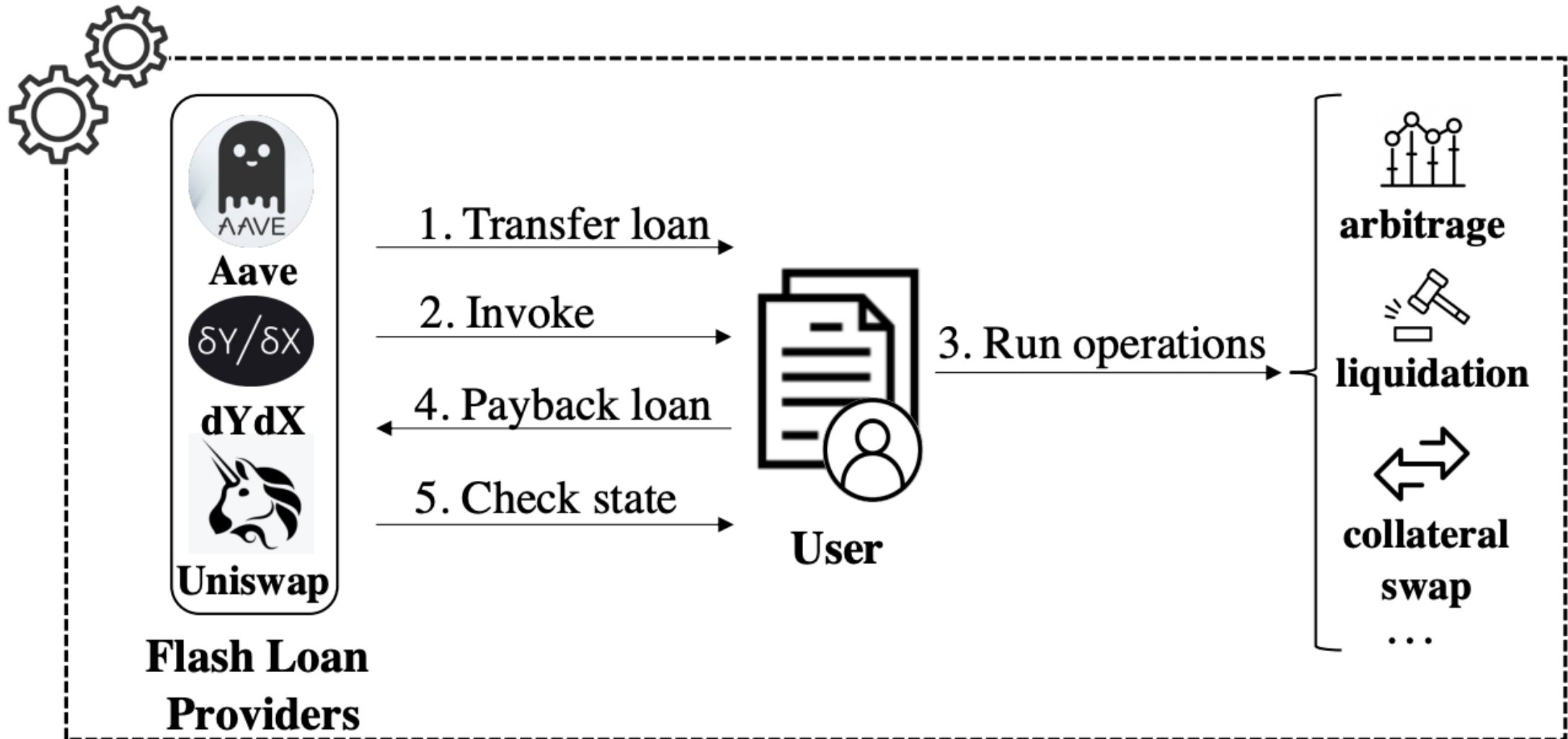
Stablecoins

- **How stable are stablecoins?**
- **Domestic and global regulatory and supervisory approaches**

Macro-Financial

- **Cryptoization, capital flows, and restrictions**
- **Monetary policy transmission**
- **Bank disintermediation**

Decentralized Finance Applications (DApps): Flash Loan Transaction

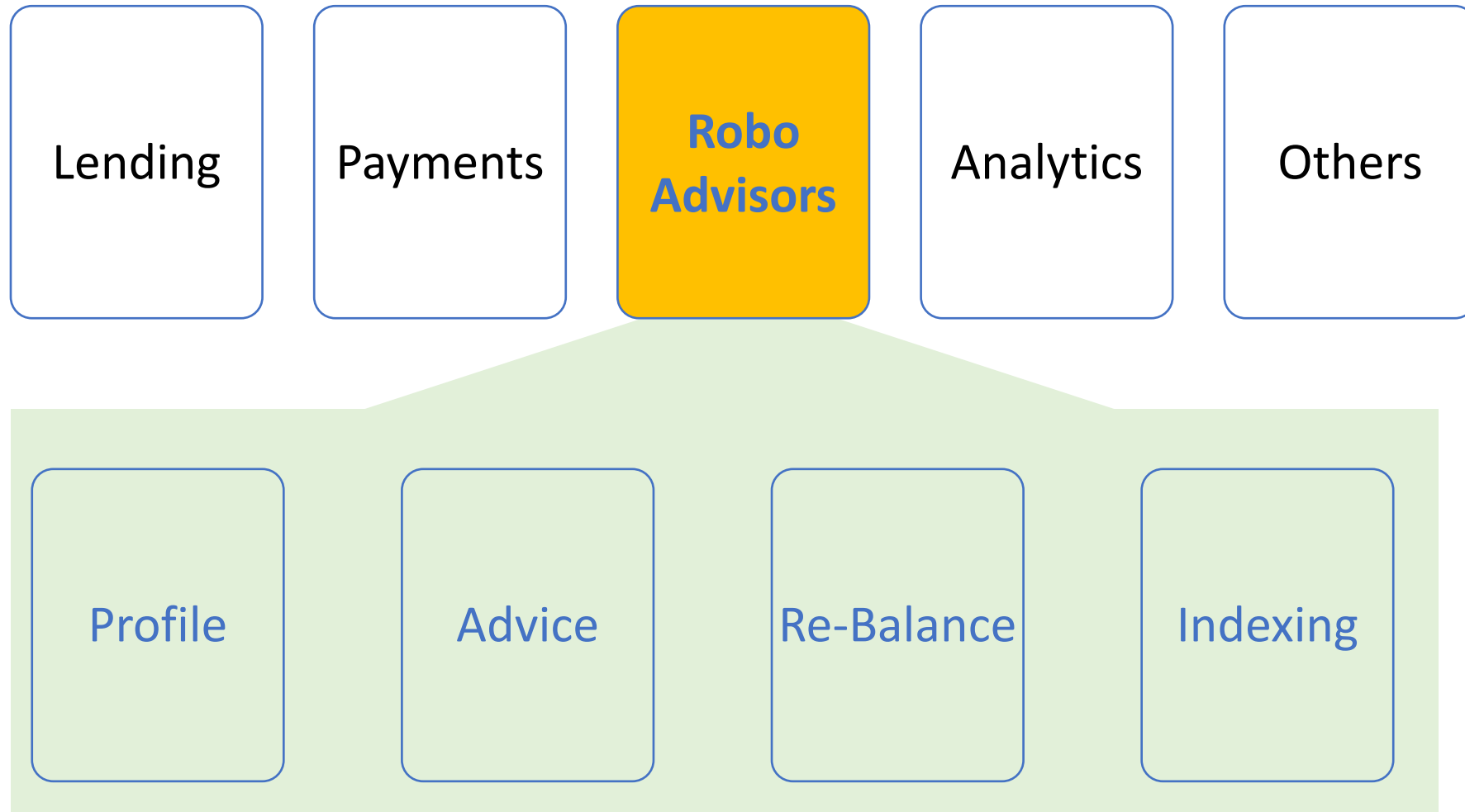


Financial Services

Technology Innovation

FinTech Innovation

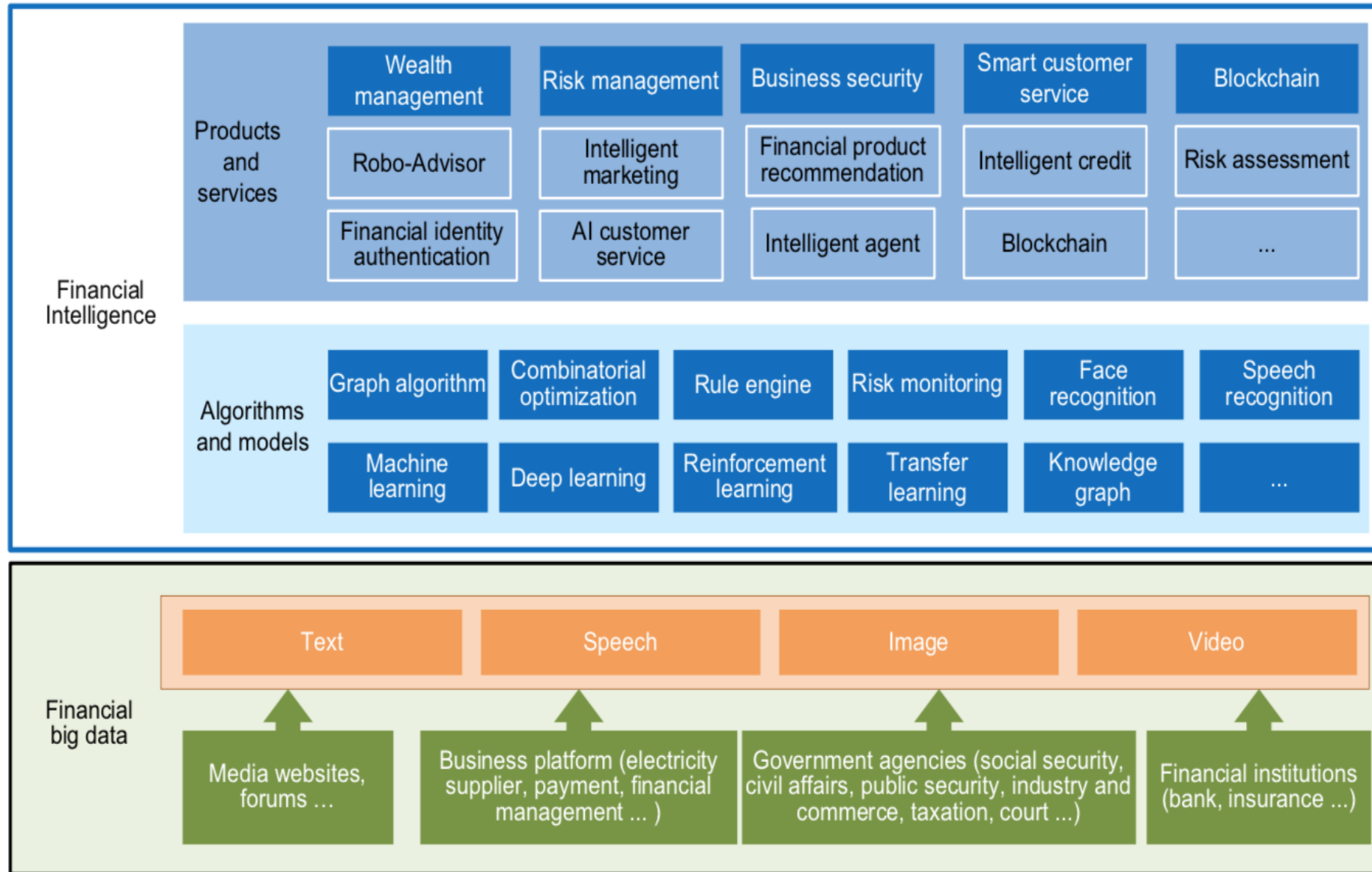
FinTech high-level classification



Technology-driven Financial Industry Development

FinBrain: when Finance meets AI 2.0

(Zheng et al., 2019)



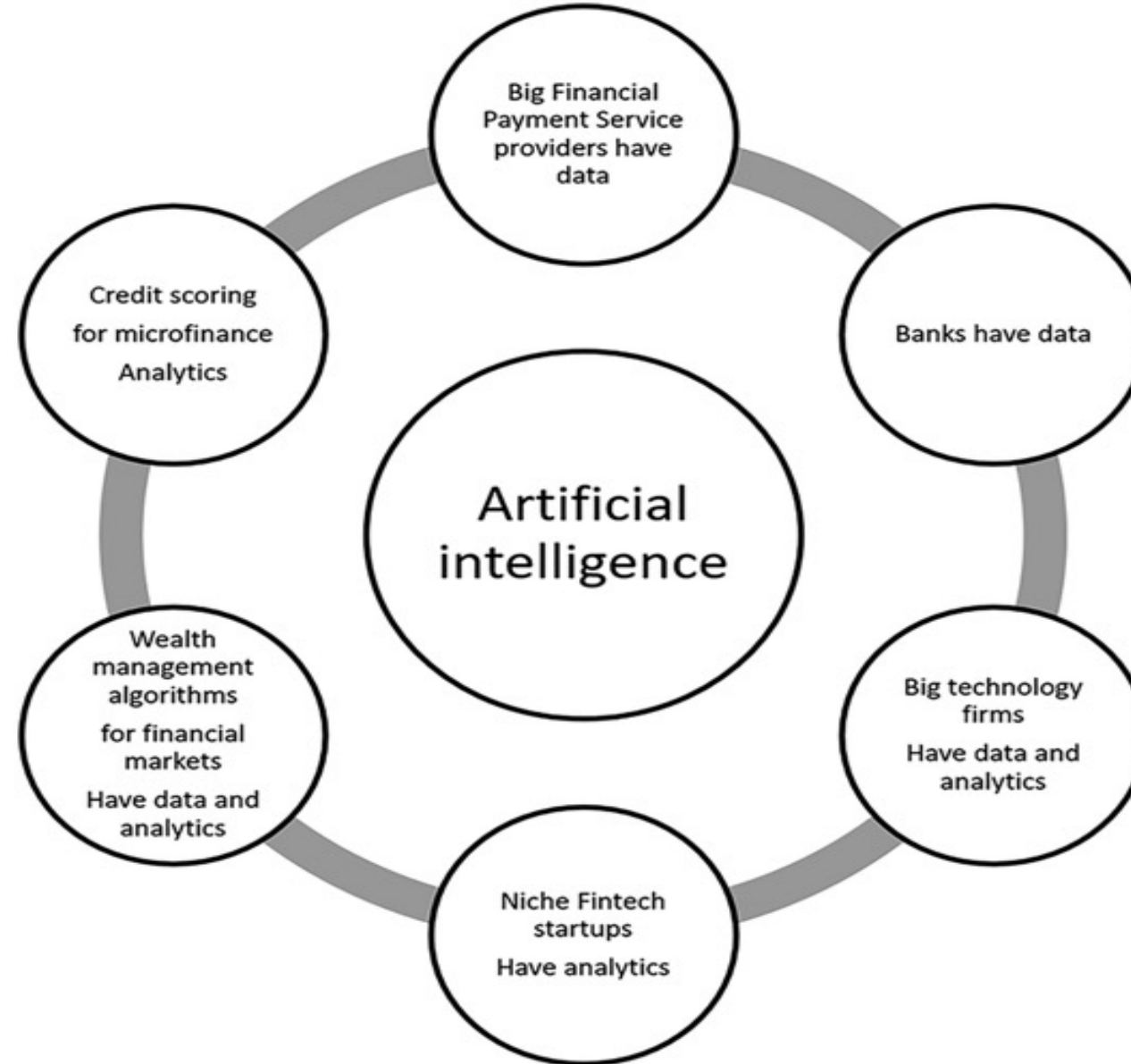
AI 2.0

**a new generation of AI
based on the
novel information environment of
major changes and
the development of
new goals.**

Technology-driven Financial Industry Development

Development stage	Driving technology	Main landscape	Inclusive finance	Relationship between technology and finance
Fintech 1.0 (financial IT)	Computer	Credit card, ATM, and CRMS	Low	Technology as a tool
Fintech 2.0 (Internet finance)	Mobile Internet	Marketplace lending, third-party payment, crowdfunding, and Internet insurance	Medium	Technology-driven change
Fintech 3.0 (financial intelligence)	AI, Big Data, Cloud Computing, Blockchain	Intelligent finance	High	Deep fusion

Artificial Intelligence in the Financial Markets



AI in Managerial Blind Spots: Unknown Knowns and Unknown Unknowns

		Do I know?	
		Yes	No
Do I know whether I know?	Yes	ERP, CRM, MIS, Transaction Processing Systems	Data Science & Business Intelligence
	No	Data Mining & Supervised Machine Learning	Big Data & Unsupervised Machine Learning

Green Finance

Sustainability

SDGs

CSR

ESG

Sustainable Development Goals (SDGs)



Source: <https://sdgs.un.org/goals>

Sustainable Development Goals (SDGs) and 5P

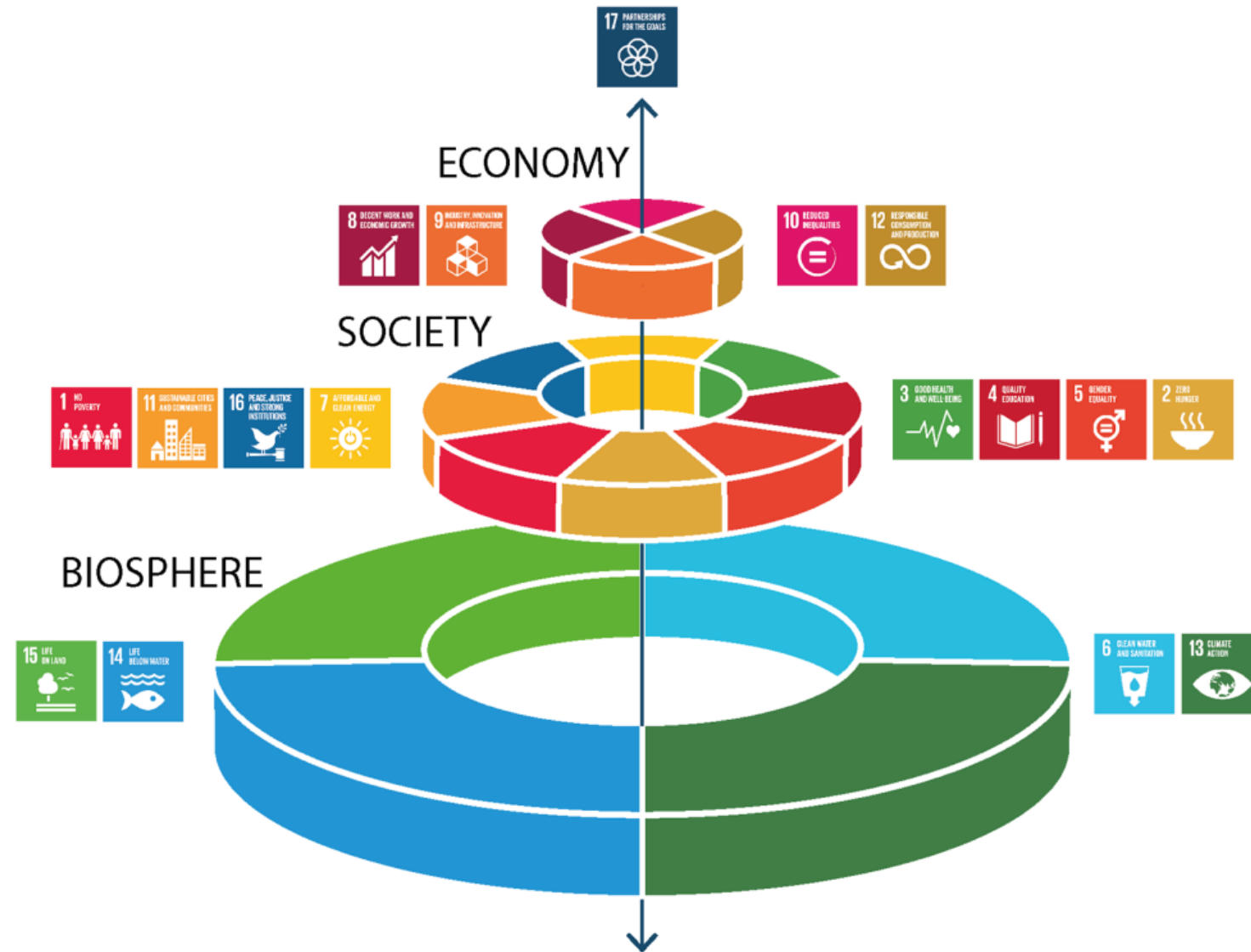
Partnership

Peace

Prosperity

People

Planet



Green Finance

Generic term

implying use or diversion

of financial resources

to deploy and support projects

with long term positive impact

on the environment

Sustainable Finance

Finances

**deployed in support of projects
that ensure just, sustainable and
inclusive growth
or attainment of one or more
sustainable development goals**

Carbon Finance

Financial instruments
based on

economic value of carbon emissions

which an organization cannot avoid but which
it offsets by funding other compensatory projects
that contribute to **carbon emissions reduction**

Climate Finance

Finances deployed
in support of low carbon and
climate resilient projects
that help in **climate change mitigation** and
adaptation efforts,
particularly in the
energy and infrastructure sectors

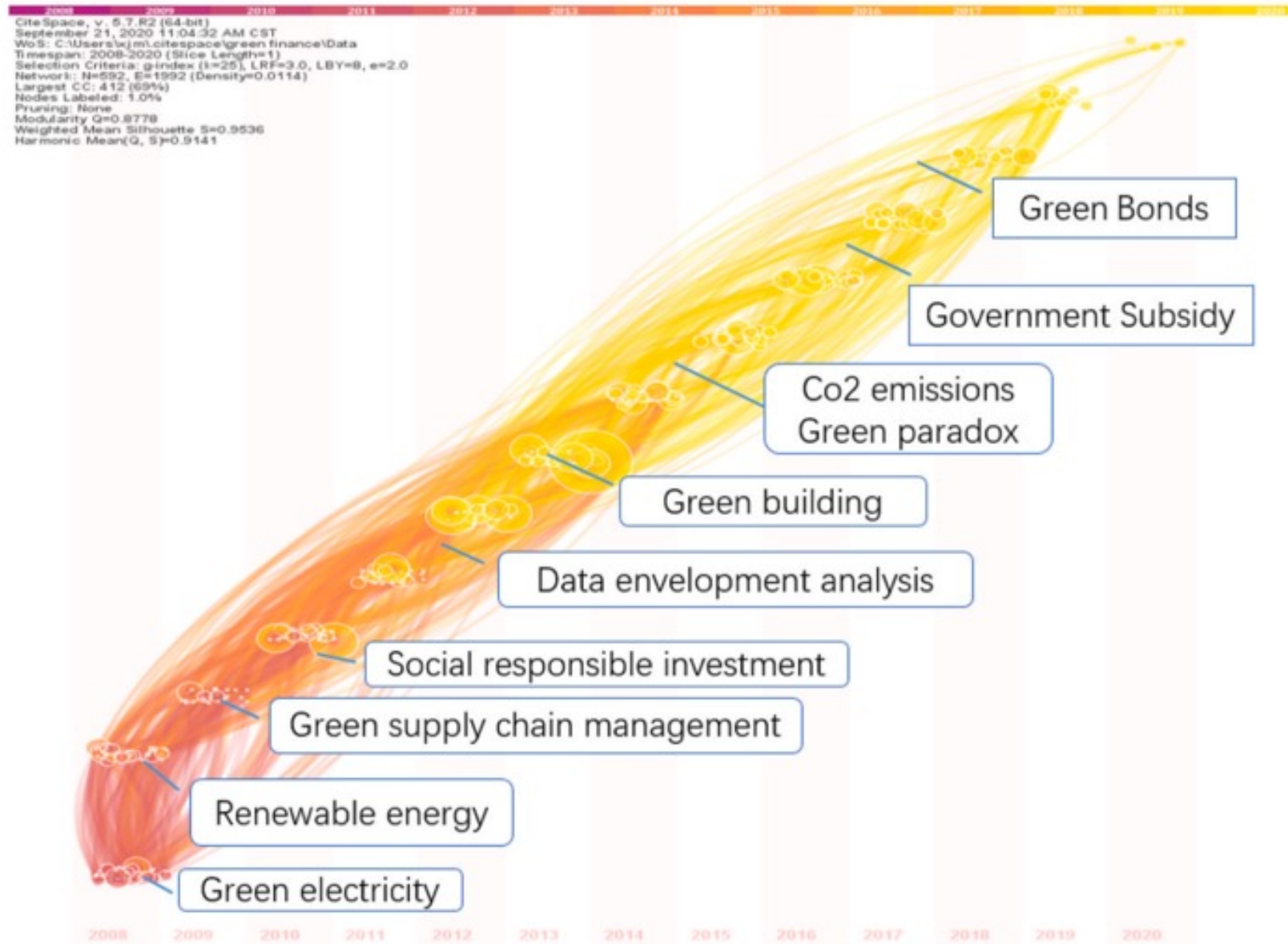
ESG Investing

Investments considering the broad range of
environmental (e.g. climate change,
pollution biodiversity loss),
social (e.g. working conditions, human rights, salary or
compensation structures)
and **governance** (e.g. board composition, diversity and
inclusion, taxes)
characteristics of the projects or companies being invested in;
ethical and business sustainability considerations are
integral part of financing

Impact Investing

Investing in projects
that solve a social or environmental problem;
the focus is on the positive impact
rather than the
means used to produce that impact

Dynamic Trends of Green Finance and Energy Policy



ESG:

Environmental

Social

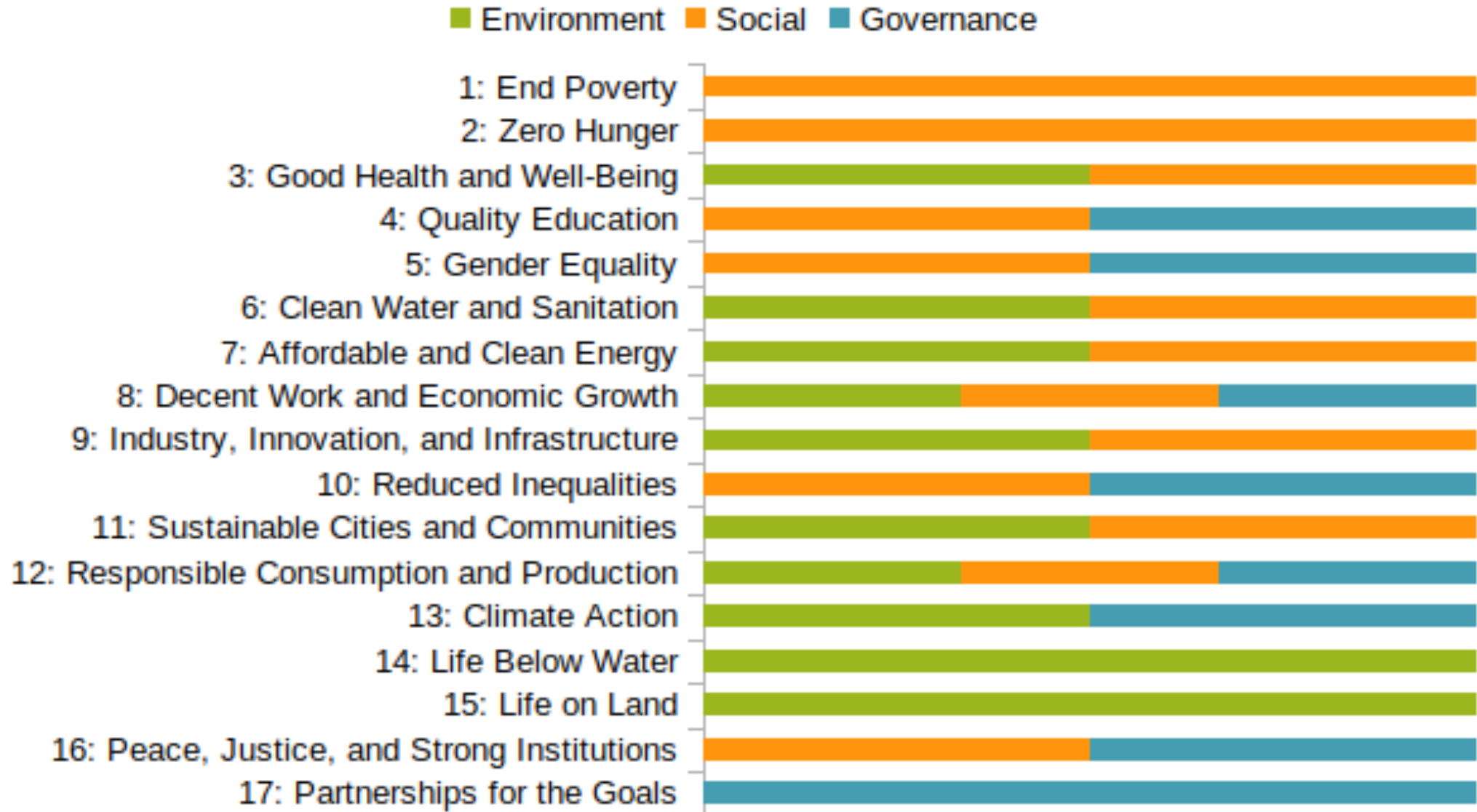
Governance

CSR: Corporate Social Responsibility

ESG to 17 SDGs

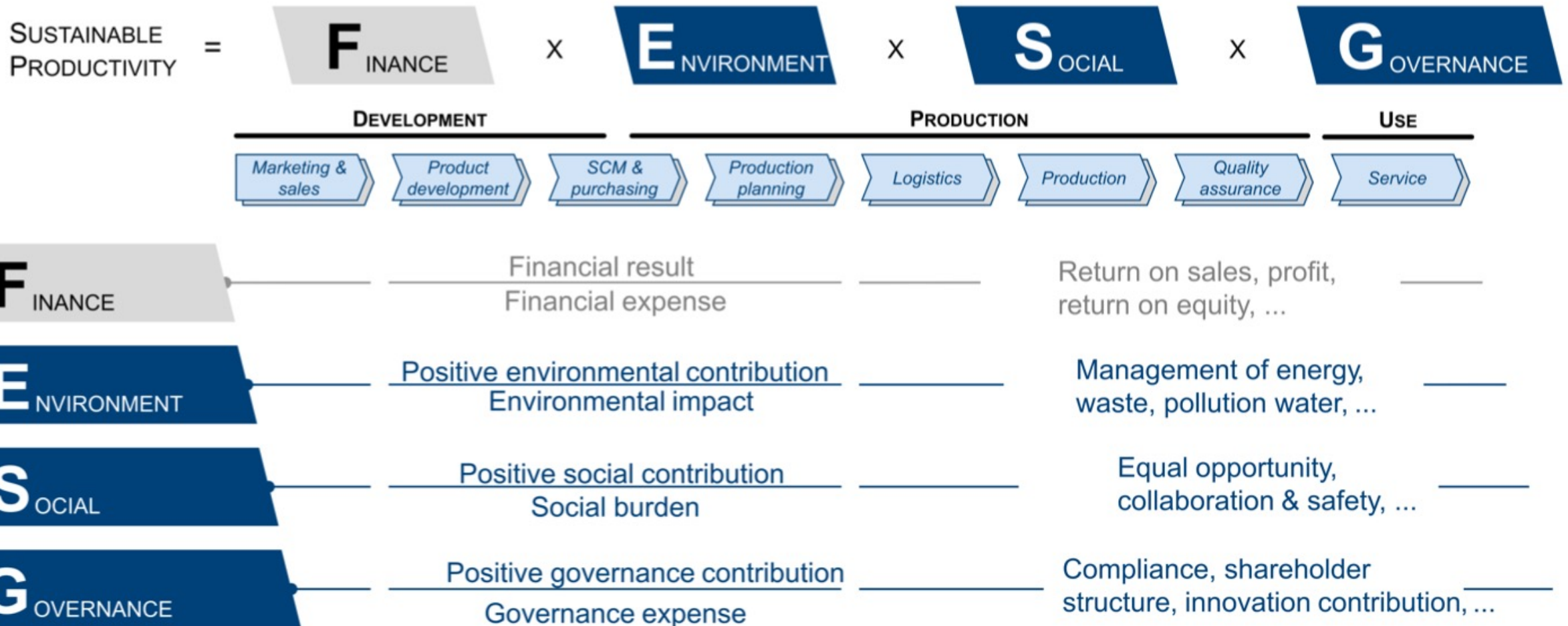


ESG to 17 SDGs



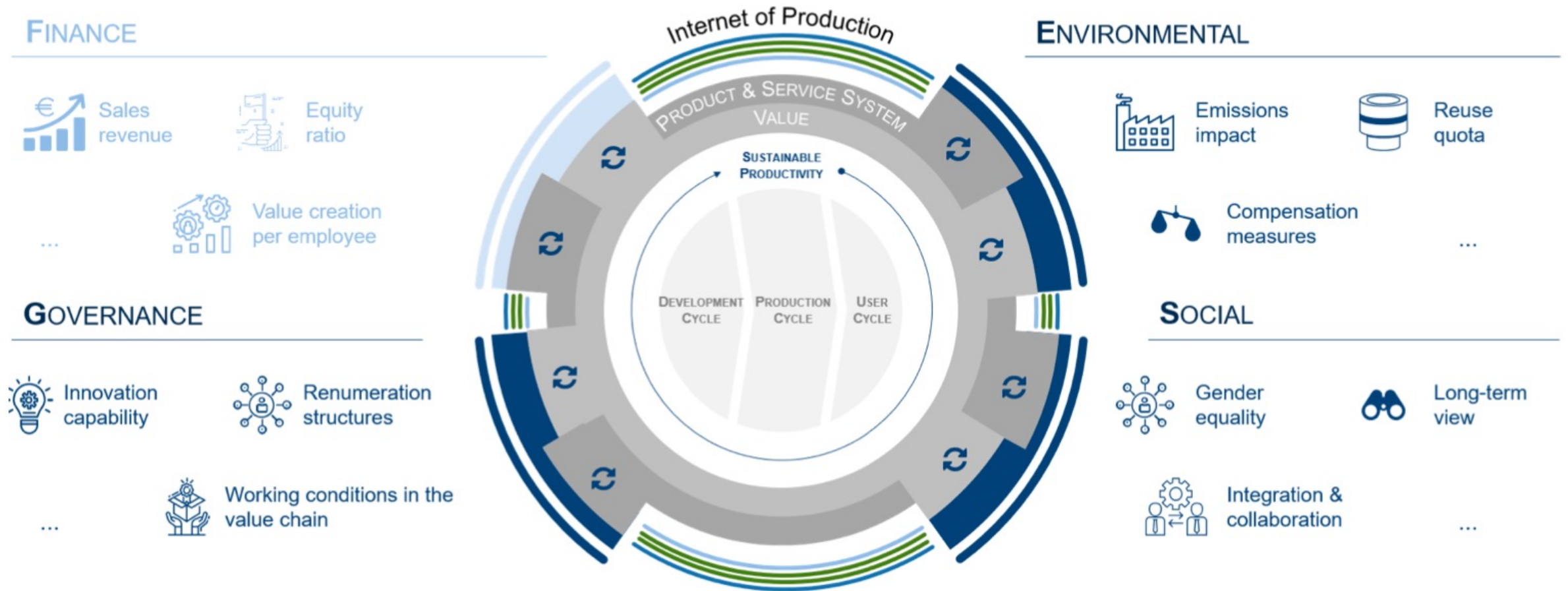
Sustainable Productivity:

Finance ESG



Sustainable Resilient Manufacturing

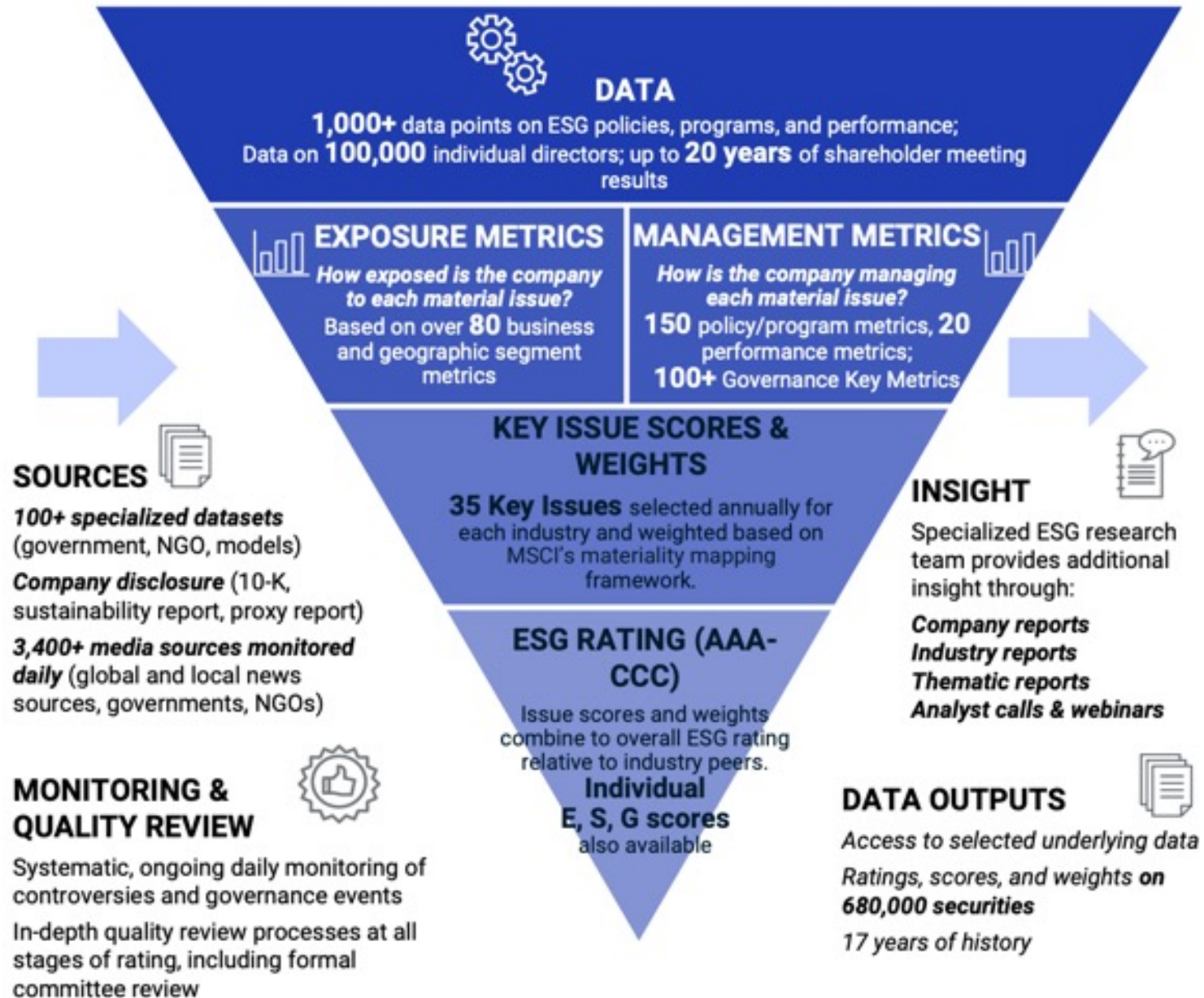
ESG



ESG Indexes

- **MSCI ESG Index**
- **Dow Johns Sustainability Indices (DJSI)**
- **FTSE ESG Index**

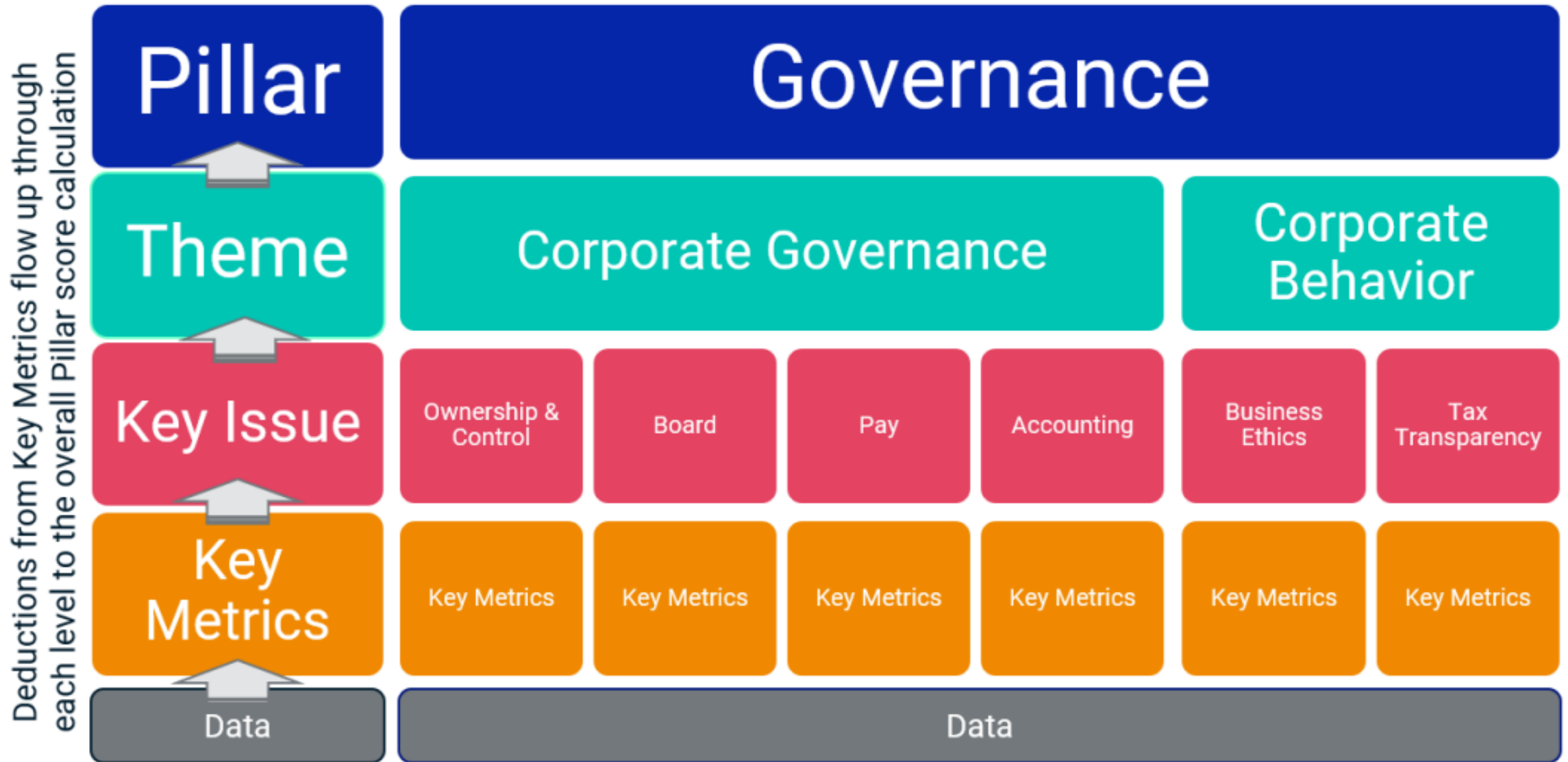
MSCI ESG Rating Framework



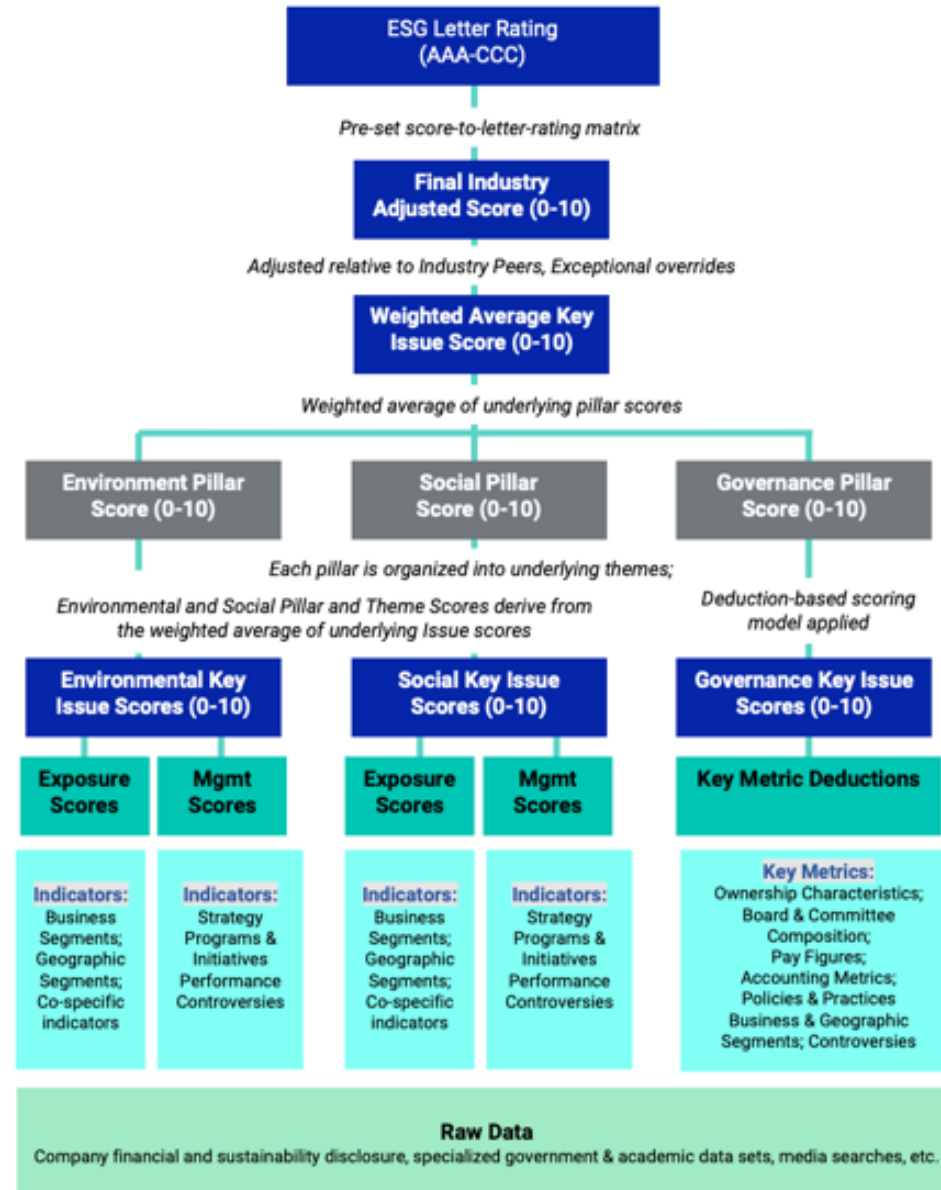
MSCI ESG Key Issue Hierarchy

3 Pillars	10 Themes	35 ESG Key Issues	
Environment	Climate Change	Carbon Emissions Product Carbon Footprint	Financing Environmental Impact Climate Change Vulnerability
	Natural Capital	Water Stress Biodiversity & Land Use	Raw Material Sourcing
	Pollution & Waste	Toxic Emissions & Waste Packaging Material & Waste	Electronic Waste
	Environmental Opportunities	Opportunities in Clean Tech Opportunities in Green Building	Opportunities in Renewable Energy
Social	Human Capital	Labor Management Health & Safety	Human Capital Development Supply Chain Labor Standards
	Product Liability	Product Safety & Quality Chemical Safety Consumer Financial Protection	Privacy & Data Security Responsible Investment Health & Demographic Risk
	Stakeholder Opposition	Controversial Sourcing Community Relations	
	Social Opportunities	Access to Communications Access to Finance	Access to Health Care Opportunities in Nutrition & Health
Governance	Corporate Governance	Ownership & Control Board	Pay Accounting
	Corporate Behavior	Business Ethics Tax Transparency	

MSCI Governance Model Structure



MSCI Hierarchy of ESG Scores



FTSE Russell ESG Ratings



Summary

- **AI in FinTech**
 - **Metaverse, Web3, DeFi, NFT**
 - **Financial Services Innovation and Applications**
 - **Technology-driven Financial Industry Development**
- **Green Finance and Sustainability**
 - **SDGs: Sustainable Development Goals**
 - **ESG: Environmental, Social, and Governance**
 - **CSR: Corporate Social Responsibility**



Q & A

AI in Fintech, Green Finance, and Sustainability (人工智慧金融科技、綠色金融與永續)

時間：2022/12/01 (四) 10:20-12:10

地點：國立臺灣大學國家發展研究所 3F 300教室

主持人：林竣達 教授, 國立臺灣大學國家發展研究所



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Institute of Information Management, National Taipei University

<https://web.ntpu.edu.tw/~myday>



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