Sustainability and ESG Data Analytics

Web 3.0 and Big Data Analysis in Fintech, Green and Sustainable Finance

1141ESGDA04
MBA, IM, NTPU (M5265) (Fall 2025)
Wed 2, 3, 4 (9:10-12:00) (B3F17)

https://meet.google.com/miy-fbif-max

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Professor and Director

Institute of Information Management, National Taipei University

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

2025-10-08

Syllabus

Week	Date	Subject/Topics
1	2025/09/10	Introduction Sustainability and ESG Data Analytics
2	2025/09/17	Environmental, Social, and Governance (ESG) in Net-Zero Digital Transformation
3	2025/09/24	Data Science for Sustainability and ESG
4	2025/10/01	Case Study on Sustainability and ESG Data Analytics I
5	2025/10/08	Web 3.0 and Big Data Analysis in Fintech, Green and Sustainable Finance
6	2025/10/15	ESG Data Gathering, Analysis, and Visualization

Syllabus

Week	Date	Subject/Topics
7	2025/10/22	NVIDIA Building RAG Agents with LLMs Part I: LLM Services and AI Foundation Models
8	2025/10/29	Self-Learning
9	2025/11/05	Midterm Project Report
10	2025/11/12	NVIDIA Building RAG Agents with LLMs Part II: Document Loading, Chunking, and Embeddings
11	2025/11/19	NVIDIA Building RAG Agents with LLMs Part III: Retrieval-Augmented Generation with Vector Stores and RAG Evaluation

Syllabus

Week	Date	Subject/Topics
12	2025/11/26	Case Study on Sustainability and ESG Data Analytics II
13	2025/12/03	Artificial Intelligence of things (AIoT) in ESG and Sustainability Applications
14	2025/12/10	Generative AI for ESG Rating and Reporting Generation
15	2025/12/17	Final Project Report I
16	2025/12/24	Final Project Report II

Web 3.0 and Big Data Analysis in Fintech, Green and Sustainable Finance

Outline

- **Web 3.0**
- **Big Data Analysis**
- **Fintech**
- **Green and Sustainable Finance**

Sustainability and ESG Data Analytics

FinTech ABCD

AI

Block Chain

Cloud Computing

Big **D**ata

Decentralized Finance (DeFi)

Block Chain Financial Technology

Block Chain & Bitcoin (BTC)

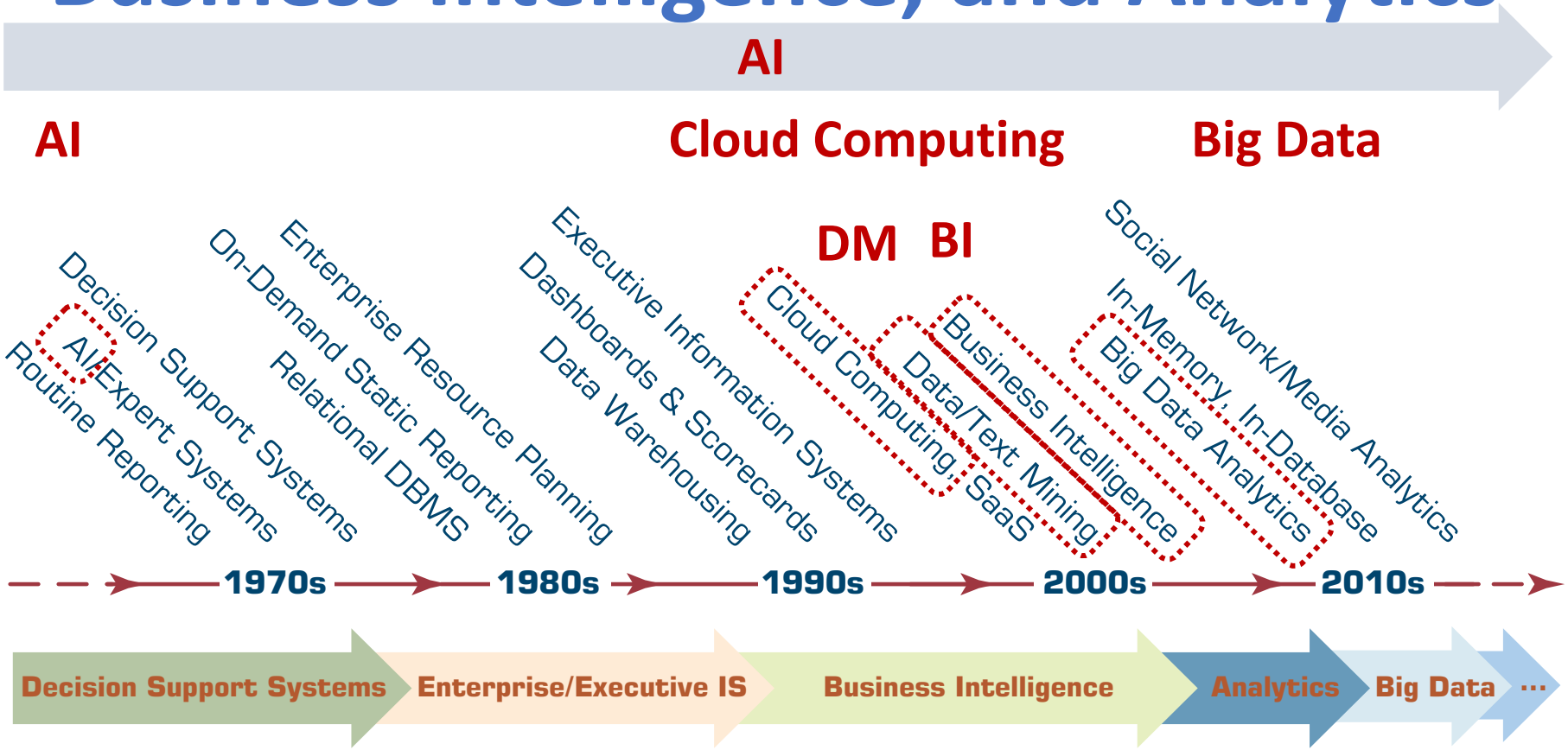
Smart Contract & Ethereum (ETH)

Decentralized Application (DApp)

Artificial Intelligence (AI)

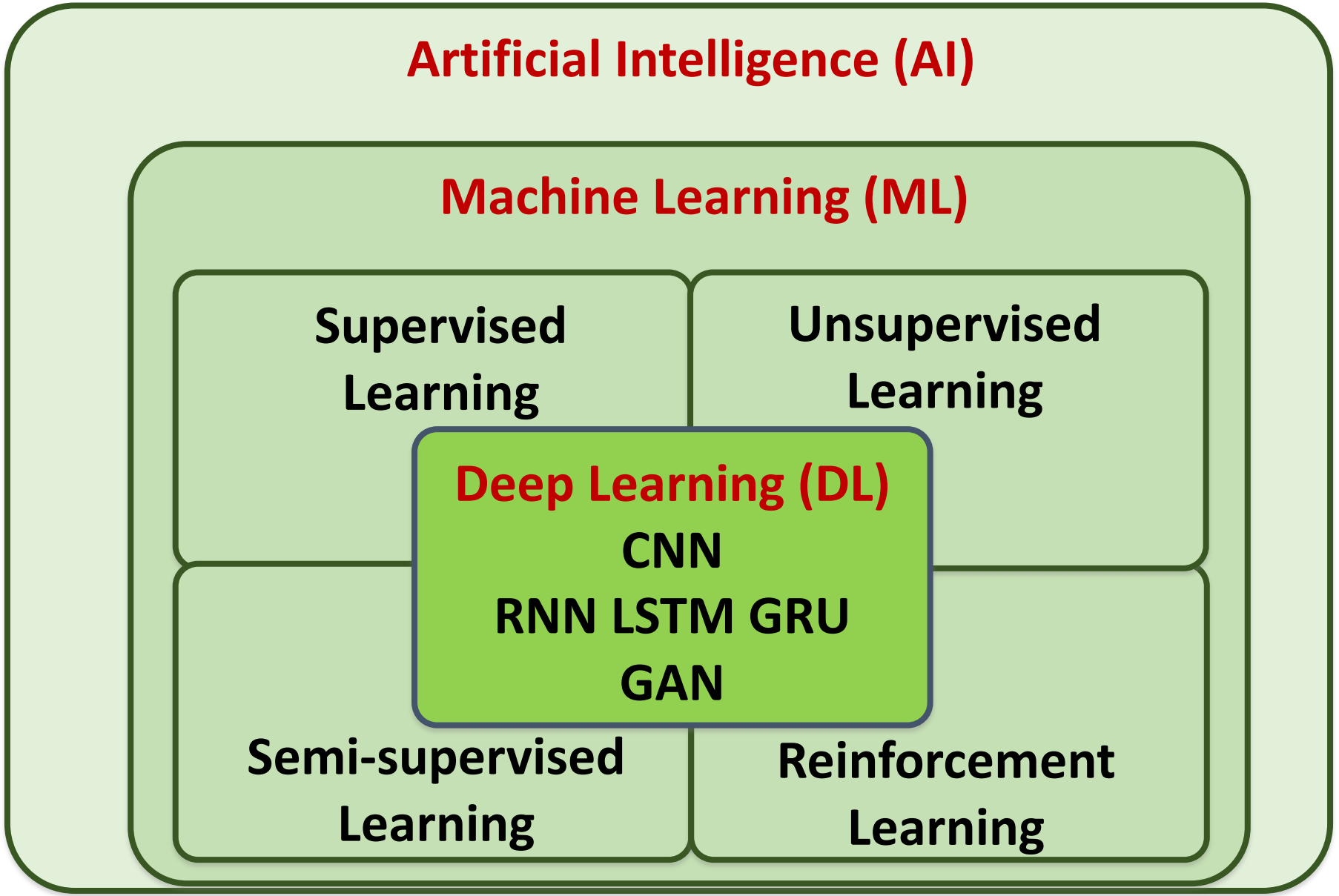
AI, Big Data, Cloud Computing

Evolution of Decision Support, Business Intelligence, and Analytics



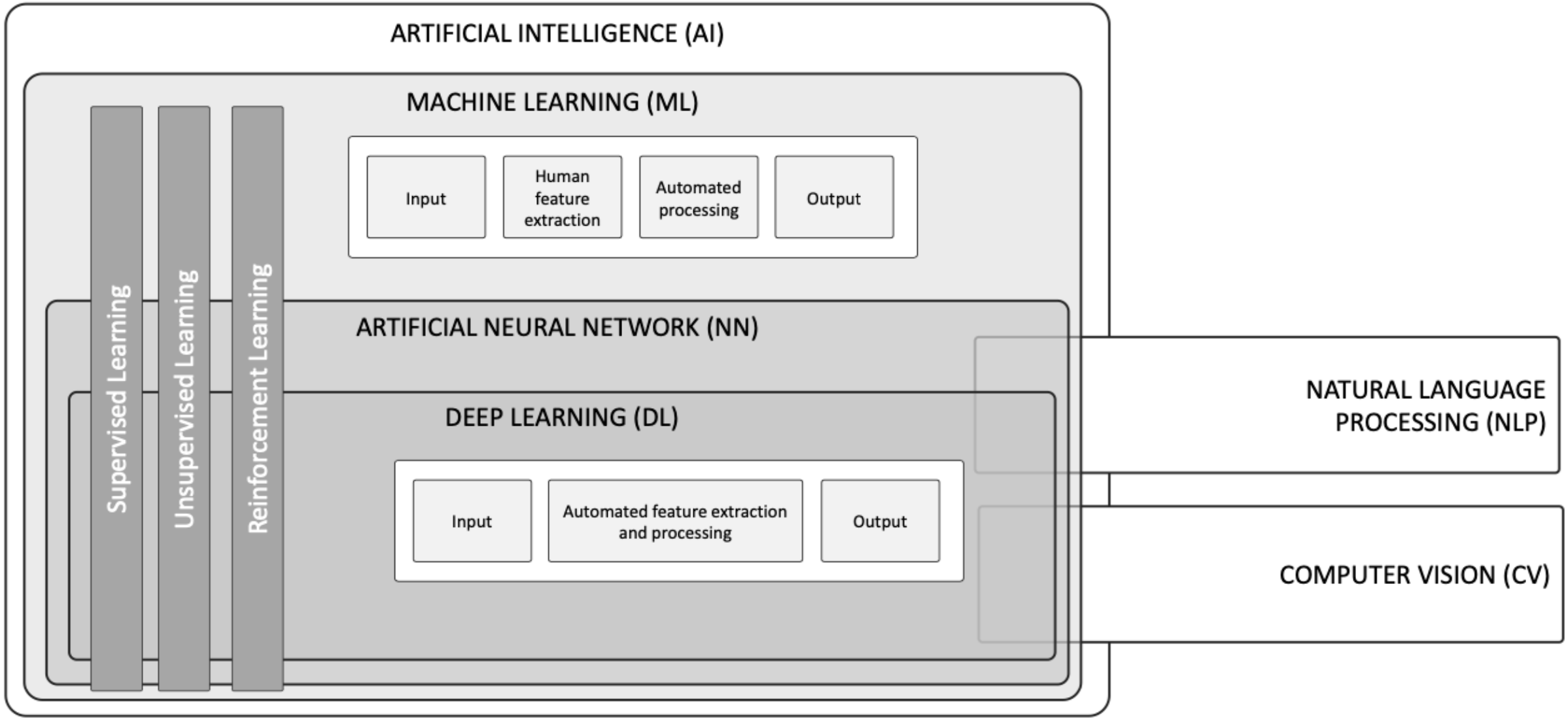
Source: Ramesh Sharda, Dursun Delen, and Efraim Turban (2017),
Business Intelligence, Analytics, and Data Science: A Managerial Perspective, 4th Edition, Pearson

AI, ML, DL



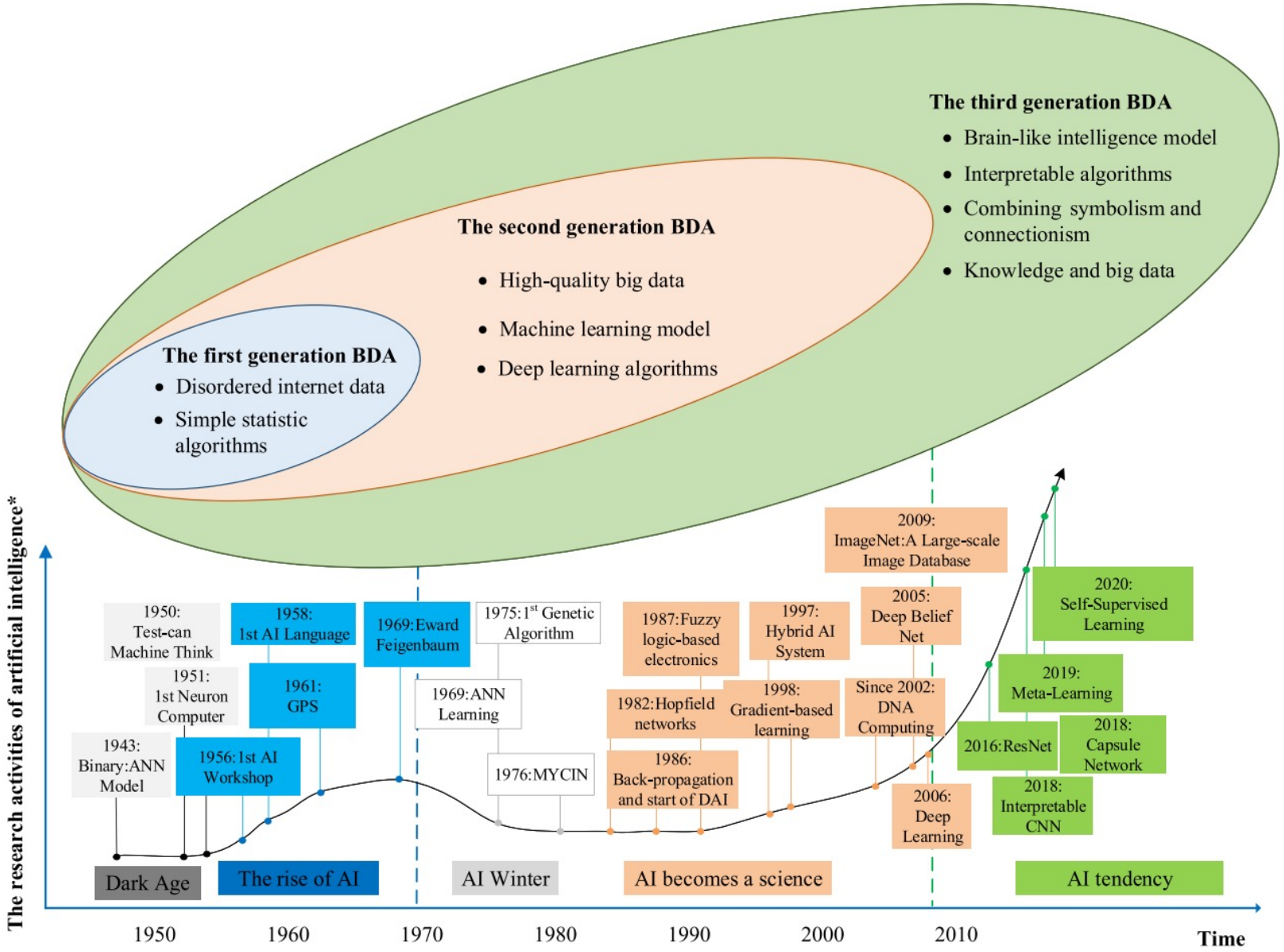
Source: https://leonardoaraujosantos.gitbooks.io/artificial-inteligence/content/deep_learning.html

AI, ML, NN, DL



Source: Schoormann, T., Strobel, G., Möller, F., Petrik, D., & Zschech, P. (2023). Artificial Intelligence for Sustainability—A Systematic Review of Information Systems Literature. Communications of the Association for Information Systems, 52(1), 8.

AI and Big Data Analytics (BDA)

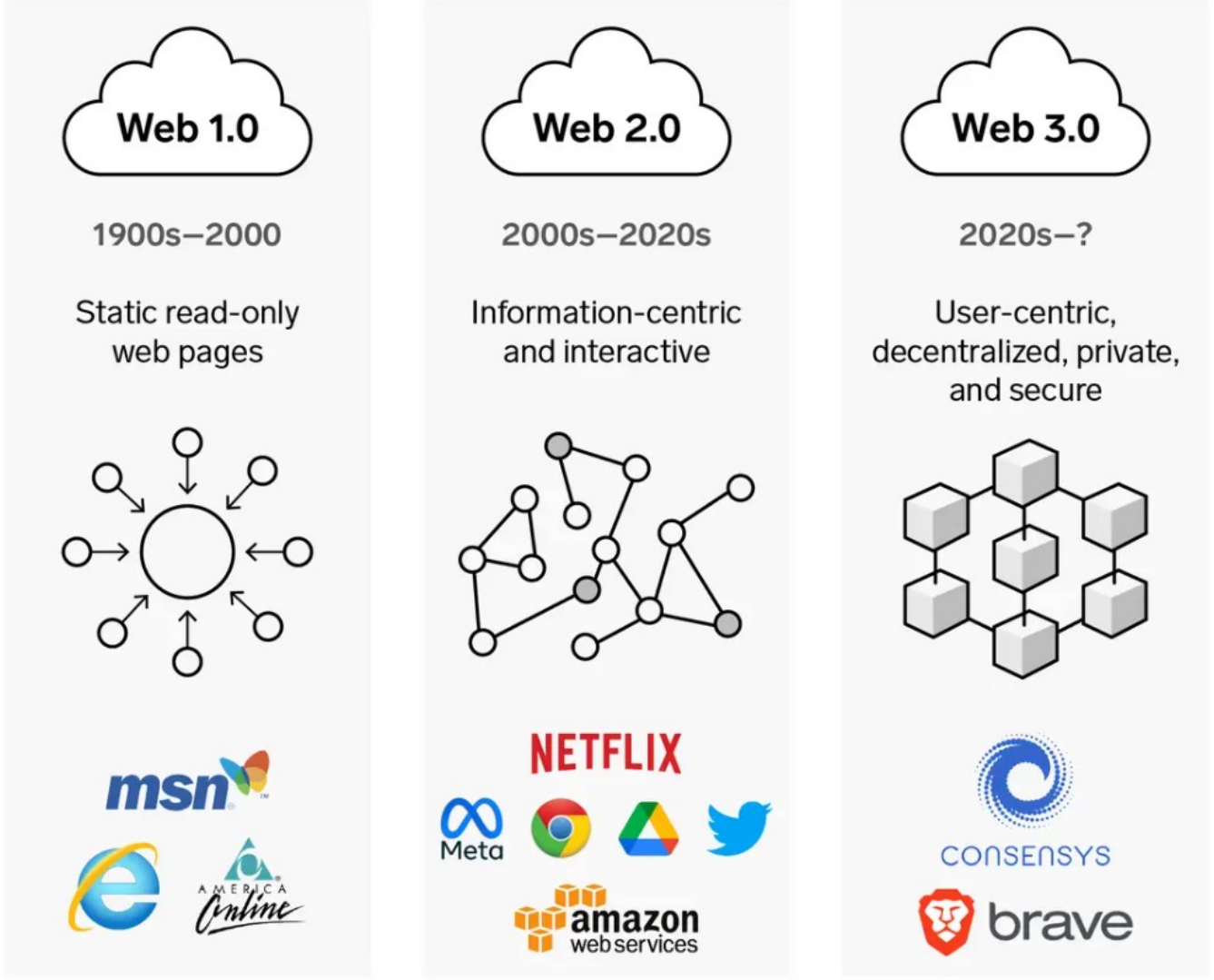


Source: Wang, Junliang, Chuqiao Xu, Jie Zhang, and Ray Zhong (2022). "Big data analytics for intelligent manufacturing systems: A review." Journal of Manufacturing Systems 62 (2022): 738-752.

Web 3.0

Web3
Metaverse
DeFi
NFT

Web3: Decentralized Web Internet Evolution



1990 2000 2020

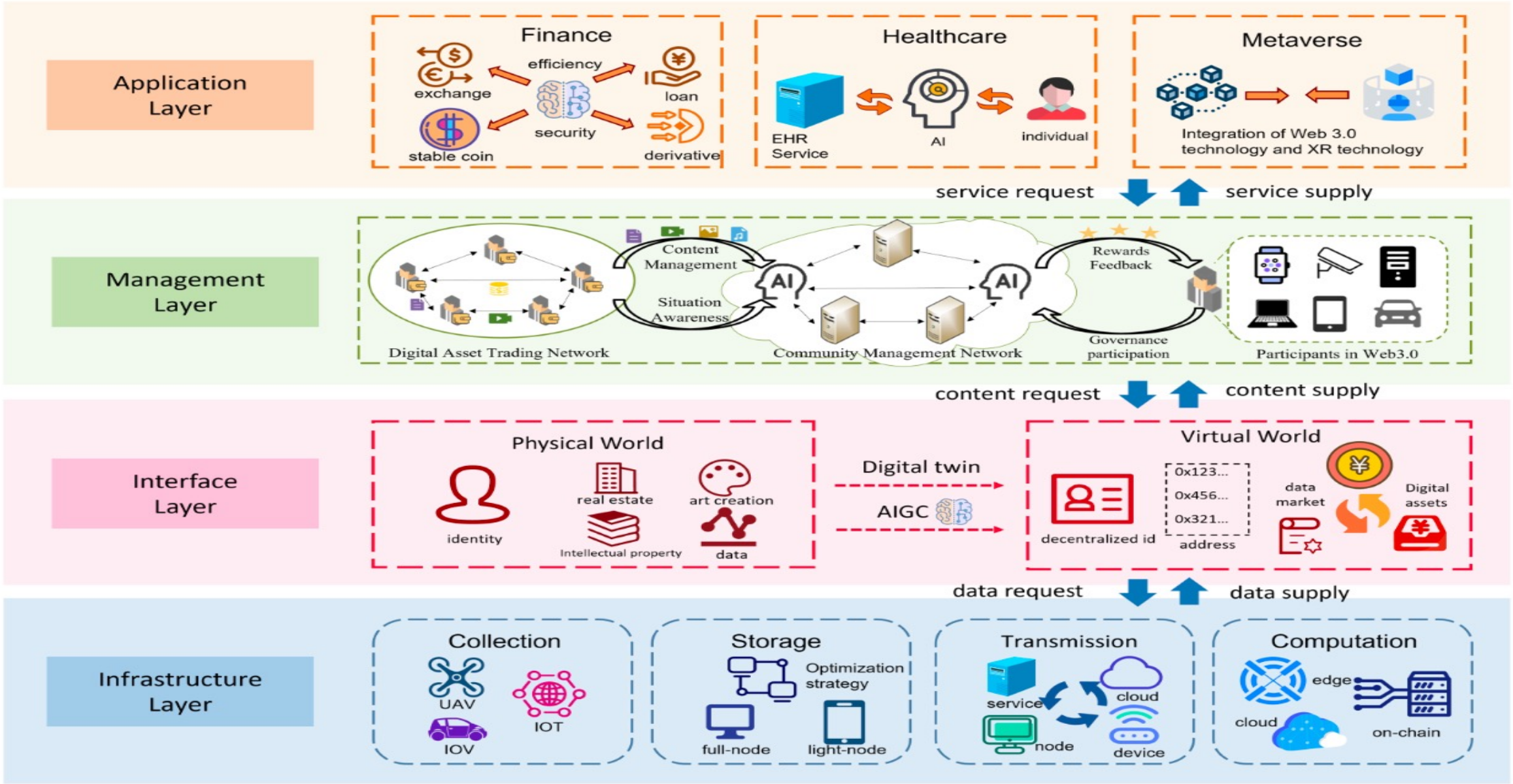
Source: https://www.businessinsider.com/personal-finance/what-is-web3

Web 3.0: Key Features of the Web Evolution

The Evolution of Web	Web 1.0 (1980s–)	Web 2.0 (2000s–)	Web 3.0 (2020s–)
Entrance	Browser	App	Wallet
Back-end computing center	Server	Clouds	Peer-to-peer network, blockchain
Interactive mode	Read-only	Read & write	Read & write & own
Economic model	Advertising economy	Platform economy, advertising economy	Ownership/creator economics
Network form	Centralized	Centralized	Decentralized
Data/content publisher	Web portals	PGC, UGC	PGC, UGC, DAO, AIGC
Data/content ownership	Institution	Company and platform	Individuals and organizations, portable
Digital identity system	Username & password	Platform-based identity	Decentralized digital identity

Source: Meng Shen, Zhehui Tan, Dusit Niyato, Yuzhi Liu, Jiawen Kang, Zehui Xiong, Liehuang Zhu, Wei Wang, and Xuemin Shen (2024). "Artificial intelligence for web 3.0: A comprehensive survey." ACM Computing Surveys 56, no. 10 (2024): 1-39..

Web 3.0 Architecture



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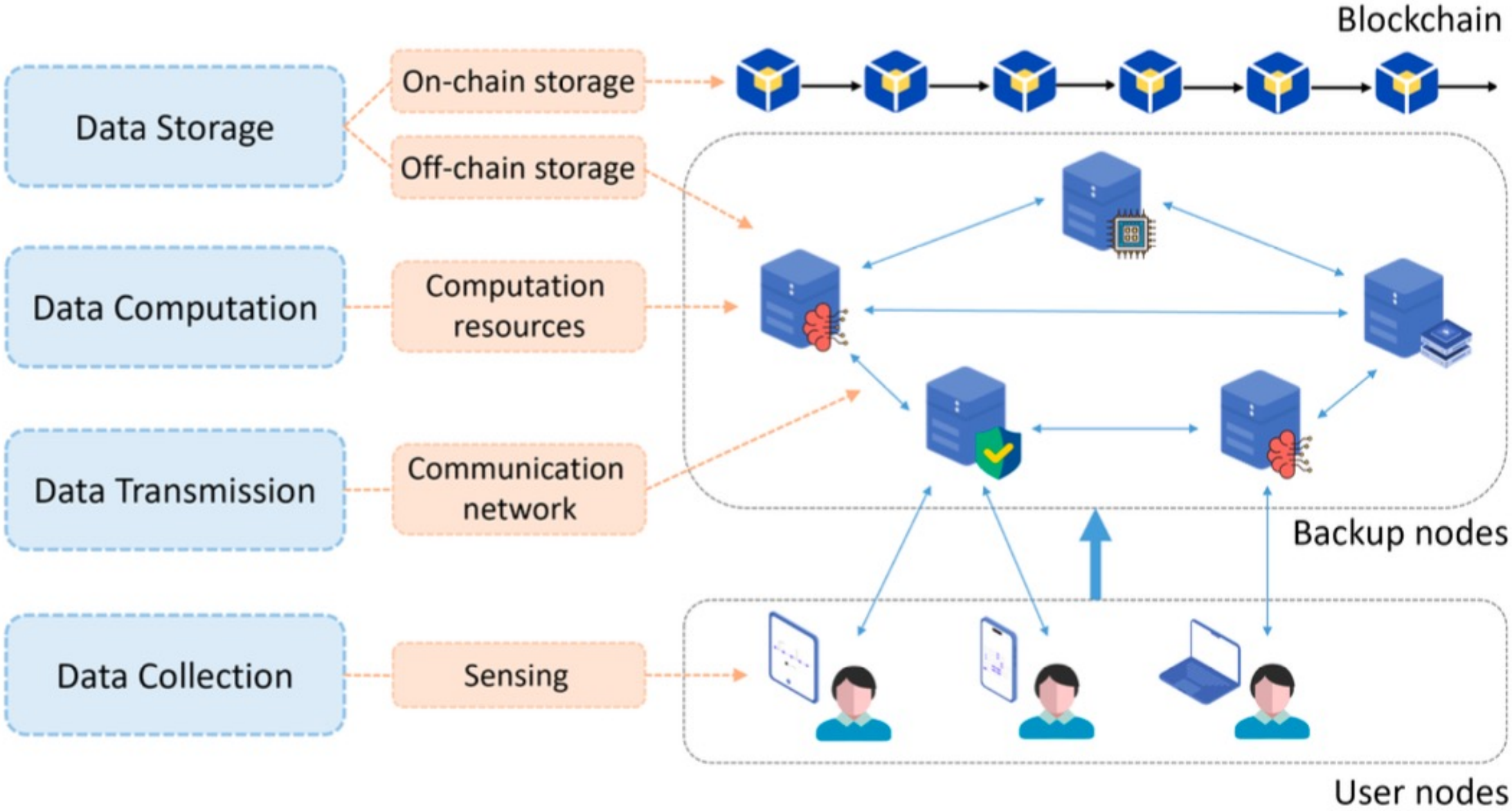
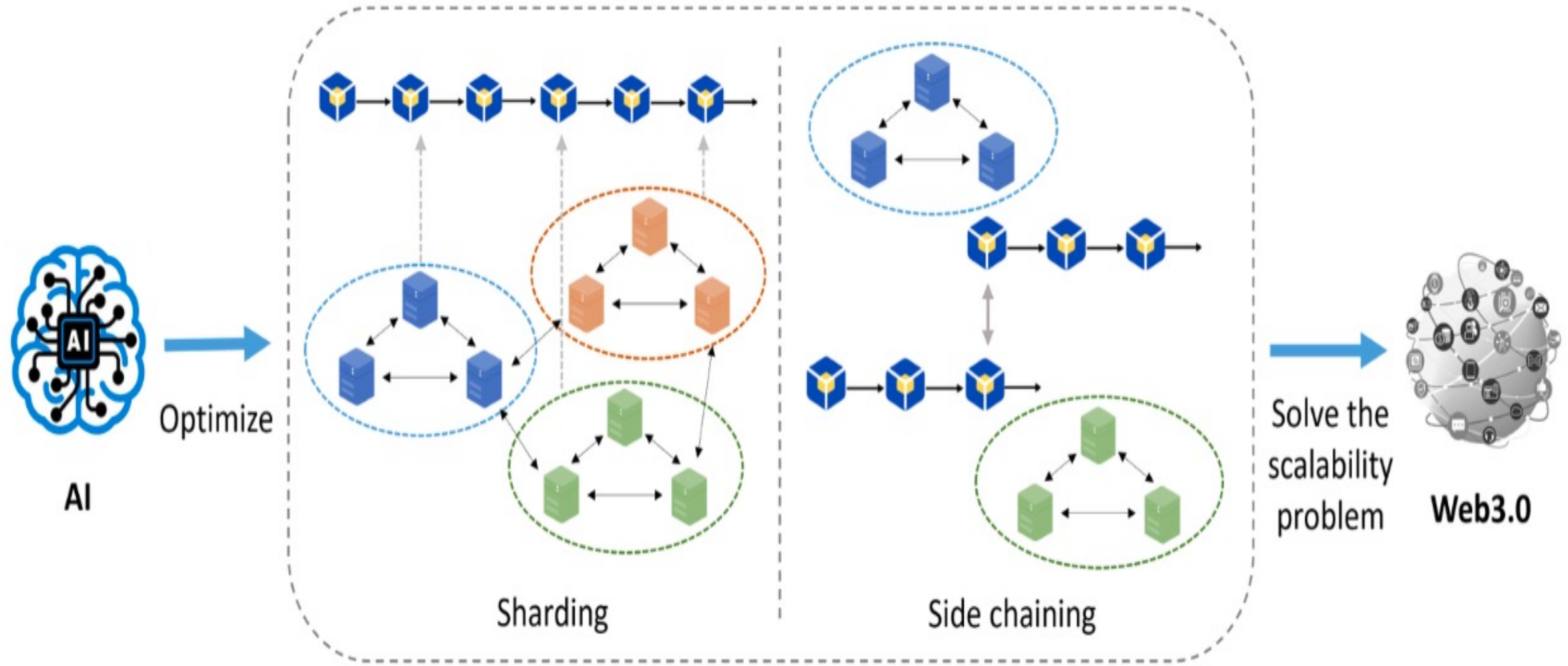
Web 3.0 Infrastructure Layer



Source: Meng Shen, Zhehui Tan, Dusit Niyato, Yuzhi Liu, Jiawen Kang, Zehui Xiong, Liehuang Zhu, Wei Wang, and Xuemin Shen (2024). "Artificial intelligence for web 3.0: A comprehensive survey." ACM Computing Surveys 56, no. 10 (2024): 1-39..

Artificial Intelligence for Web 3.0



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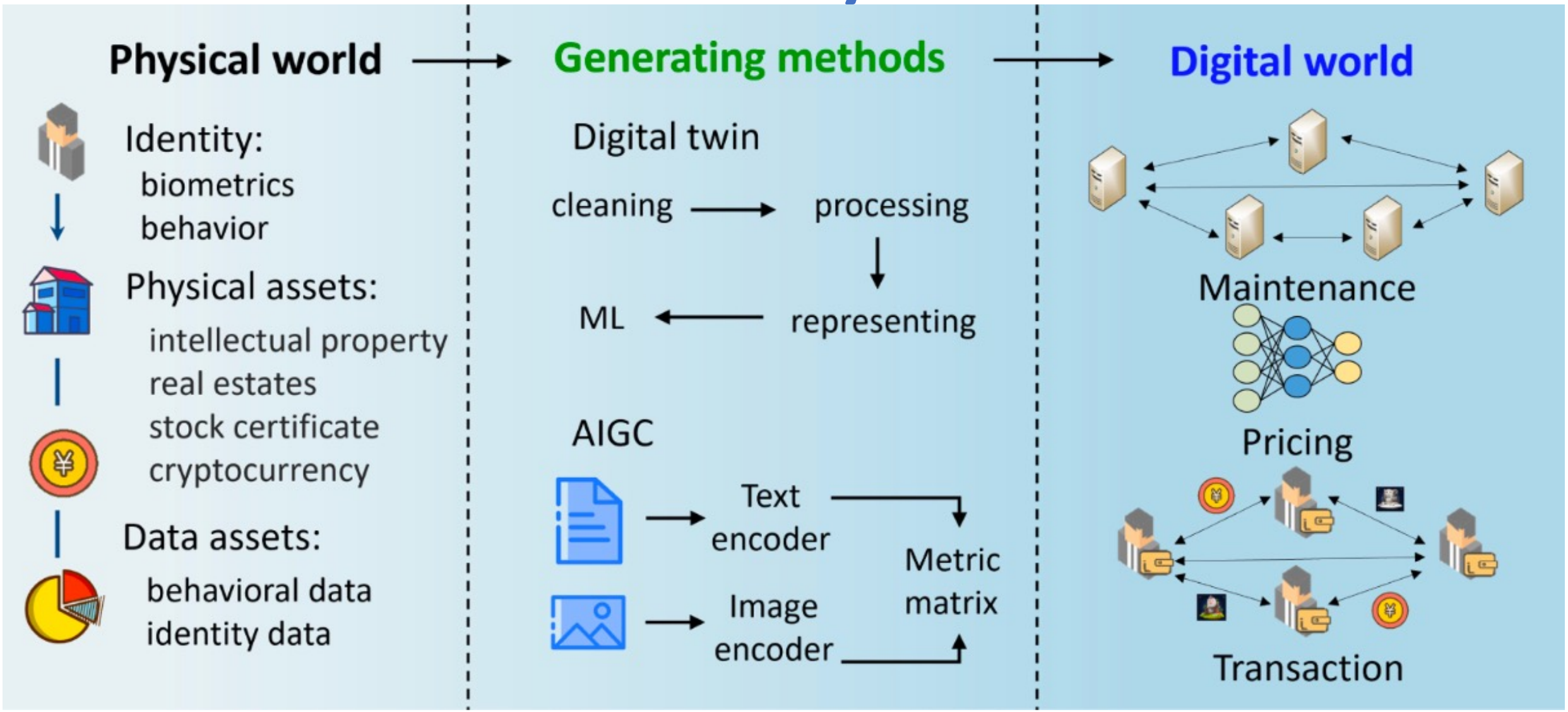
Physical World to the Digital World in the Interface Layer of Web 3.0



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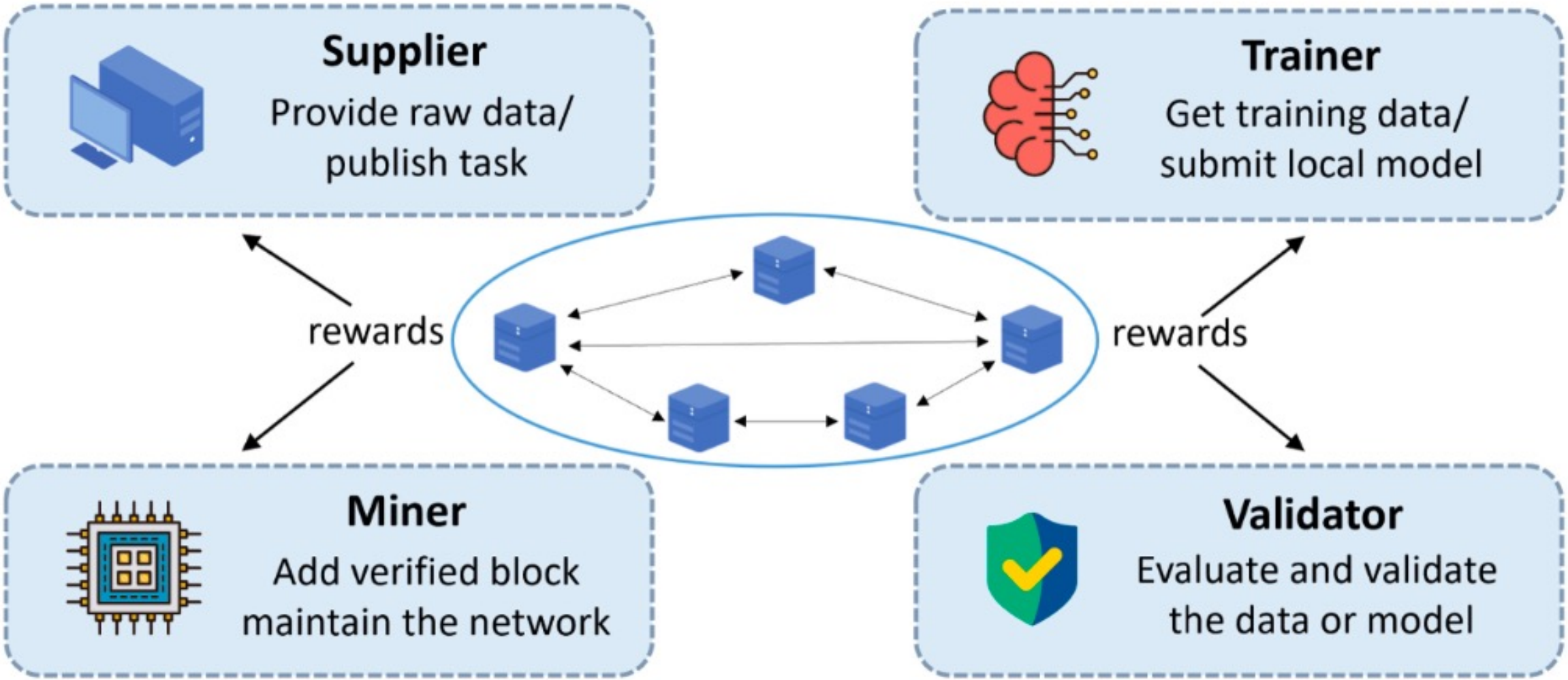
AI-assisted Incentive Mechanism Structure in the Management Layer of Web 3.0



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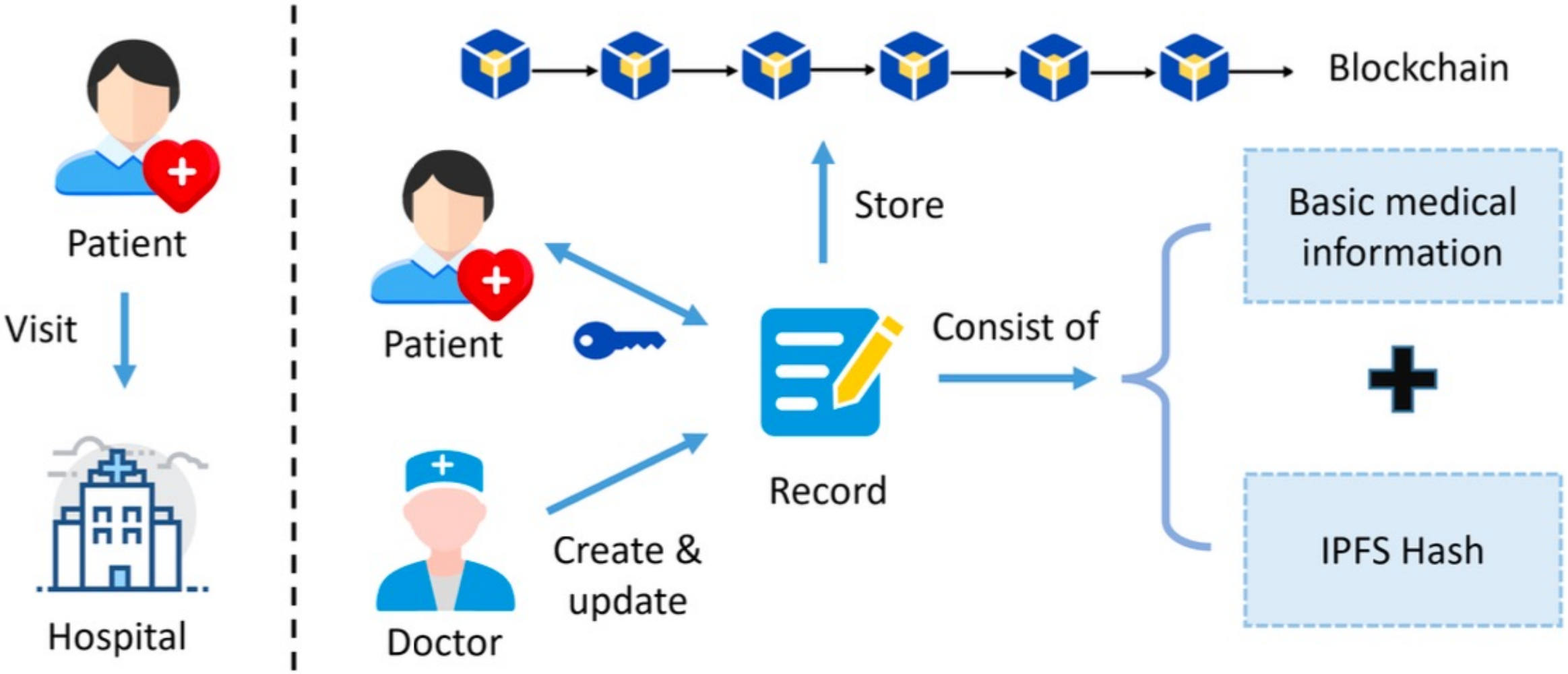
Research on AI-based Applications in Web 3.0

Subject	Ref.	AI Methods	Solutions	Web 3.0 tasks
Finance	[62]	DL	AI-based systematic modular framework	Detecting smart contract vulnerabilities
Finance	[63]	LSTM	Applying short- and long-term memory model	Learning vulnerabilities in sequence
Finance	[64]	GNNs	Using graph neural networks for detection	Smart contract vulnerability analysis
Metaverse	[67]	DRL	Visual deep learning	Novel virtual environment establishment
Metaverse	[68]	FL	Federated-learning-based mobile edge computing	Proving computational efficiency of AR applications
Metaverse	[147]	RL	Training virtual characters to move participants	Precomputing avatar behavior
Metaverse	[148]	CNNs	Overlay food segmentation image inferred by CNNs	Improving the presence of users eating in metaverse
Healthcare	[65]	ANN	AI enabled and blockchain driven	Medical healthcare system for COVID-19
Healthcare	[149]	DCNNs	An intermediate fusion framework	Physical activity recognition

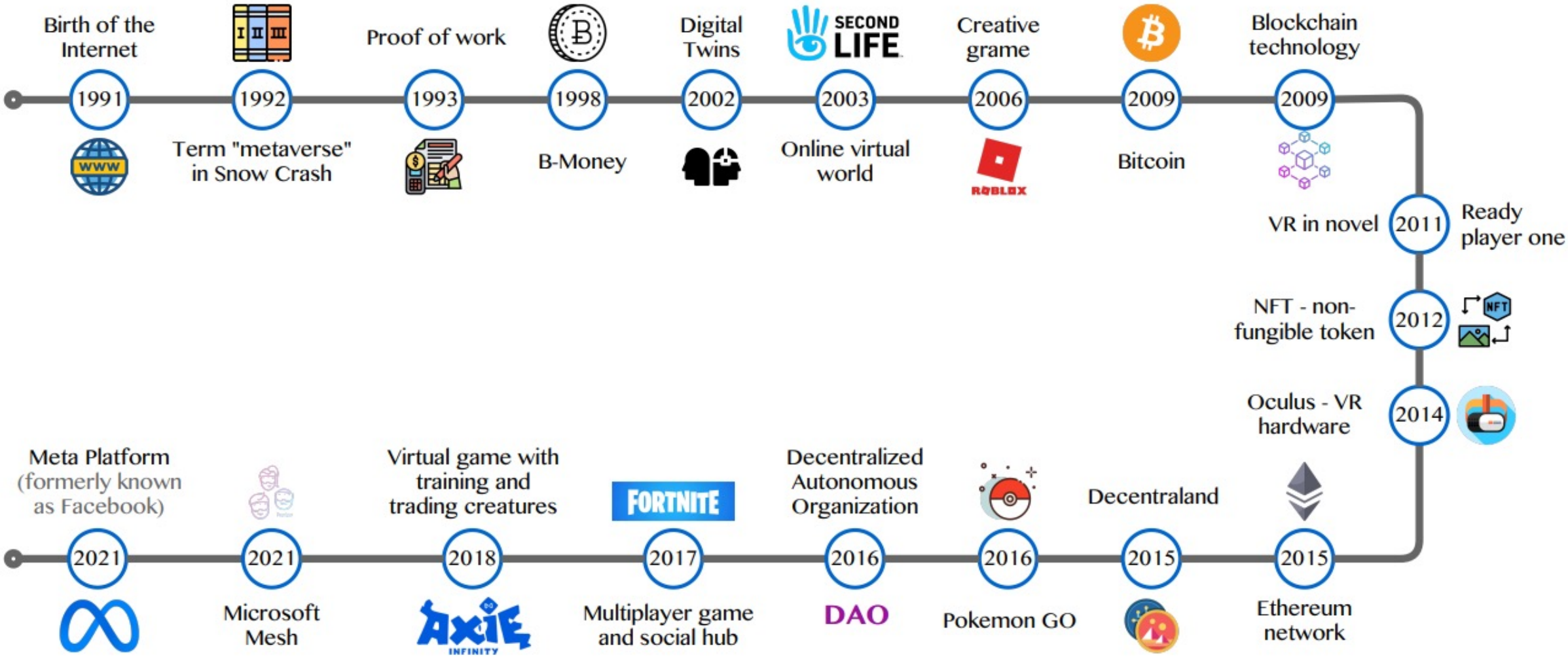
Source: Meng Shen, Zhehui Tan, Dusit Niyato, Yuzhi Liu, Jiawen Kang, Zehui Xiong, Liehuang Zhu, Wei Wang, and Xuemin Shen (2024). "Artificial intelligence for web 3.0: A comprehensive survey." ACM Computing Surveys 56, no. 10 (2024): 1-39..

The Framework of EHR Management System based on Blockchain



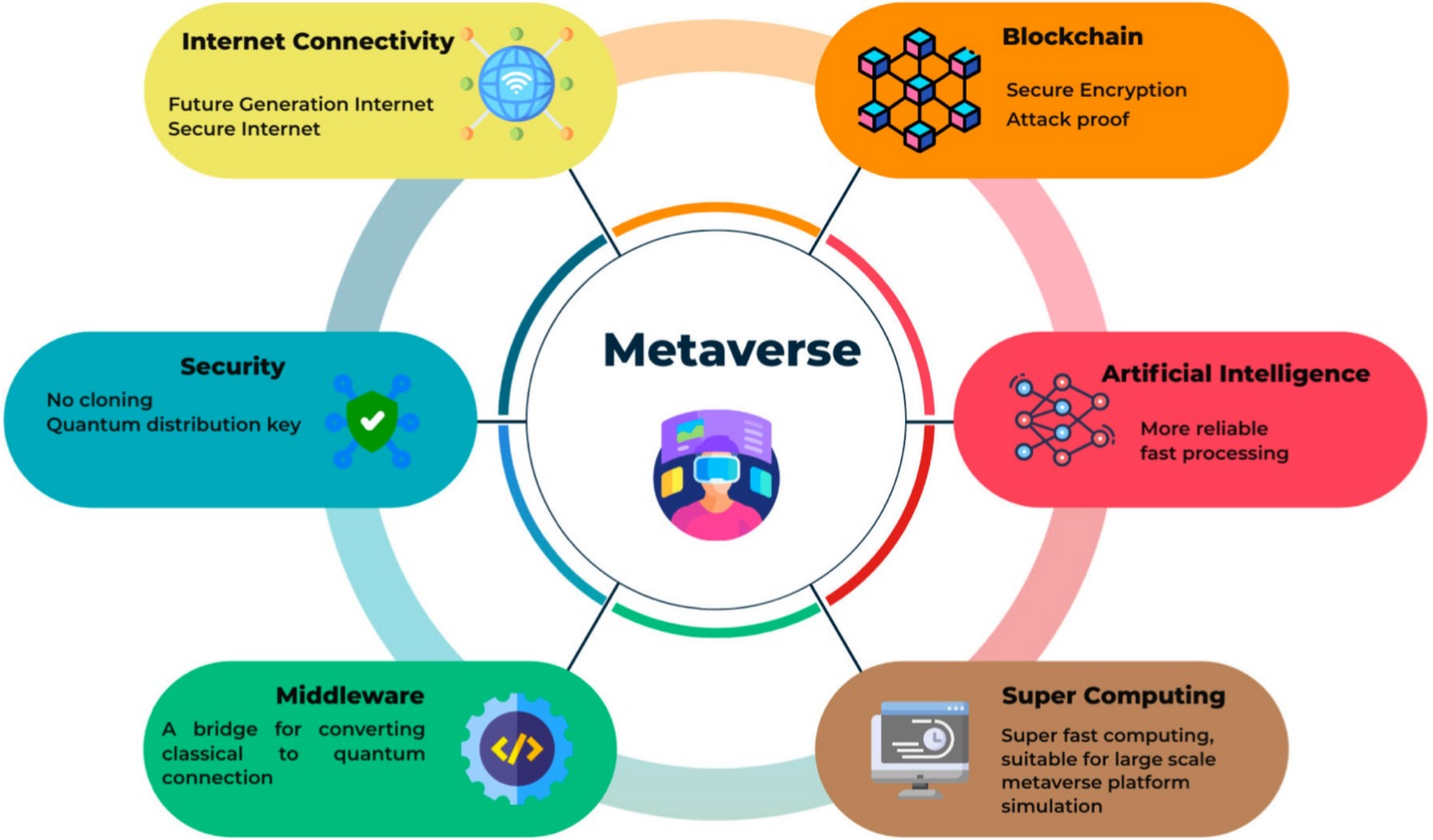
Source: Meng Shen, Zhehui Tan, Dusit Niyato, Yuzhi Liu, Jiawen Kang, Zehui Xiong, Liehuang Zhu, Wei Wang, and Xuemin Shen (2024). "Artificial intelligence for web 3.0: A comprehensive survey." ACM Computing Surveys 56, no. 10 (2024): 1-39..

Metaverse Development from 1991 to 2021



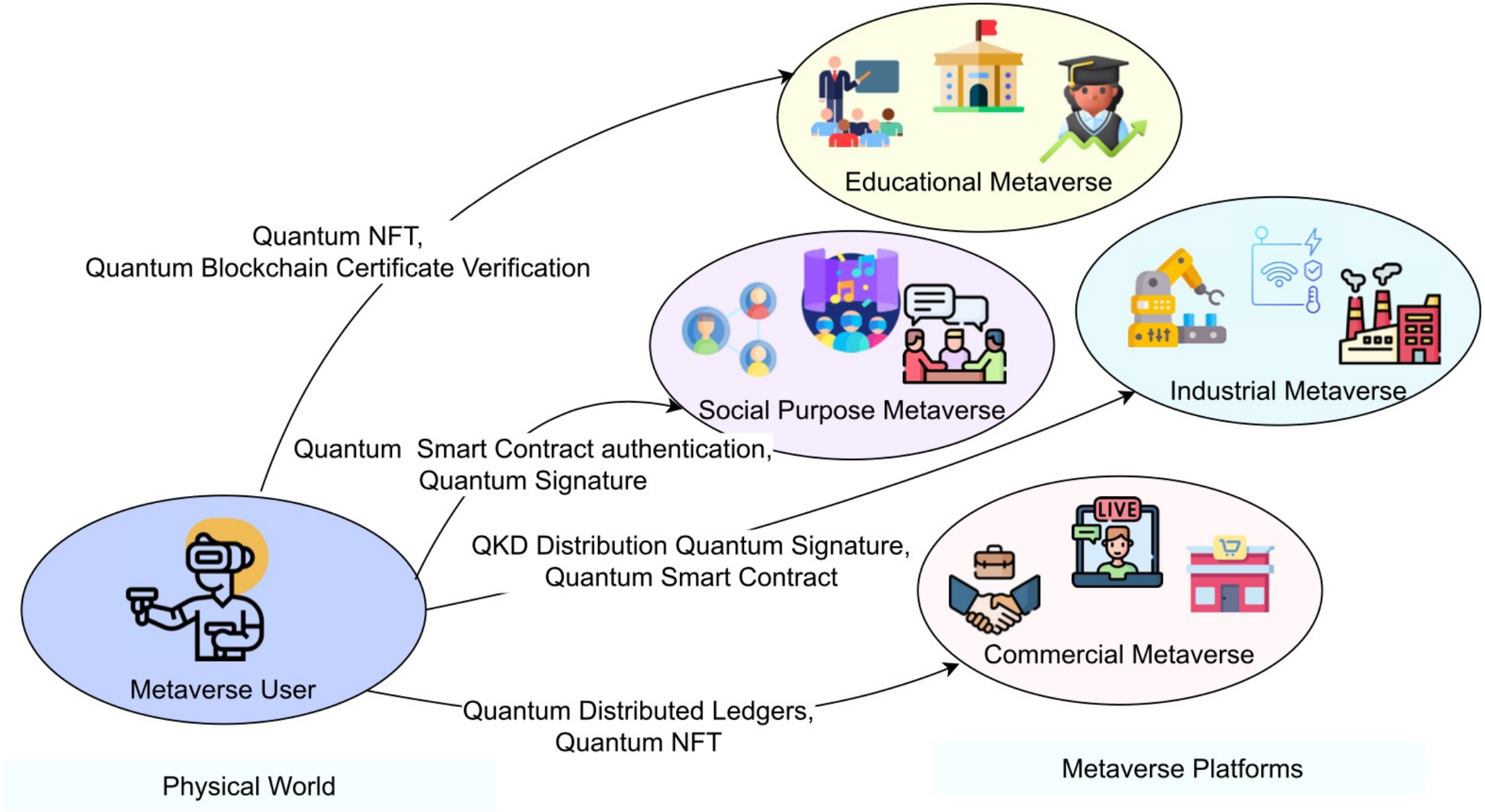
Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Qui Pham, Thanh Thi Nguyen, Zhu Han, and Dong-Seong Kim (2022). "Artificial Intelligence for the Metaverse: A Survey." arXiv preprint arXiv:2202.10336.

Quantum Computing in the Metaverse



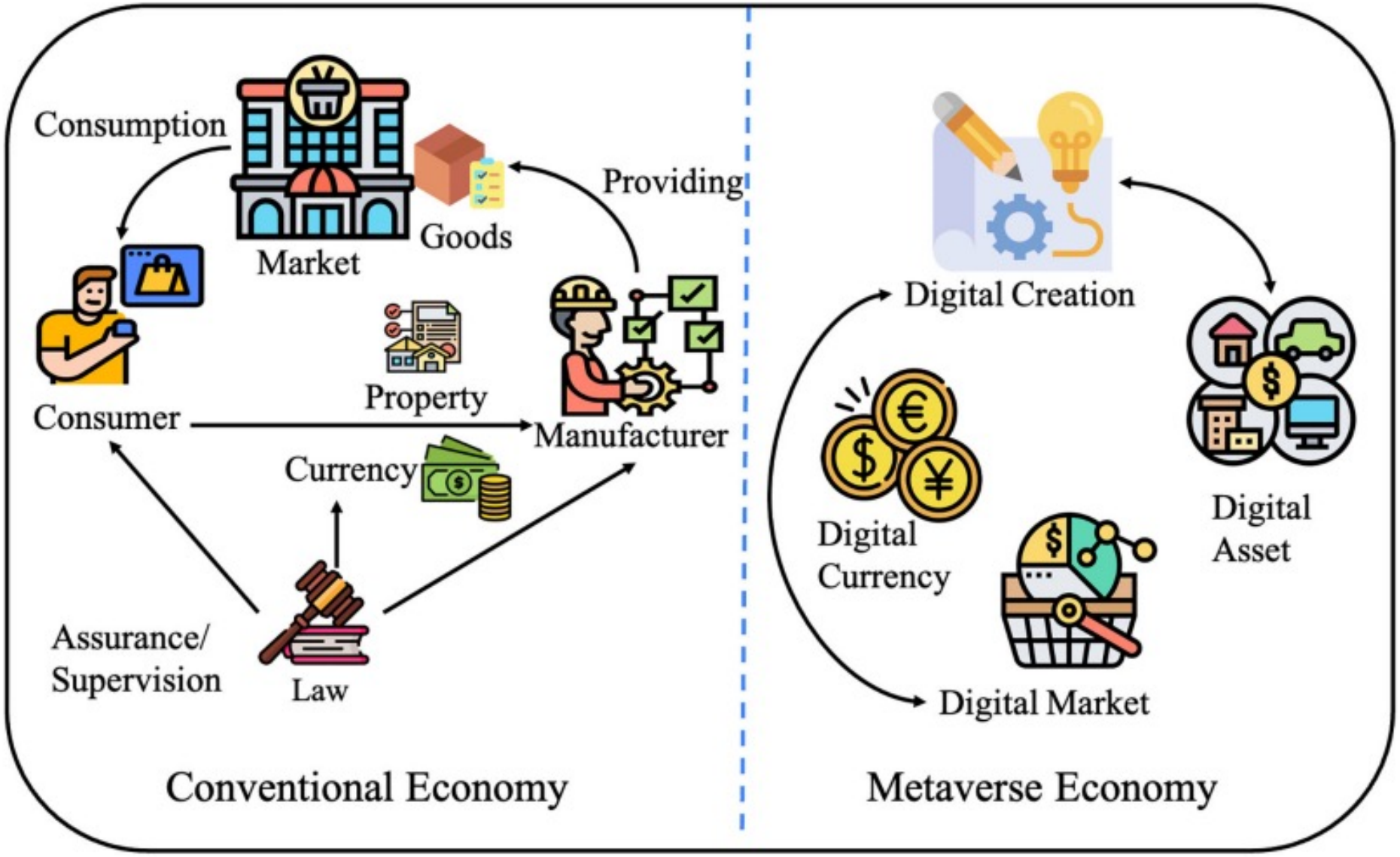
Source: Tuli, Esmot Ara, Jae-Min Lee, and Dong-Seong Kim (2024). "Integration of Quantum Technologies into Metaverse: Applications, Potentials, and Challenges." IEEE Access 12 (2024): 29995-30019.

Quantum Blockchain: Bridging between the real world and metaverse



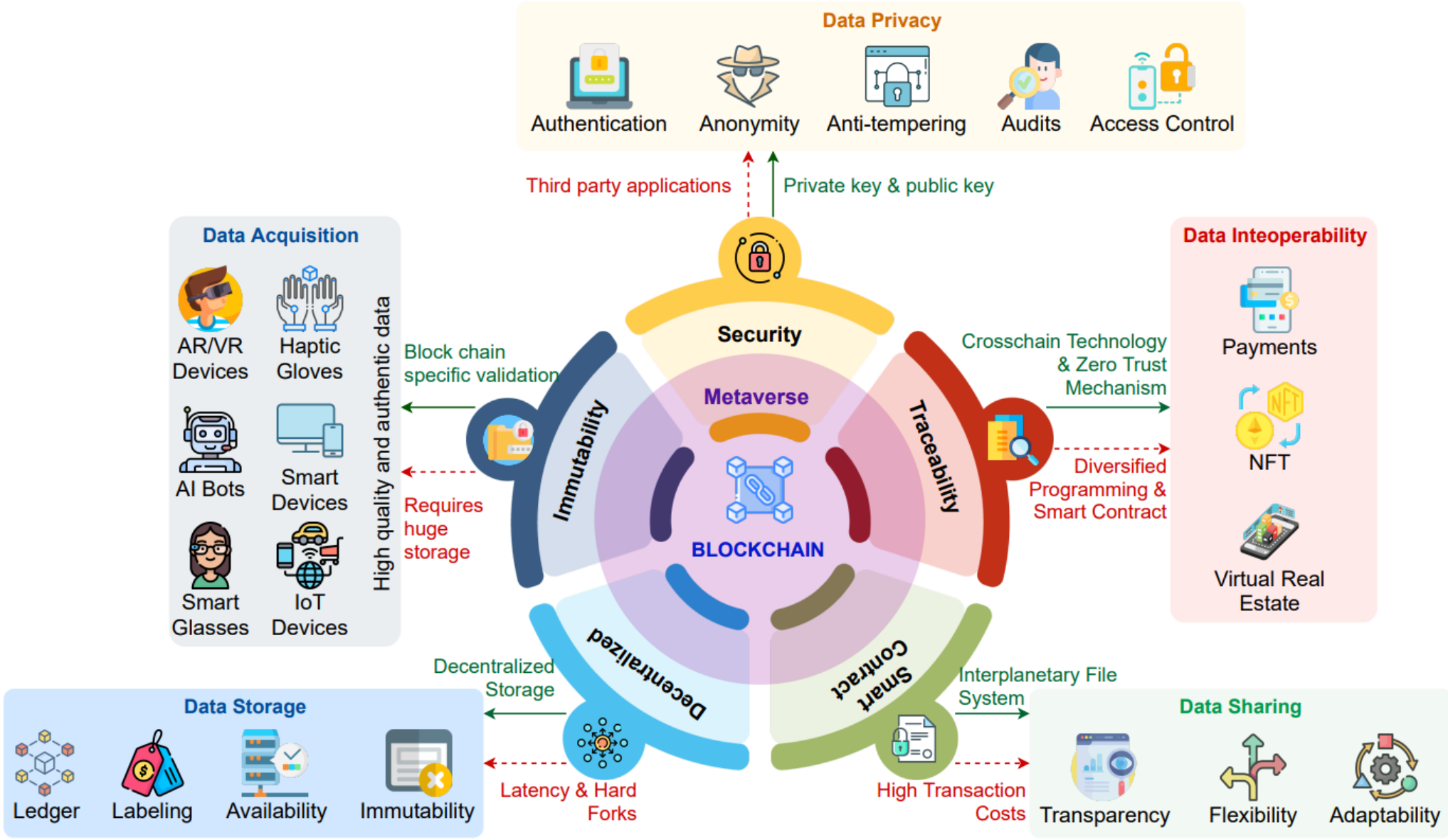
Source: Tuli, Esmot Ara, Jae-Min Lee, and Dong-Seong Kim (2024). "Integration of Quantum Technologies into Metaverse: Applications, Potentials, and Challenges." IEEE Access 12 (2024): 29995-30019.

Metaverse Economy



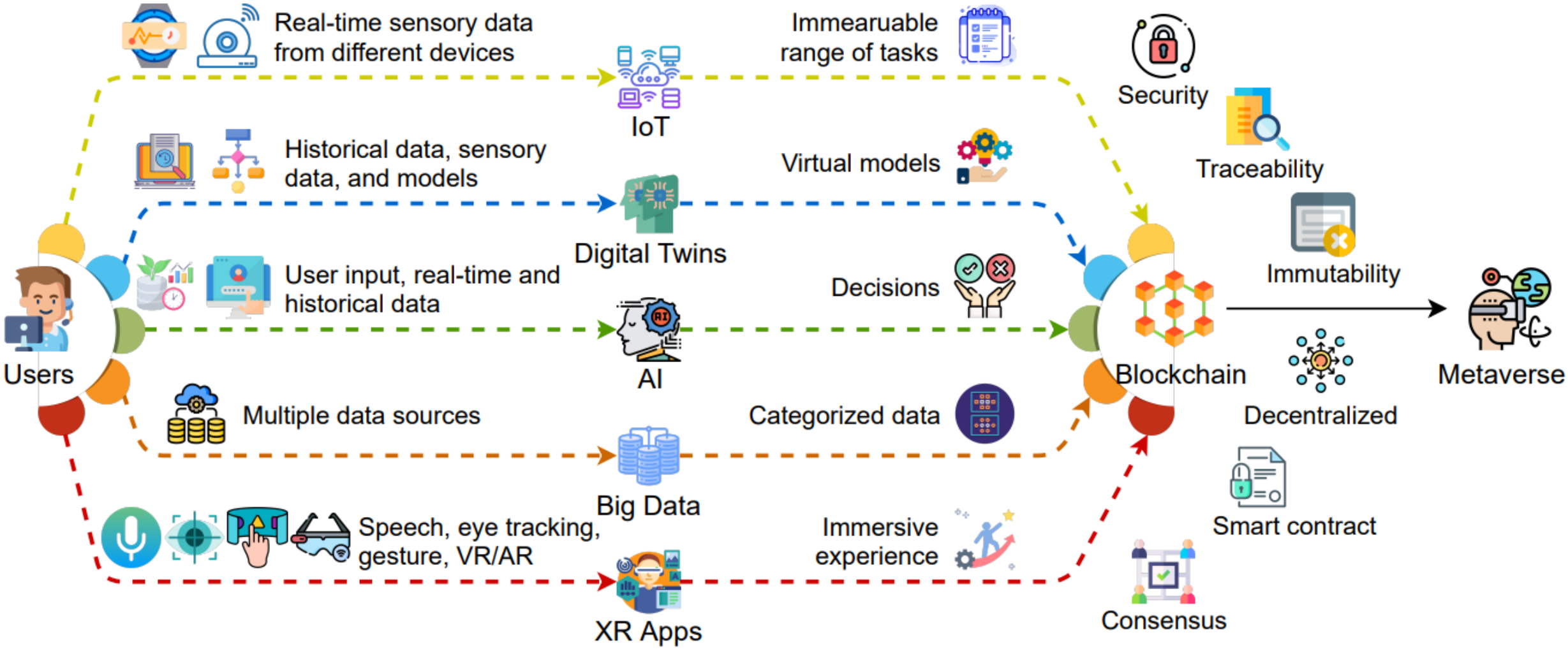
Source: Yang, Qinglin, Yetong Zhao, Huawei Huang, Zehui Xiong, Jiawen Kang, and Zibin Zheng (2022). "Fusing blockchain and AI with metaverse: A survey." IEEE Open Journal of the Computer Society 3 : 122-136.

Blockchain in the Metaverse



Source: Gadekallu, Thippa Reddy, Thien Huynh-The, Weizheng Wang, Gokul Yenduri, Pasika Ranaweera, Quoc-Viet Pham, Daniel Benevides da Costa, and Madhusanka Liyanage (2022). "Blockchain for the Metaverse: A Review." arXiv preprint arXiv:2203.09738..

Blockchain
for Key Enabling Technologies of the Metaverse



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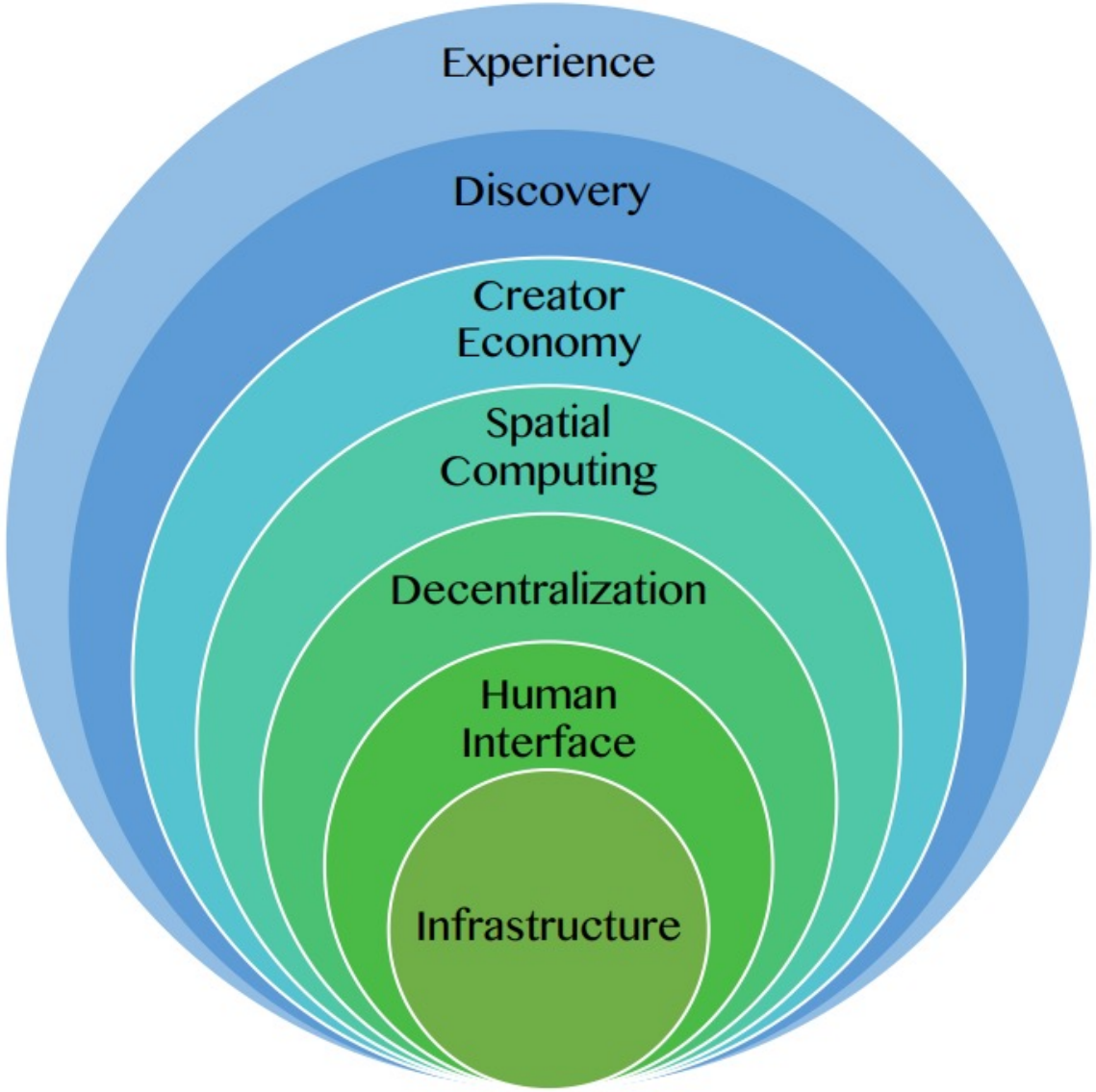
Seven Layers of a Metaverse Platform



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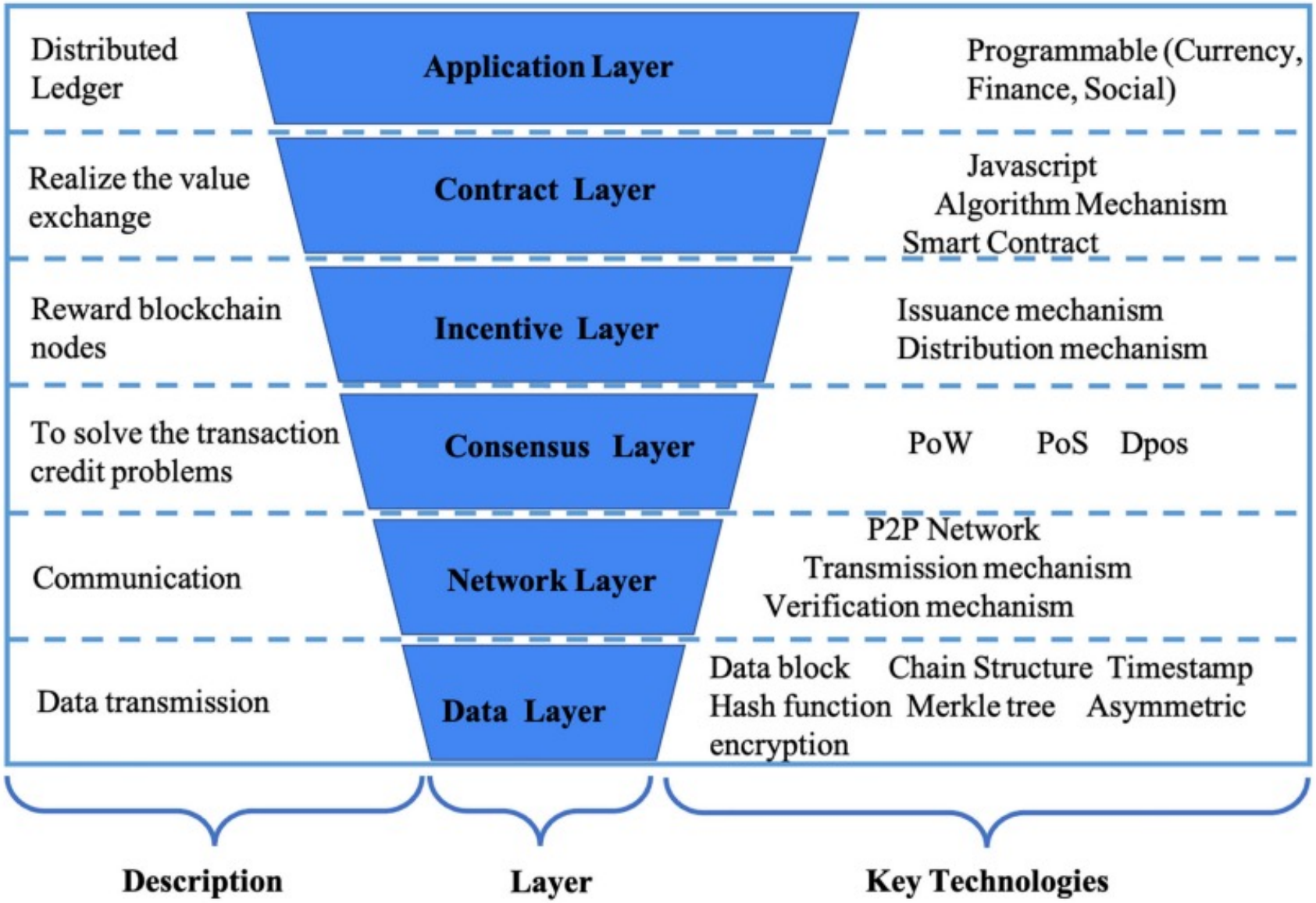
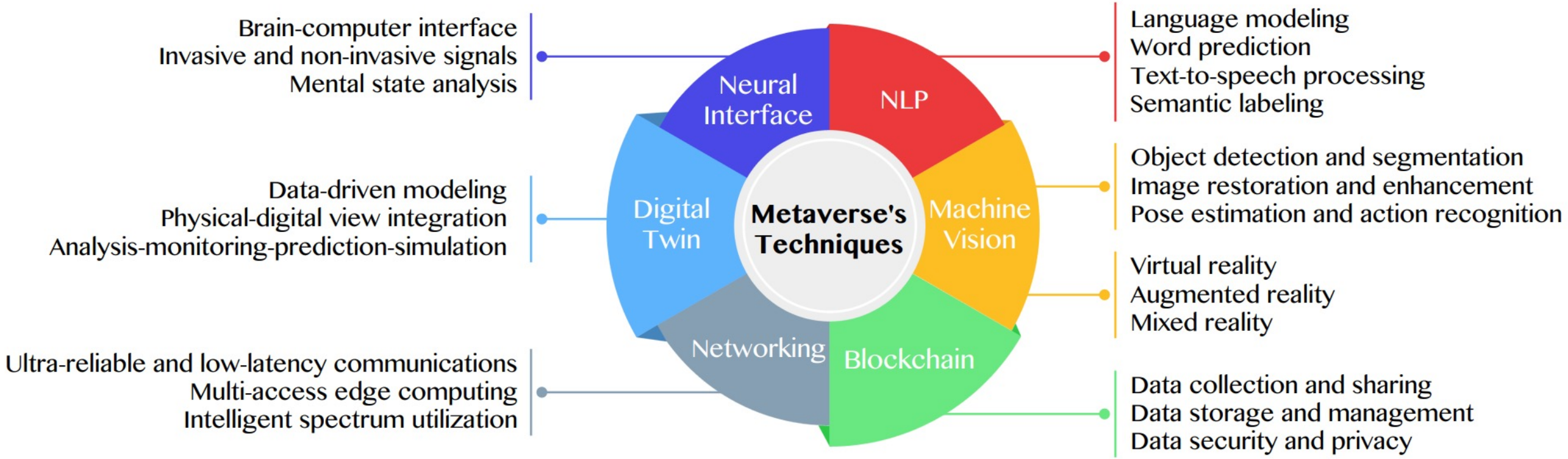
Layered Architecture of Blockchain



Source: Yang, Qinglin, Yetong Zhao, Huawei Huang, Zehui Xiong, Jiawen Kang, and Zibin Zheng (2022). "Fusing blockchain and AI with metaverse: A survey." IEEE Open Journal of the Computer Society 3 : 122-136.

Primary Technical Aspects in the Metaverse

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



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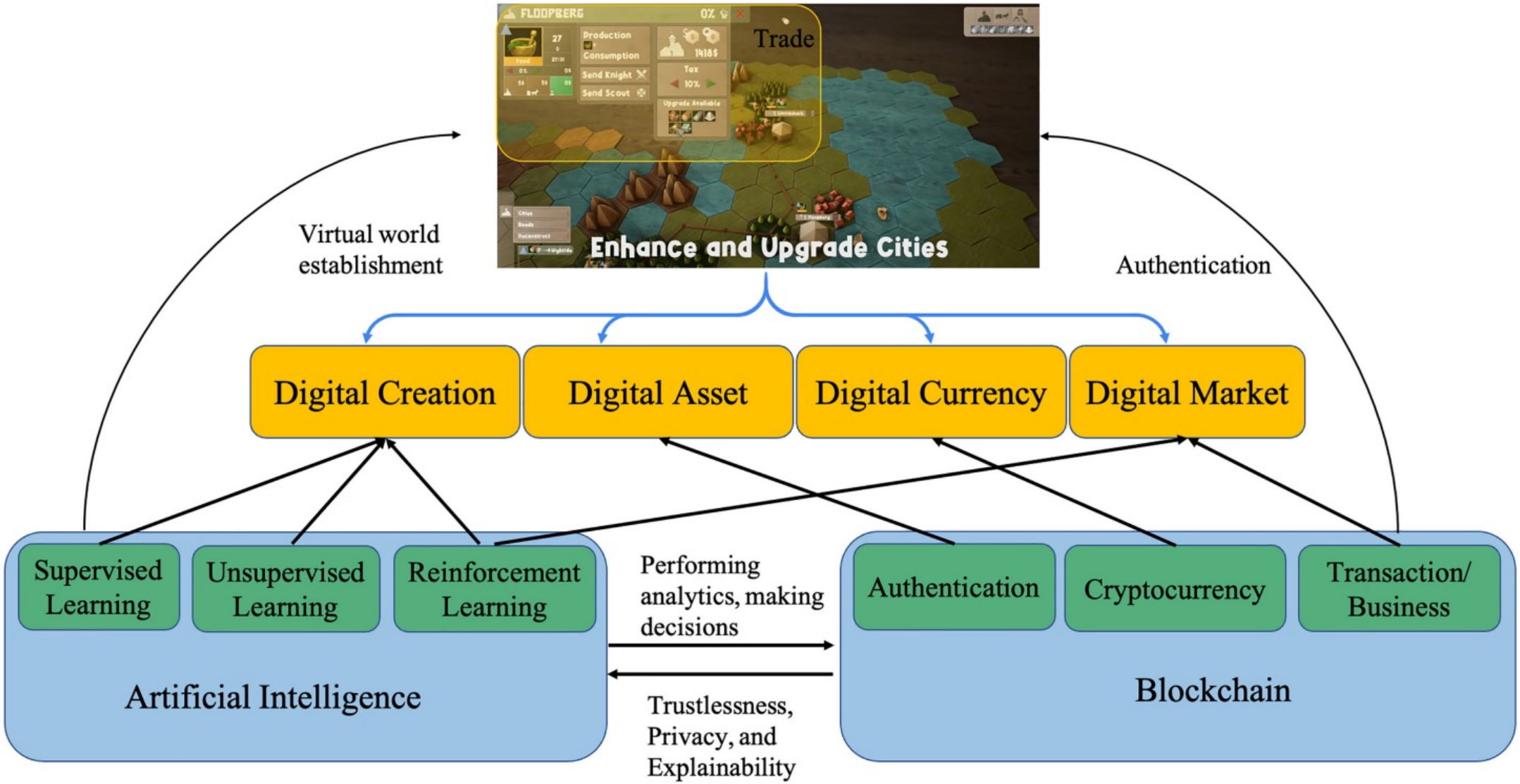
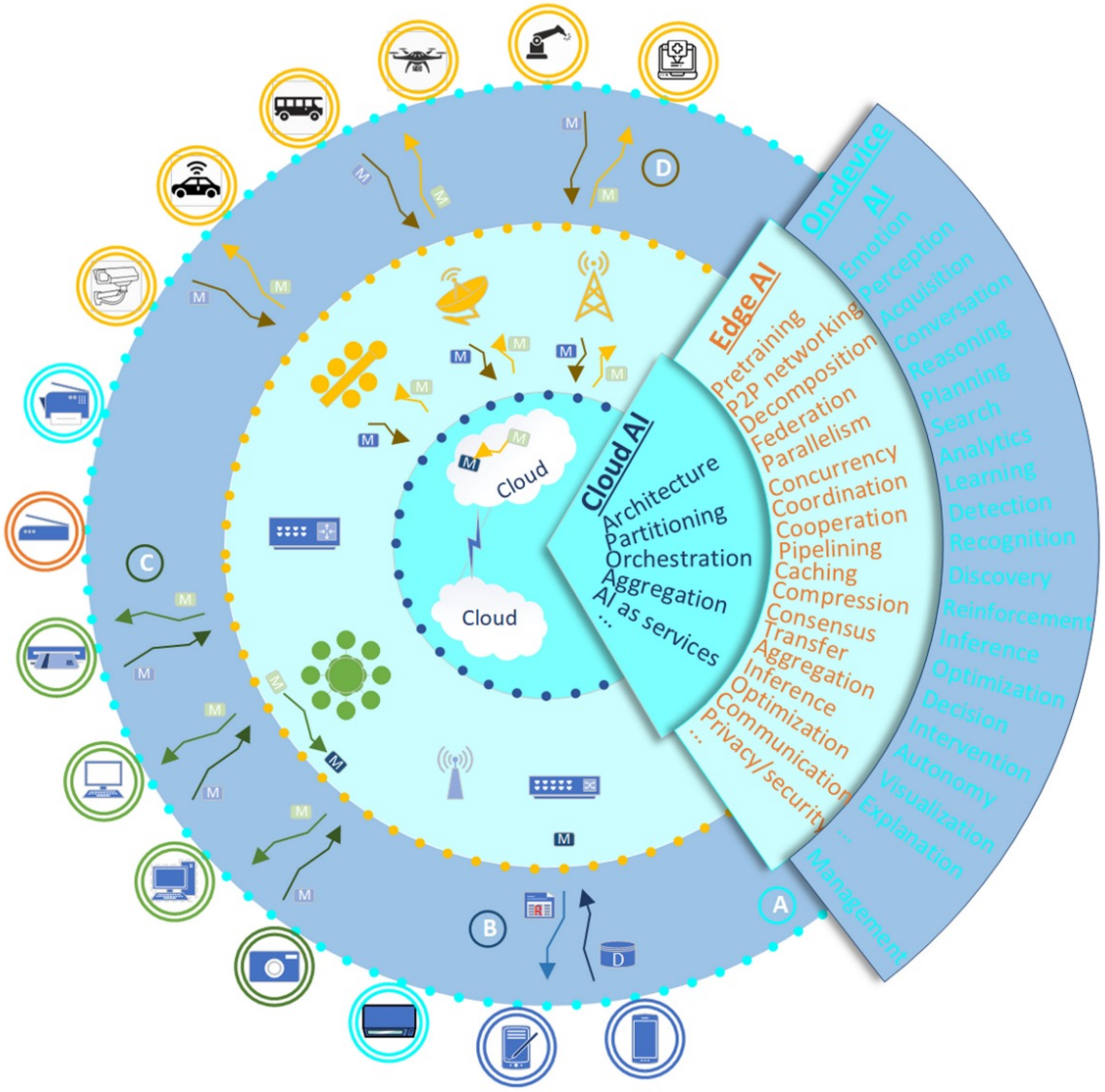
Fusion of AI and Blockchain in Metaverse



Source: Yang, Qinglin, Yetong Zhao, Huawei Huang, Zehui Xiong, Jiawen Kang, and Zibin Zheng (2022). "Fusing blockchain and AI with metaverse: A survey." IEEE Open Journal of the Computer Society 3 : 122-136.

DeAI:

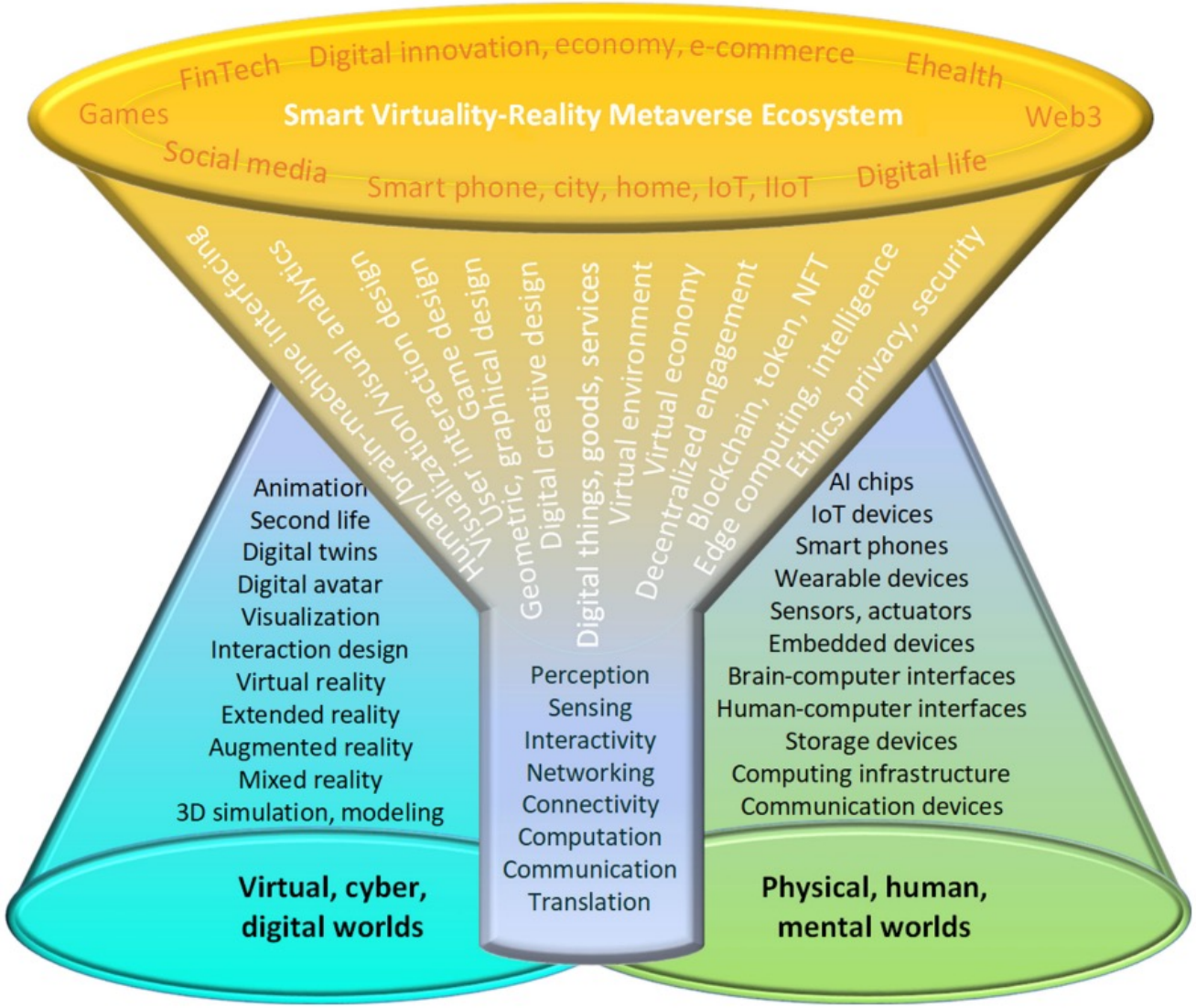
Synthesizing On-device AI, Edge AI, and Cloud AI



Source: Cao, Longbing (2022). "Decentralized ai: Edge intelligence and smart blockchain, metaverse, web3, and desci." IEEE Intelligent Systems 37, no. 3: 6-19.

Smart Virtuality-Reality Metaverse Ecosystem:

Metasynthesizing DeAI, Metaverse, Blockchain, Web3



Source: Cao, Longbing (2022). "Decentralized ai: Edge intelligence and smart blockchain, metaverse, web3, and desci." IEEE Intelligent Systems 37, no. 3: 6-19.

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

XR

Extended Reality

Entire experience spectrum from fully virtual to fully real

VR

Virtual Reality

User is completely immersed into a virtual world

MR

Mixed Reality

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

AR

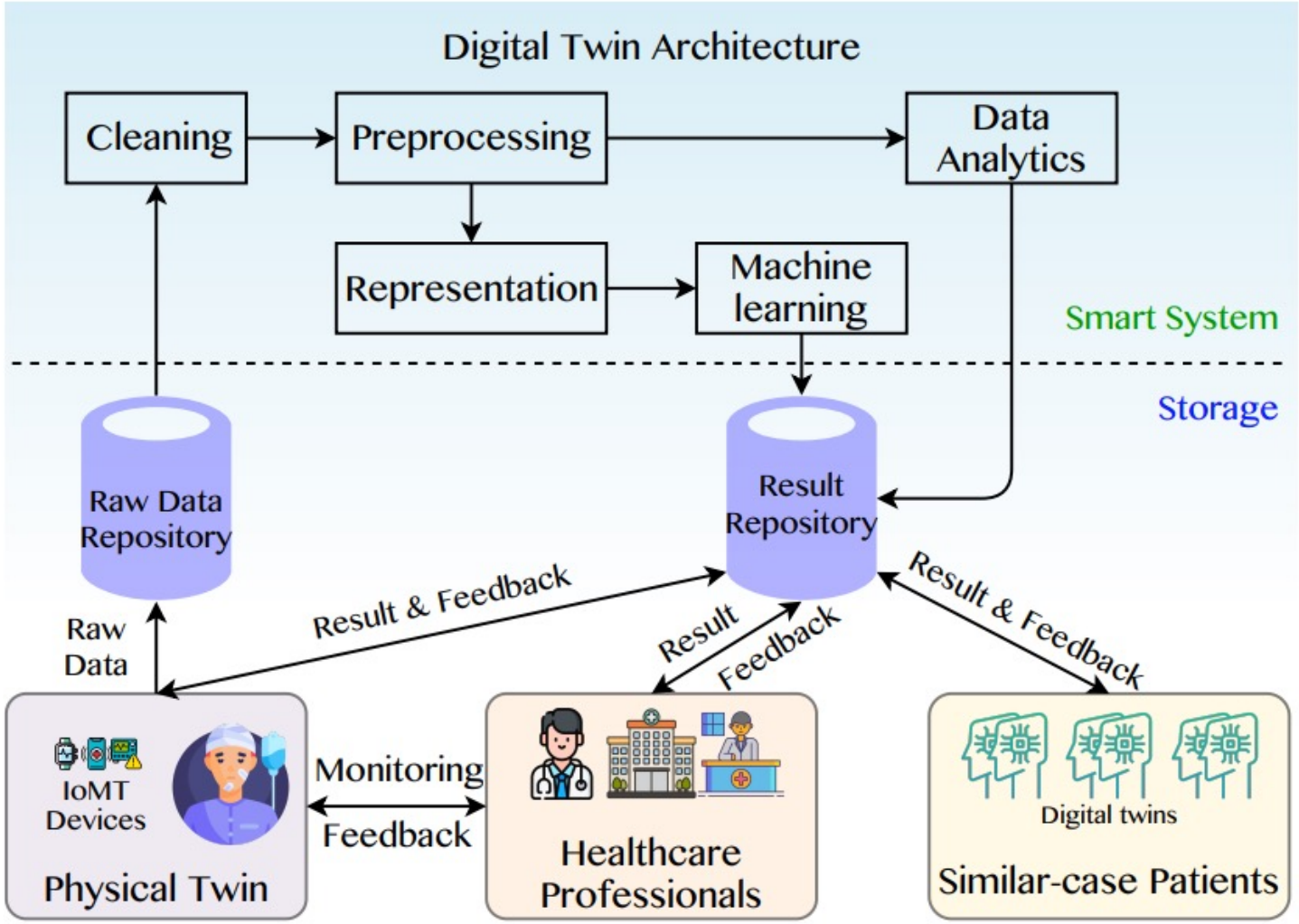
Augmented Reality

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

Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Qui 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



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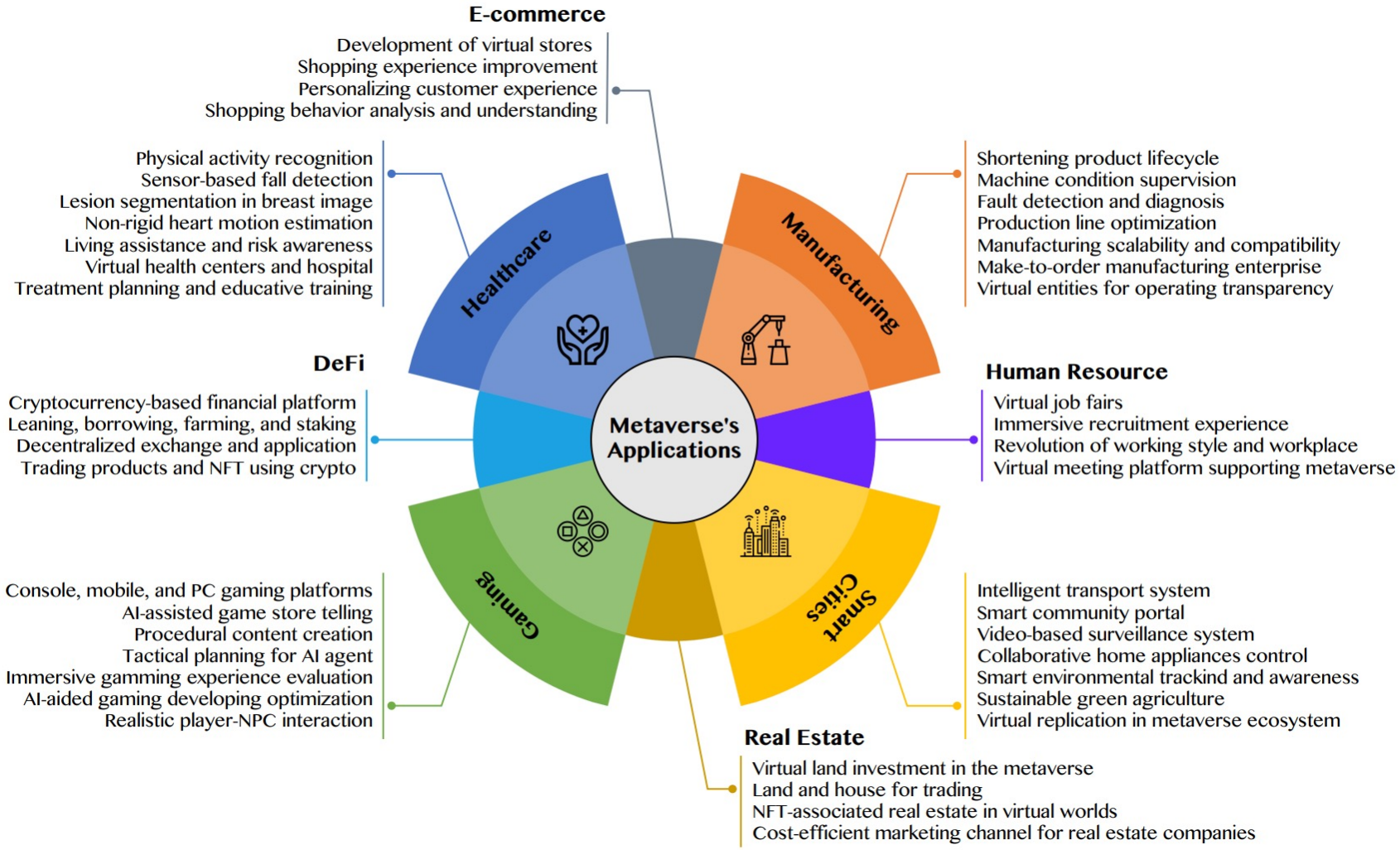
AI for the Metaverse

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.

Source: Huynh-The, Thien, Quoc-Viet Pham, Xuan-Qui 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 in the Application Aspects

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



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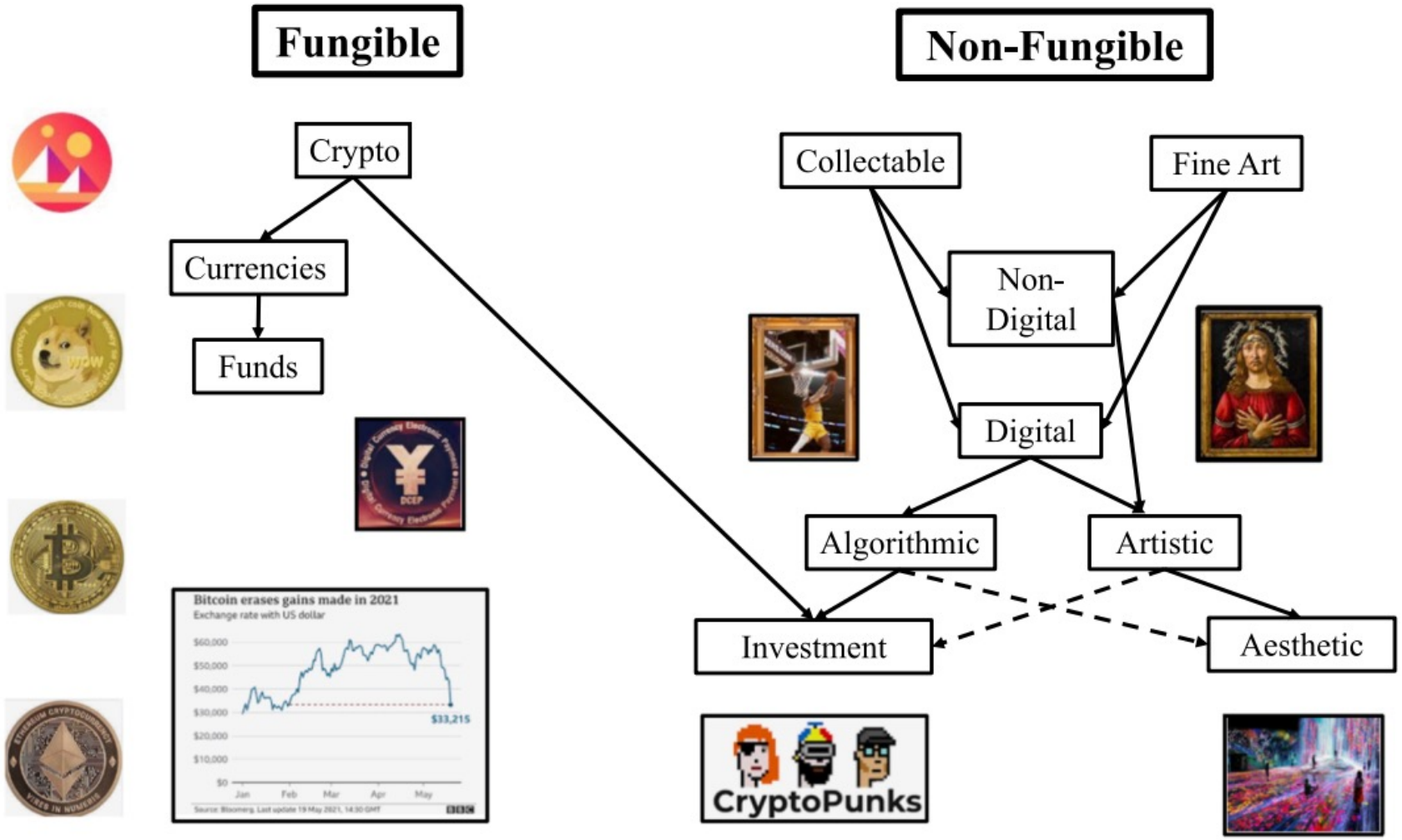
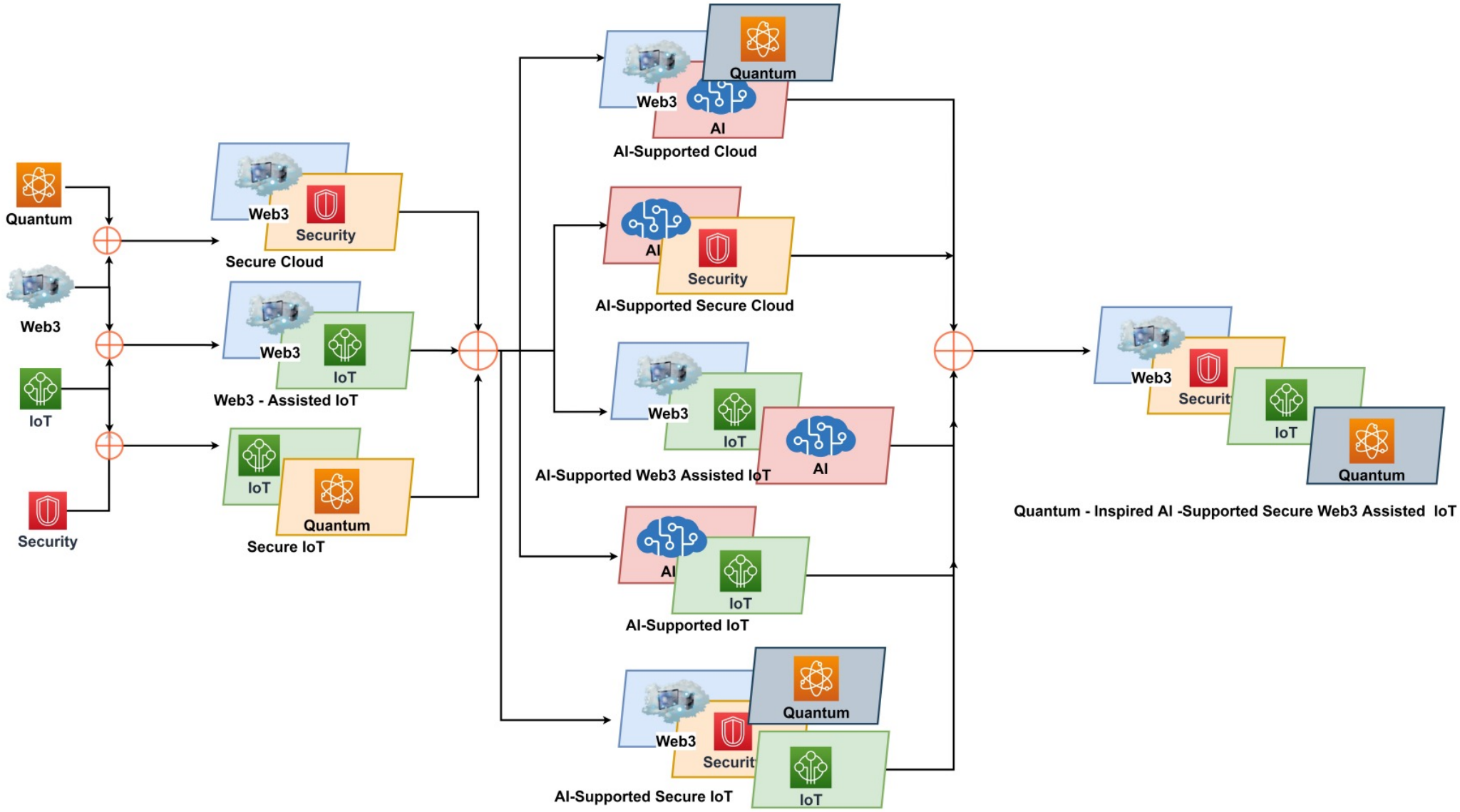
Blockchain-Registered: Crypto, Collectables, and Art.



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.

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.

FinTech

Financial Technology
FinTech

"providing
financial services
by making use of
software and
modern technology"

Source: https://www.fintechweekly.com/fintech-definition

Financial Technology

Financial Services

FinTech: Financial Services Innovation

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

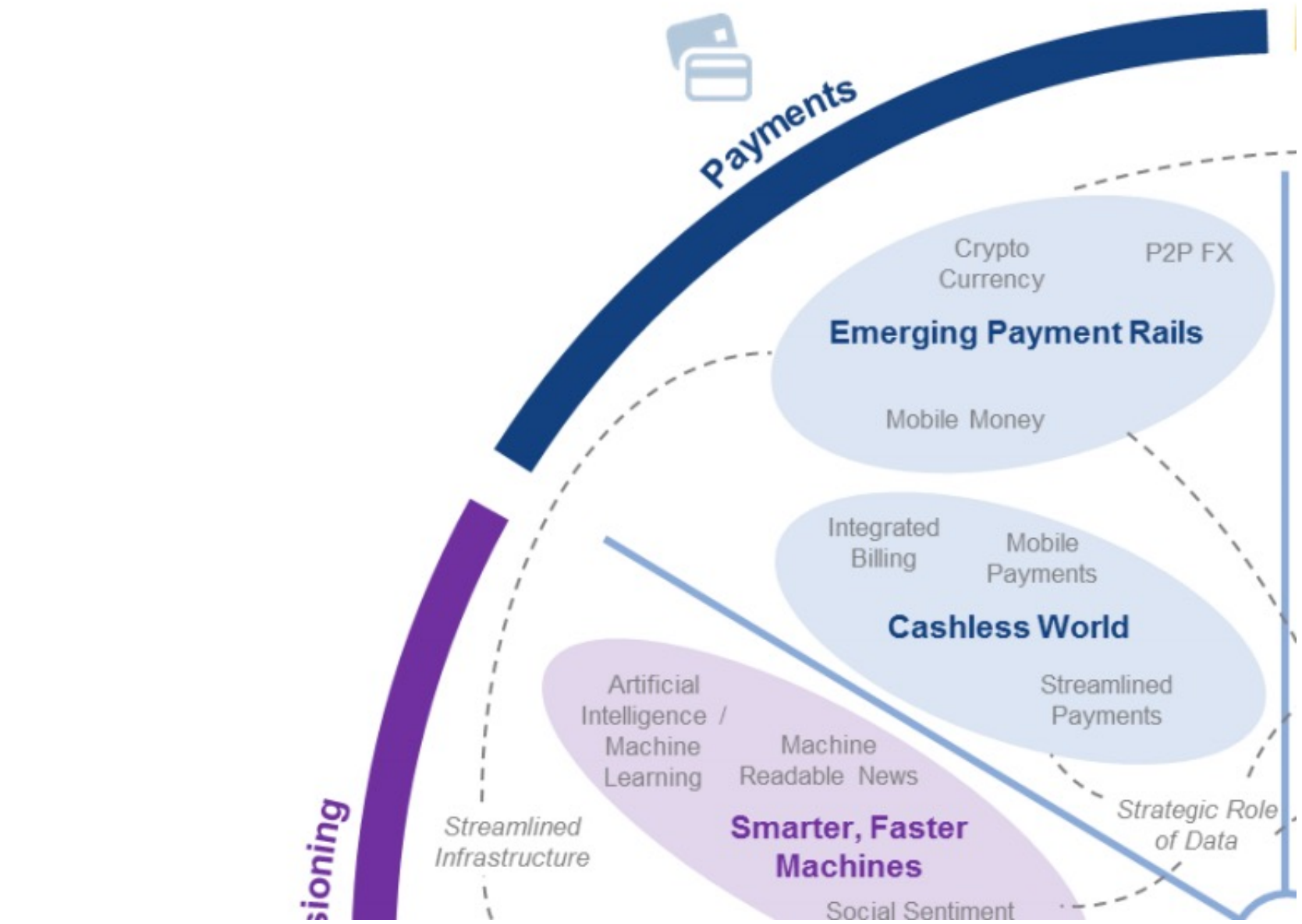
FinTech:

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

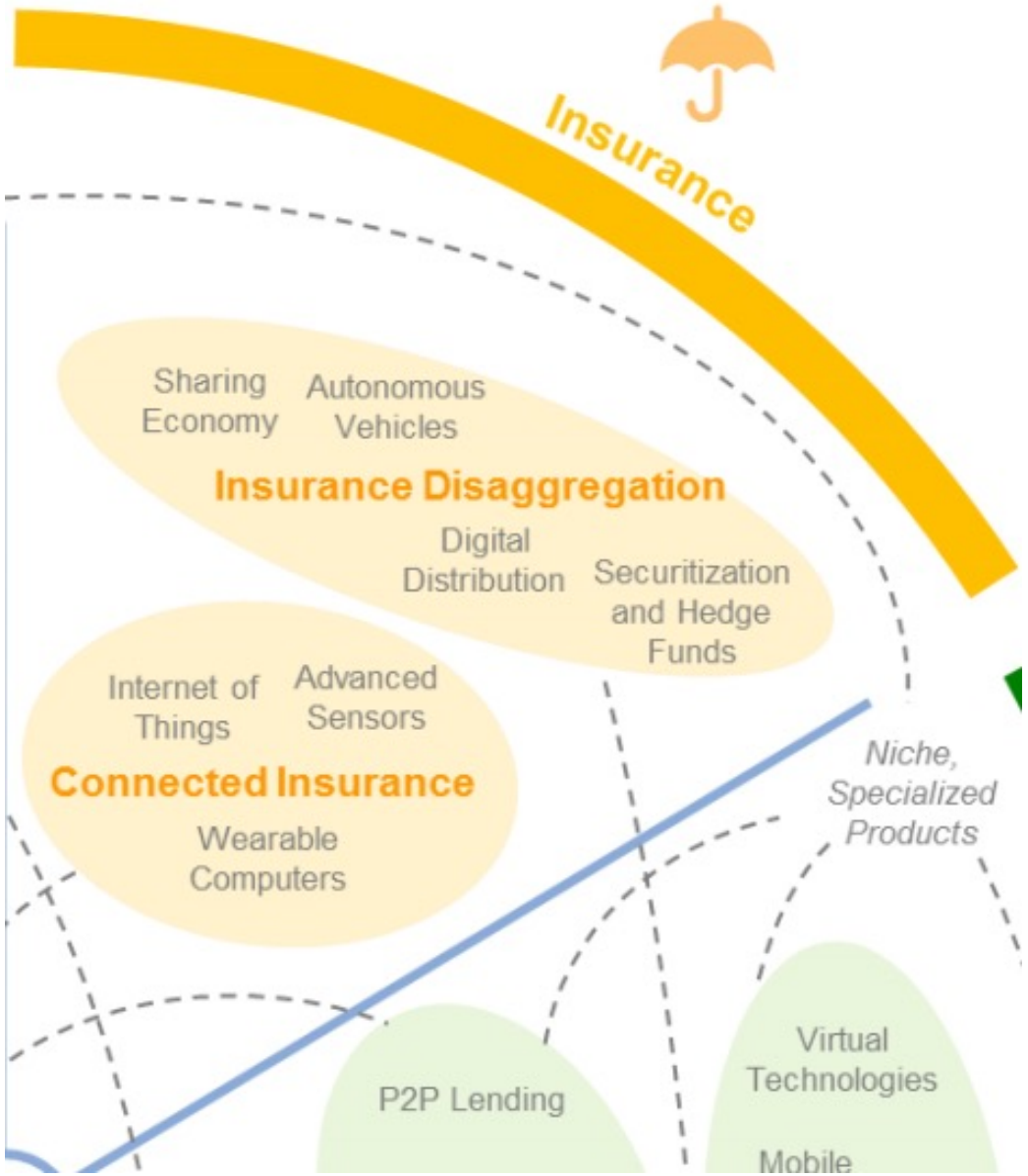
1 FinTech: Payment



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

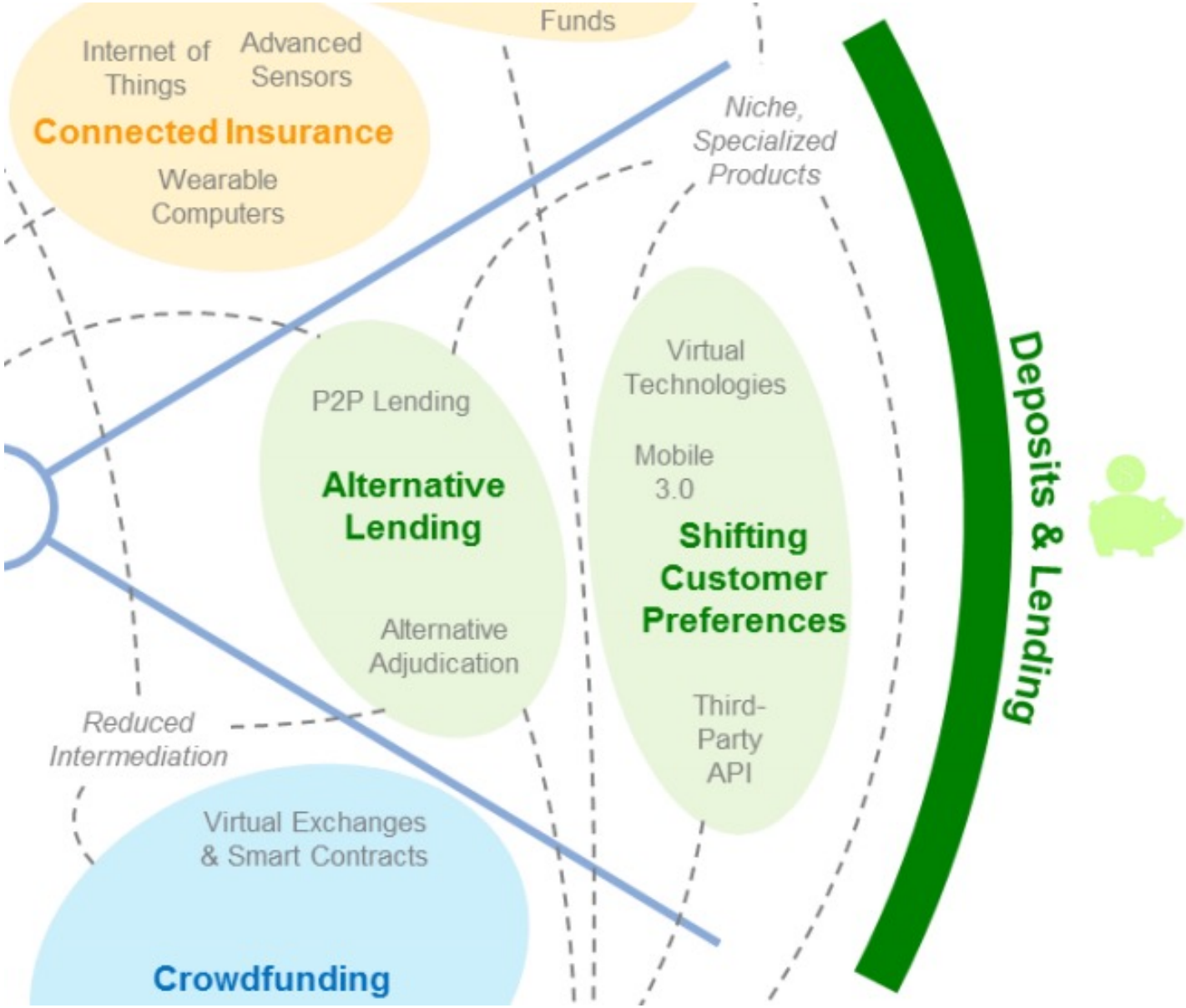
2

FinTech: Insurance



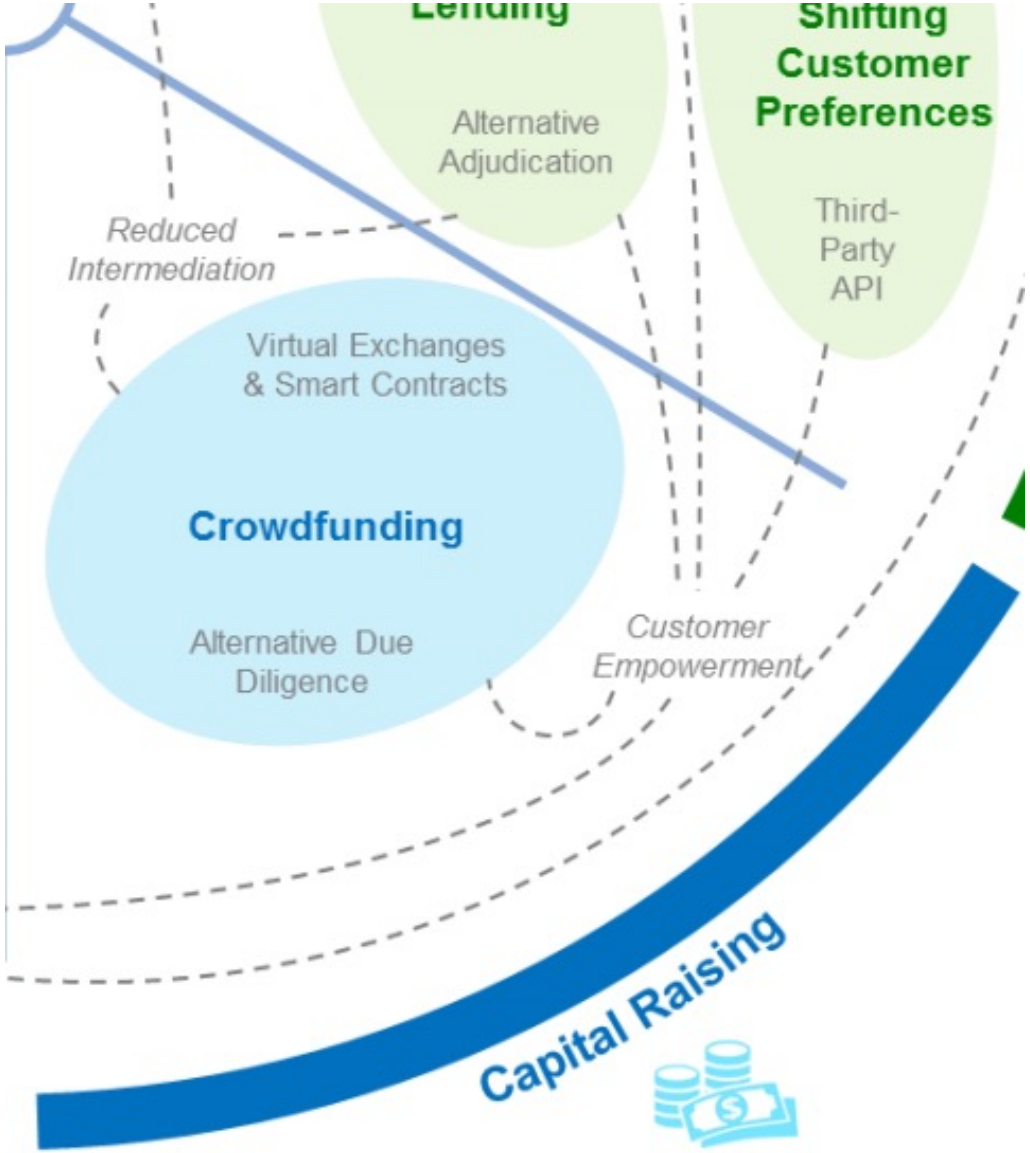
Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

3 FinTech: Deposits & Lending



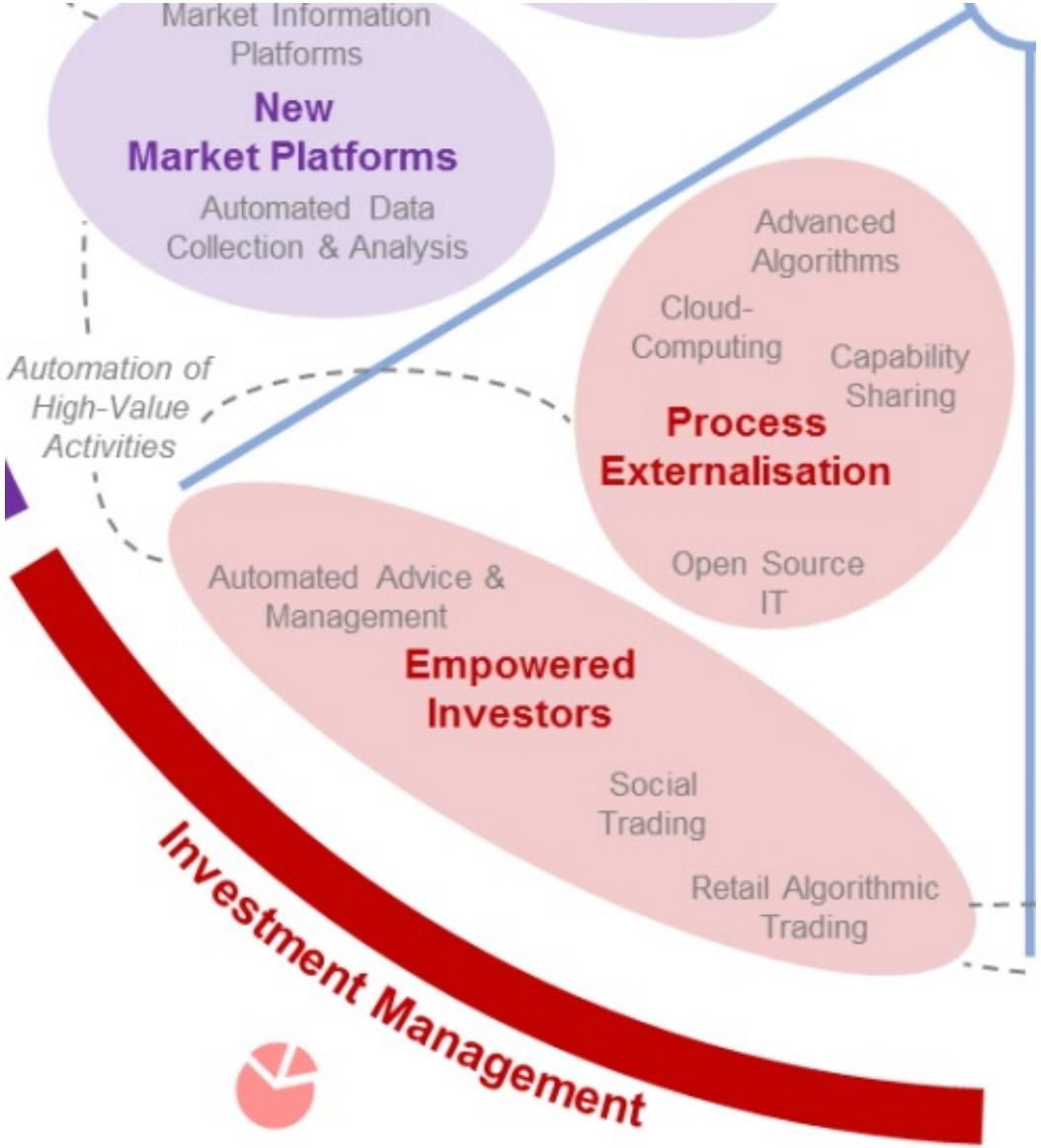
Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

4 FinTech: Capital Raising



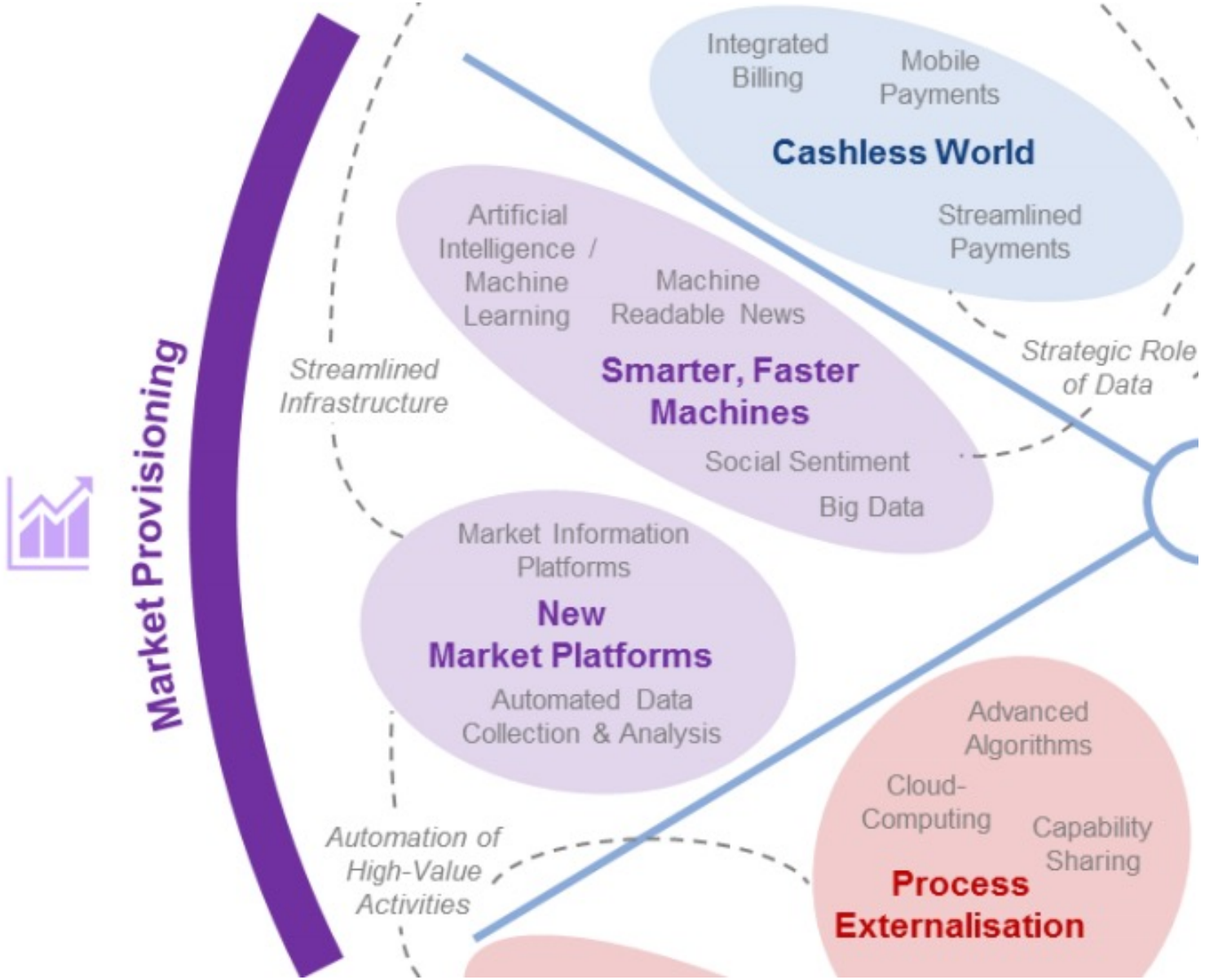
Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

5 FinTech: Investment Management



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

6 FinTech: Market Provisioning



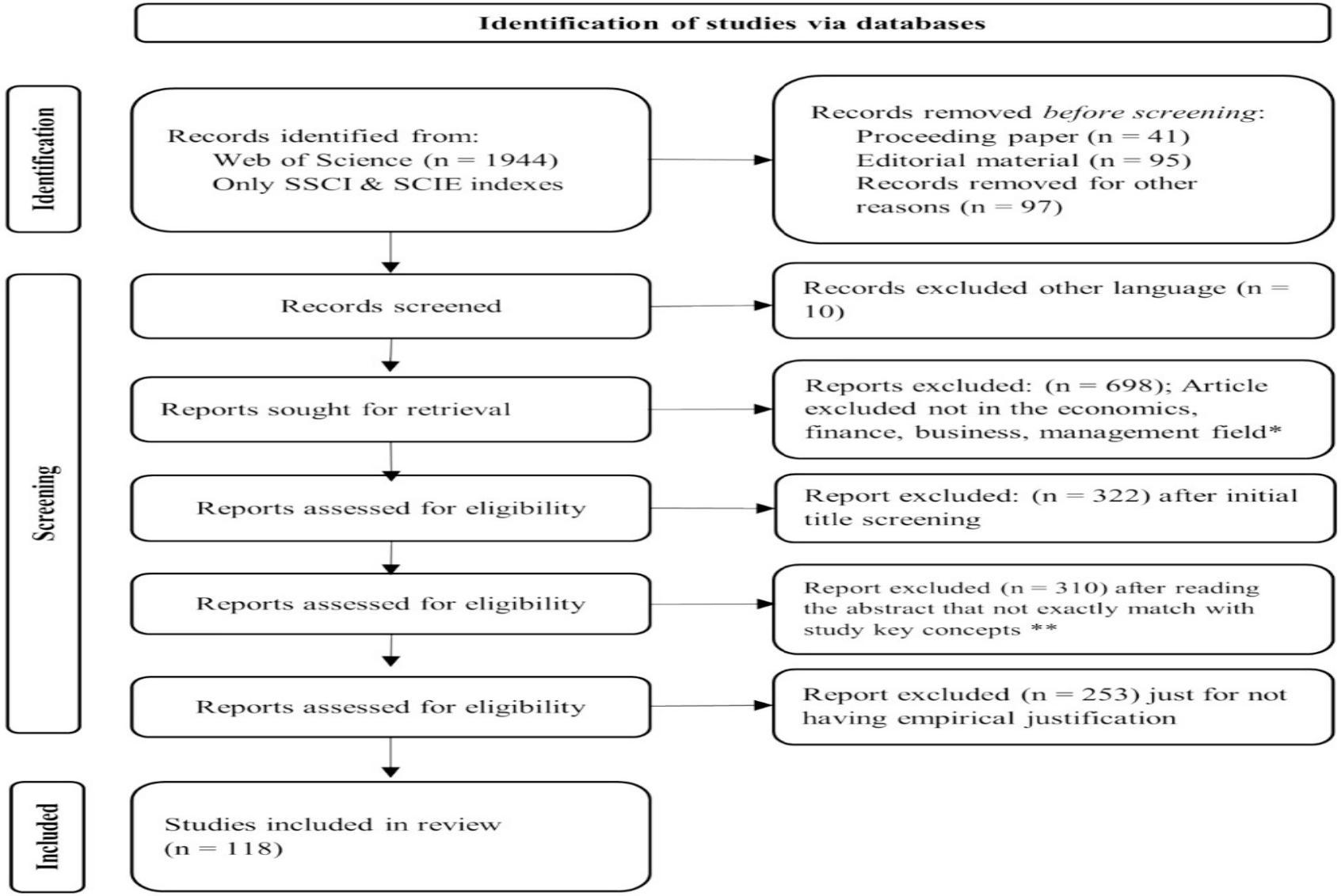
Source: http://www3.weforum.org/docs/WEF_The_future__of_financial_services.pdf

FinTech Research Published in Elite Journals

Financial Time 50 Journal (FT50)	Count	ABDC	ABS
FT50 Finance and Economics domain			
Review of Financial Studies	32	A*	4*
Journal of Financial and Quantitative Analysis	11	A*	4
Review of Economic Studies	4	A*	4*
Journal of Financial Economics	3	A*	4*
Journal of Finance	2	A*	4*
Review of Finance	2	A*	4
FT50 Others domain			
Harvard Business Review	15	A	3
Journal of Management Information Systems	9	A*	4
Entrepreneurship Theory and Practice	7	A*	4
Research Policy	6	A*	4*
Management Science	5	A*	4*
Sloan Management Review	5	A	3
The Accounting Review	3	A*	4*
Production and Operations Management	2	A*	4
Information Systems Research	1	A*	4*
Journal of Operations Management	1	A*	4*
MIS Quarterly	1	A*	4*
Organization Science	1	A*	4*
Strategic Management Journal	1	A*	4*

Source: Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024).
"FinTech and sustainable development: A systematic thematic analysis using human-and machine-generated processing." International Review of Financial Analysis 95 (2024): 103473.

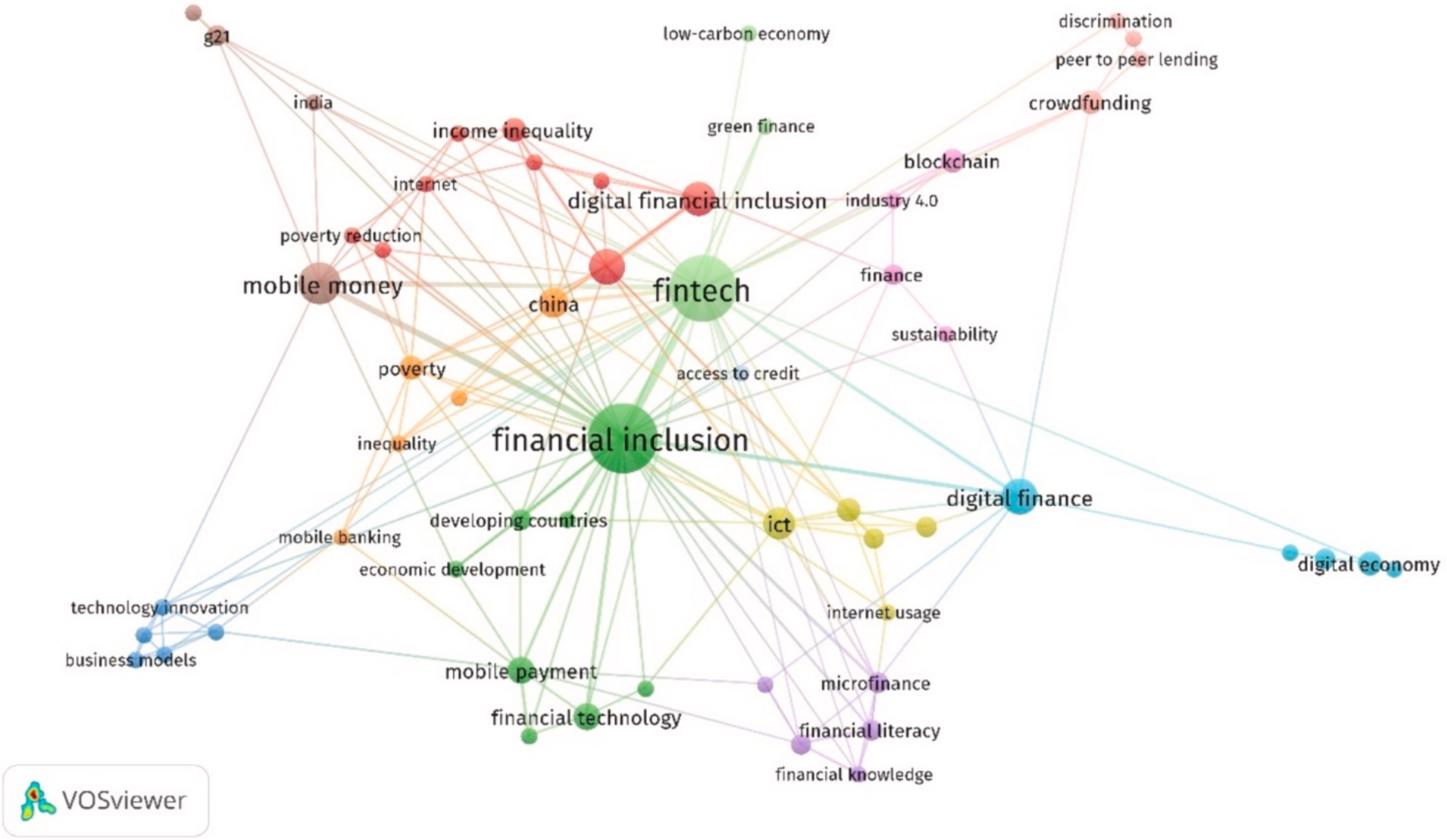
PRISMA of FinTech and Sustainable Development



Source: Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024).
"FinTech and sustainable development: A systematic thematic analysis using human-and machine-generated processing." International Review of Financial Analysis 95 (2024): 103473.

FinTech and Sustainable Development

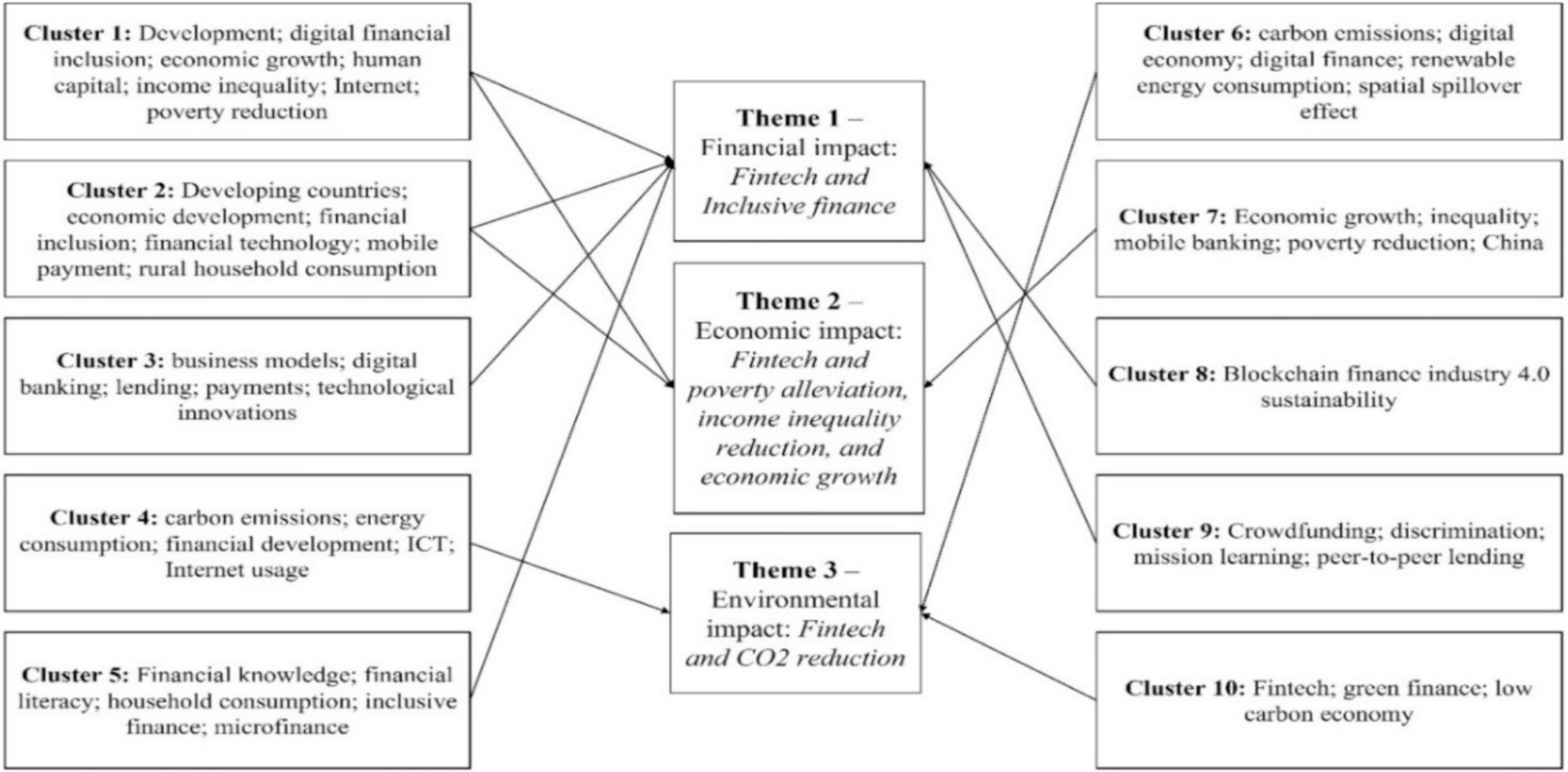
(clustering and co-occurrence networking)



Source: Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024).
"FinTech and sustainable development: A systematic thematic analysis using human-and machine-generated processing." International Review of Financial Analysis 95 (2024): 103473.

FinTech and Sustainable Development

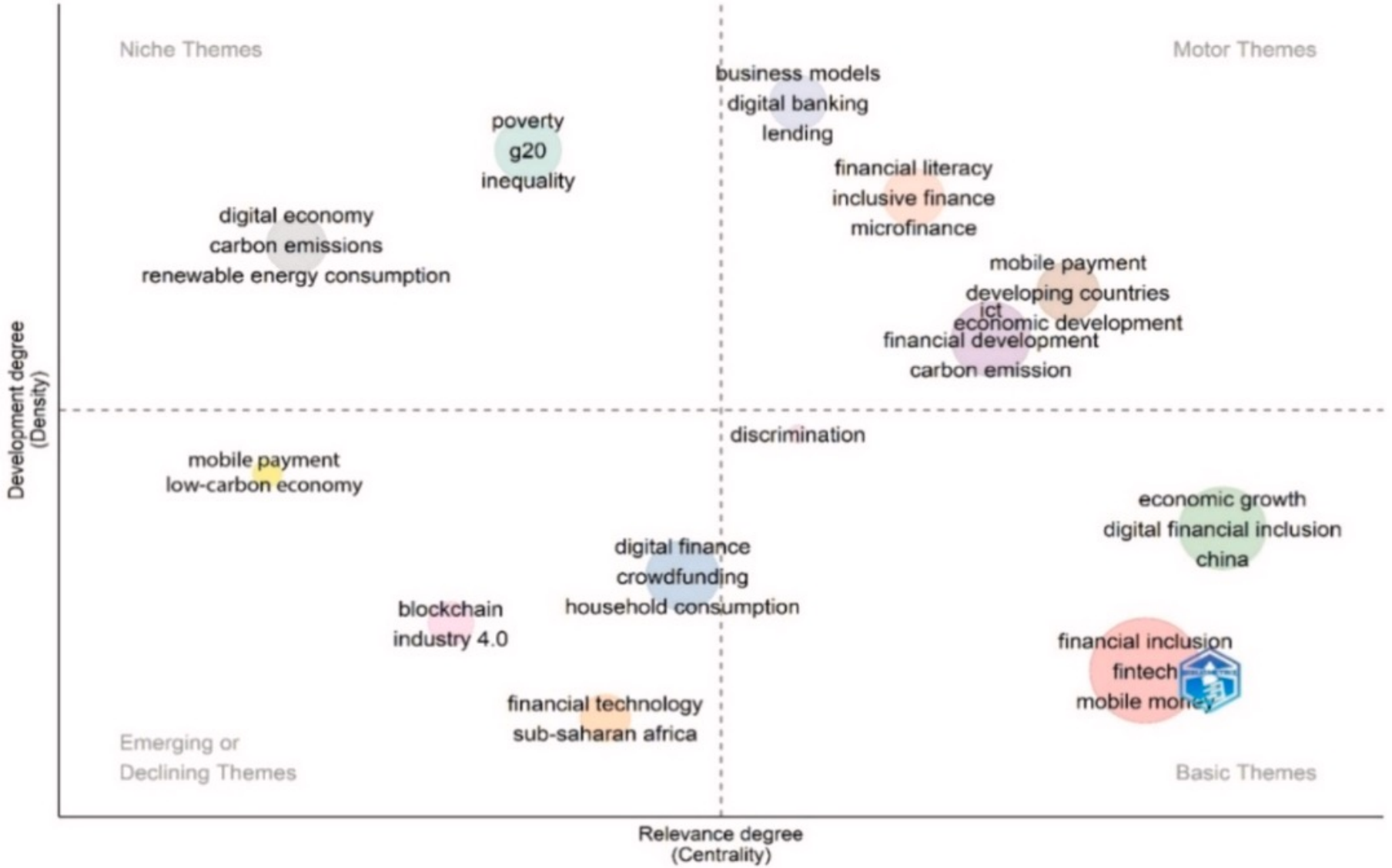
(Human specified themes and machine clustering)



Source: Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024).
"FinTech and sustainable development: A systematic thematic analysis using human-and machine-generated processing." International Review of Financial Analysis 95 (2024): 103473.

FinTech and Sustainable Development

(Thematic mapping)



Source: Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024).
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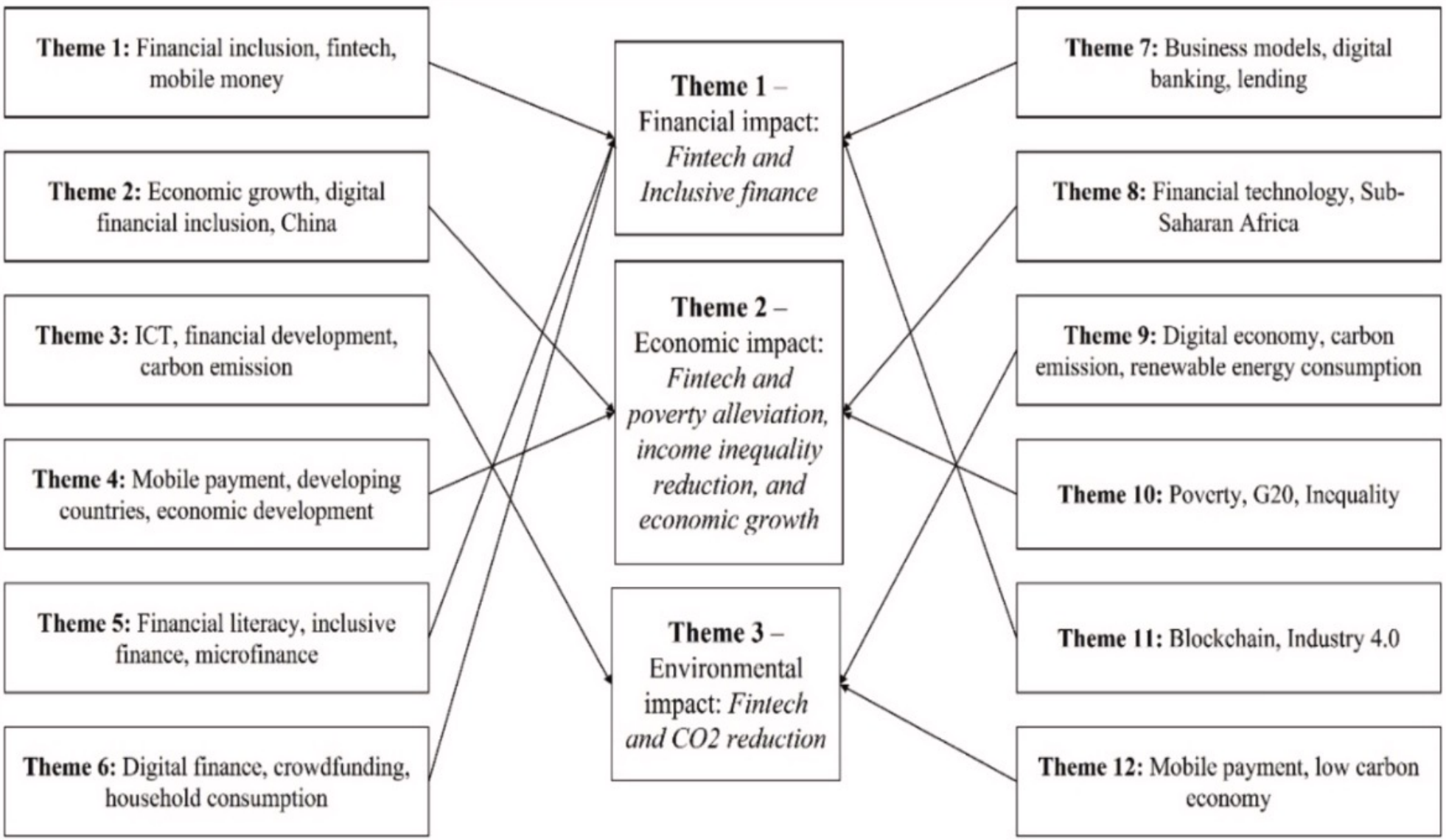
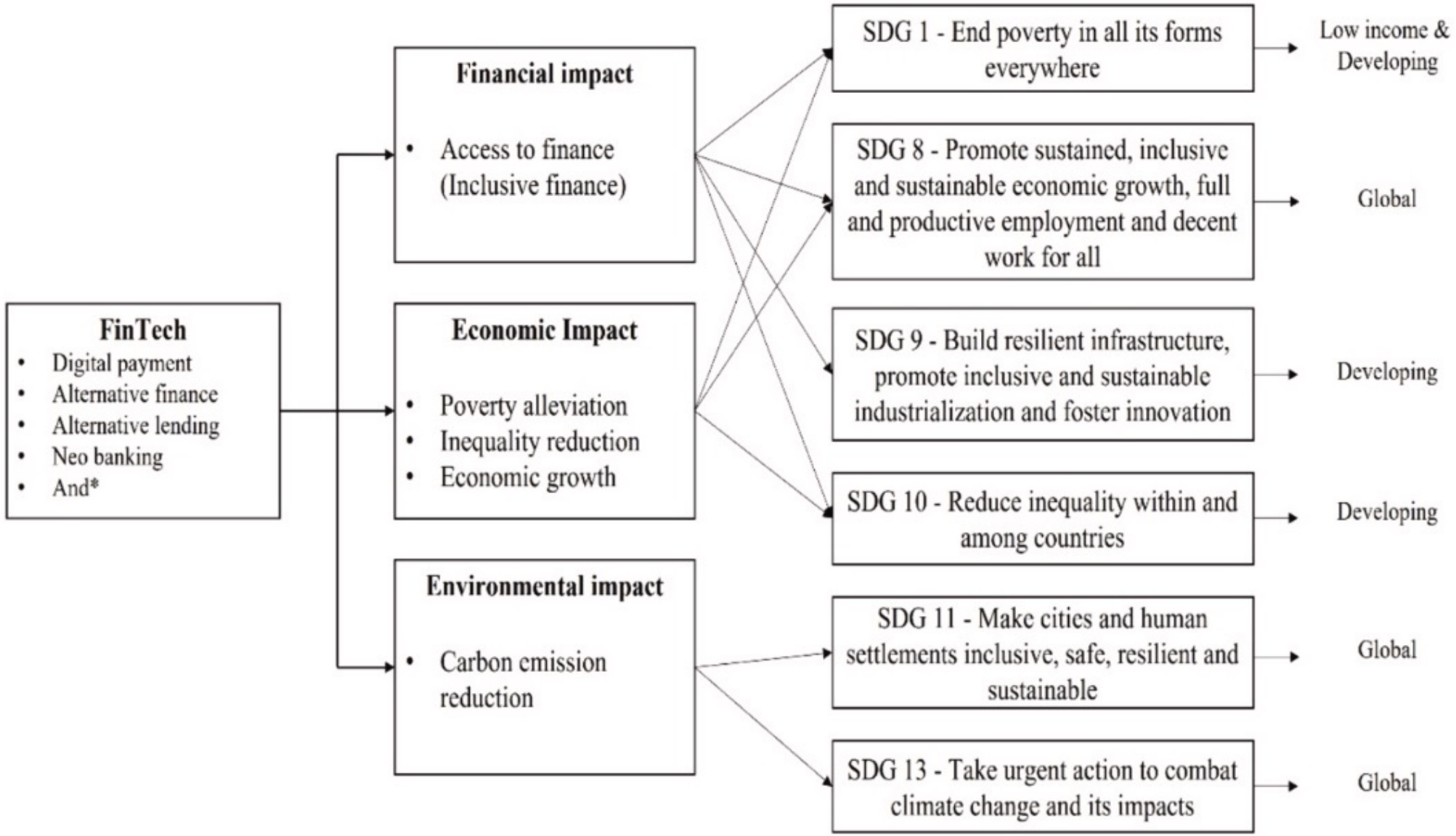
FinTech and Sustainable Development

(Thematic mapping)



Source: Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024).
"FinTech and sustainable development: A systematic thematic analysis using human-and machine-generated processing." International Review of Financial Analysis 95 (2024): 103473.

FinTech and SDGs



Source: Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024).
"FinTech and sustainable development: A systematic thematic analysis using human-and machine-generated processing." International Review of Financial Analysis 95 (2024): 103473.

FinTech Products and Services

- AI-based financial applications
- Big data-based technologically innovative financial products
- Blockchain-enhanced emissions-trading systems
- Financial innovations (innovative patents)
- Mobile payment, mobile savings
- Alternative finance (crowdfunding and P2P lending)
- Consumer lending, student microlending
- Online lending through community-based organizations

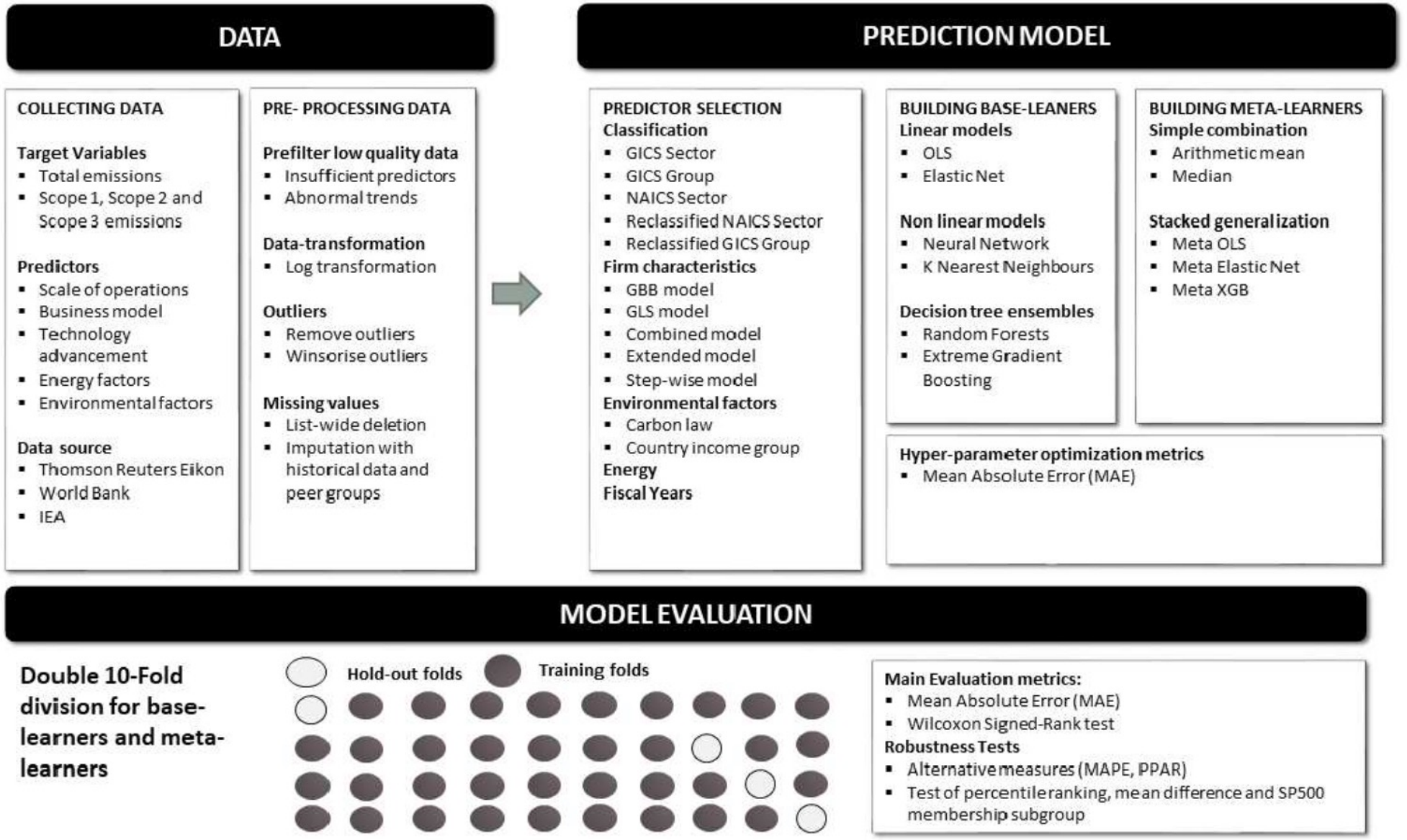
Source: Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024).
"FinTech and sustainable development: A systematic thematic analysis using human-and machine-generated processing." International Review of Financial Analysis 95 (2024): 103473.

FinTech and Sustainable Development

- **Dimension 1: Financial Impact**
  - **FinTech → Inclusive Finance → Sustainable Development**
  - **Focus: Access to finance, financial inclusion, innovative financial services**
- **Dimension 2: Economic Impact**
  - **FinTech → Economy Boosting → Sustainable Development**
  - **Focus: Poverty alleviation, income inequality reduction, economic growth**
- **Dimension 3: Environmental Impact**
  - **FinTech → Environment Quality → Sustainable Development**
  - **Focus: CO2 emissions reduction, green finance, renewable energy**

Source: Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024).
"FinTech and sustainable development: A systematic thematic analysis using human-and machine-generated processing." International Review of Financial Analysis 95 (2024): 103473.

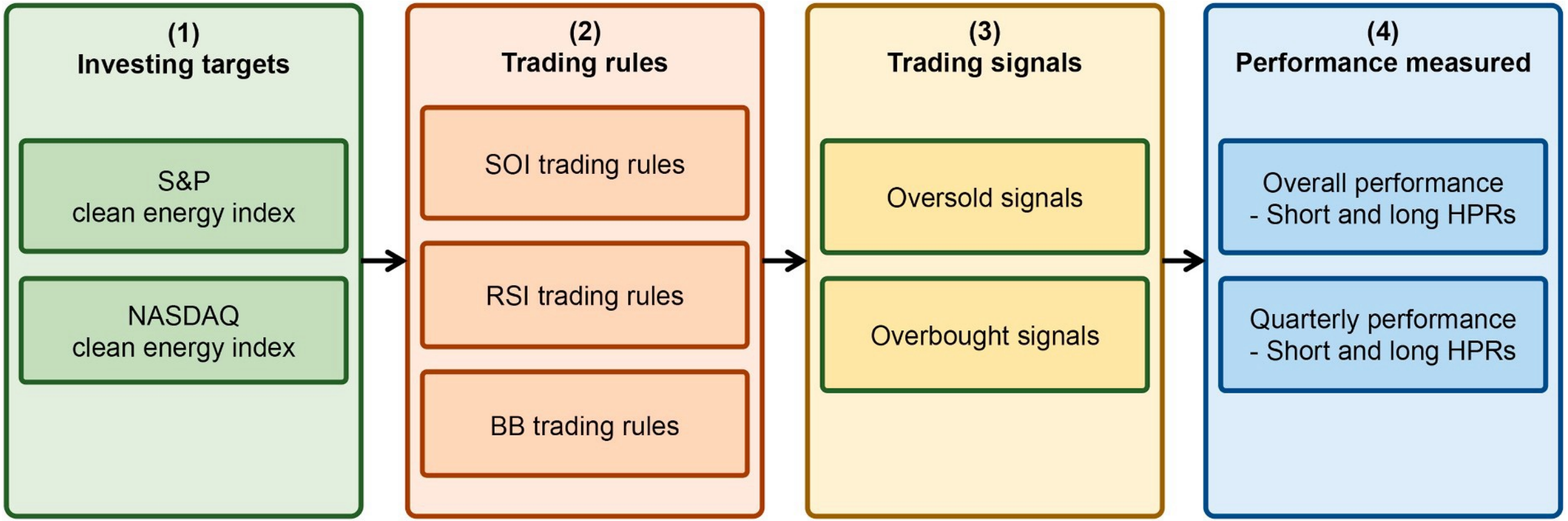
Modelling Strategy to Forecast Carbon Emissions with AI



Source: Brière, M., Keip, M., & Le Berthe, T. (2022). Artificial Intelligence for Sustainable Finance: Why it May Help. Available at SSRN 4252329.

Research Framework

Do clean energy indices outperform using contrarian strategies



Source, Min-Yuh Day and Yensen Ni (2023), "Do clean energy indices outperform using contrarian strategies based on contrarian trading rules?", Energy, Volume 272, 1 June 2023, 127113.

Artificial Intelligence for Sustainable Finance

- **Why AI may help sustainable finance?**
  - Brière, M., Keip, M., & Le Berthe, T. (2022). Artificial Intelligence for Sustainable Finance: Why it May Help. Available at SSRN 4252329.
- **How does artificial intelligence boost sustainable development?**
  - Schoormann, T., Strobel, G., Möller, F., Petrik, D., & Zschech, P. (2023). Artificial Intelligence for Sustainability—A Systematic Review of Information Systems Literature. Communications of the Association for Information Systems, 52(1), 8.
- **Does sustainability generate better financial performance?**
  - Atz, U., Van Holt, T., Liu, Z. Z., & Bruno, C. C. (2023). Does sustainability generate better financial performance? review, meta-analysis, and propositions. Journal of Sustainable Finance & Investment, 13(1), 802-825.
- **What are the major research topics in AI for Sustainable finance?**
  - Kumar, S., Sharma, D., Rao, S., Lim, W. M., & Mangla, S. K. (2022). Past, present, and future of sustainable finance: Insights from big data analytics through machine learning of scholarly research. Annals of Operations Research, 1-44.

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.

Source: https://ethereum.org/en/defi/

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.

Source: https://ethereum.org/en/defi/

DeFi vs. CeFi

Decentralized Finance (DeFi)	Traditional Finance (Centralized Finance; CeFi)
You hold your money.	Your money is held by companies.
You control where your money goes and how it's spent.	You have to trust companies not to mismanage your money, like lend to risky borrowers.
Transfers of funds happen in minutes.	Payments can take days due to manual processes.
Transaction activity is pseudonymous.	Financial activity is tightly coupled with your identity.
DeFi is open to anyone.	You must apply to use financial services.
The markets are always open.	Markets close because employees need breaks.
It's built on transparency – anyone can look at a product's data and inspect how the system works.	Financial institutions are closed books: you can't ask to see their loan history, a record of their managed assets, and so on.

Source: https://ethereum.org/en/defi/

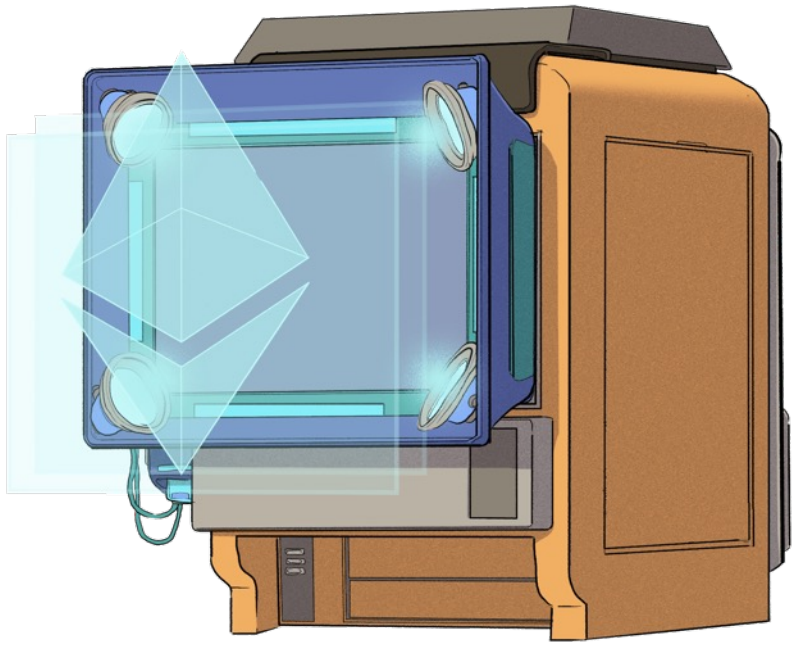
(DeFi)
Decentralized Applications (Dapps)

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

Source: https://ethereum.org/en/defi/

The Internet of Assets

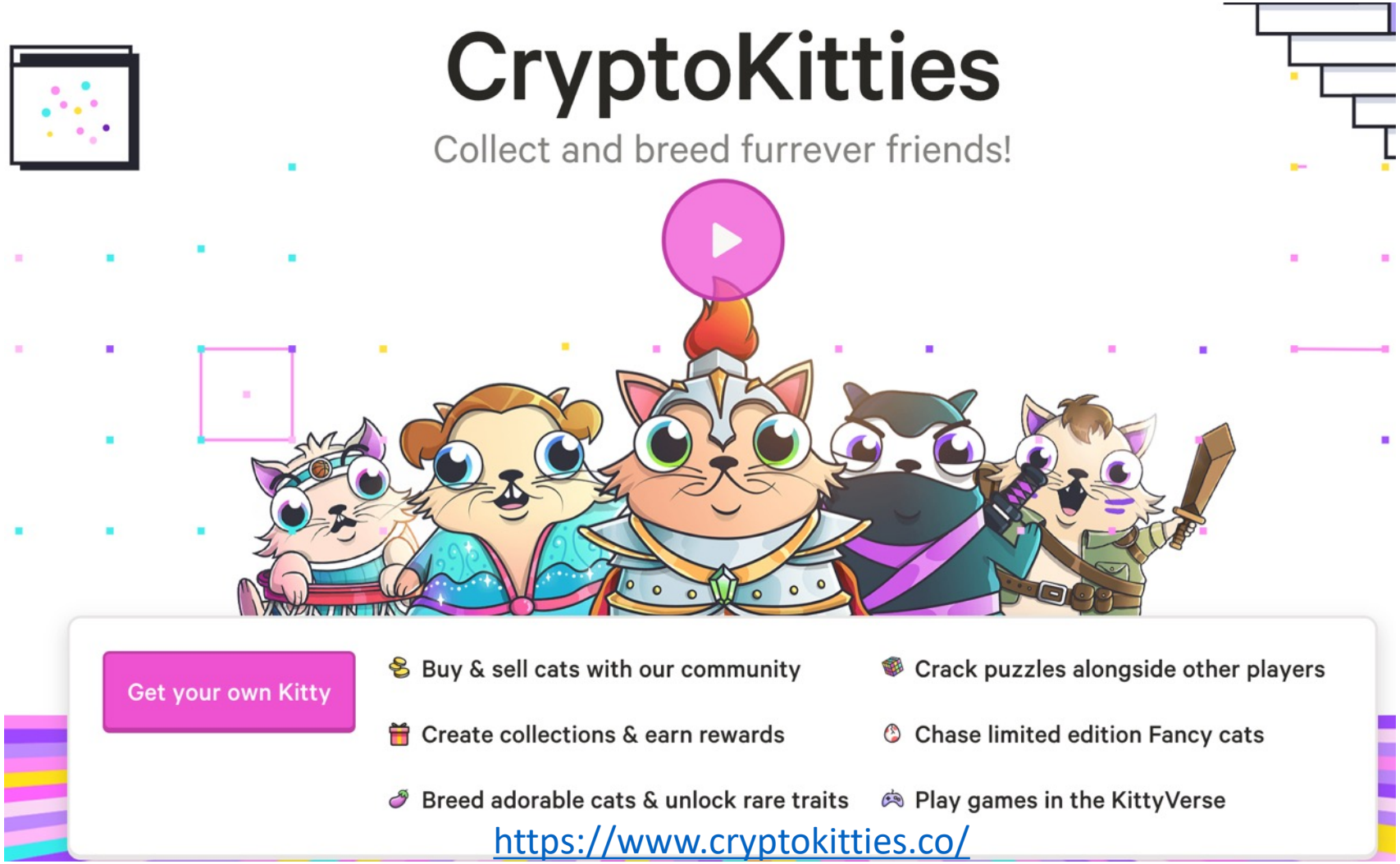
- **Ethereum** isn't just for **digital money**.
- Anything you can own can be **represented**, **traded** and **put to use** as **non-fungible tokens (NFTs)**.



Source: https://ethereum.org/en/defi/

Non-Fungible Tokens (NFT)

CryptoKitties



https://www.cryptokitties.co/

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-boarder activites**
Stablecoins	• **How stable are stablecoins?** • **Domestic and global regulatory and supervisory approaches**
Macro-Financial	• **Cryptoization, capital flows, and restrictions** • **Monetary policy transmission** • **Bank disintermediation**

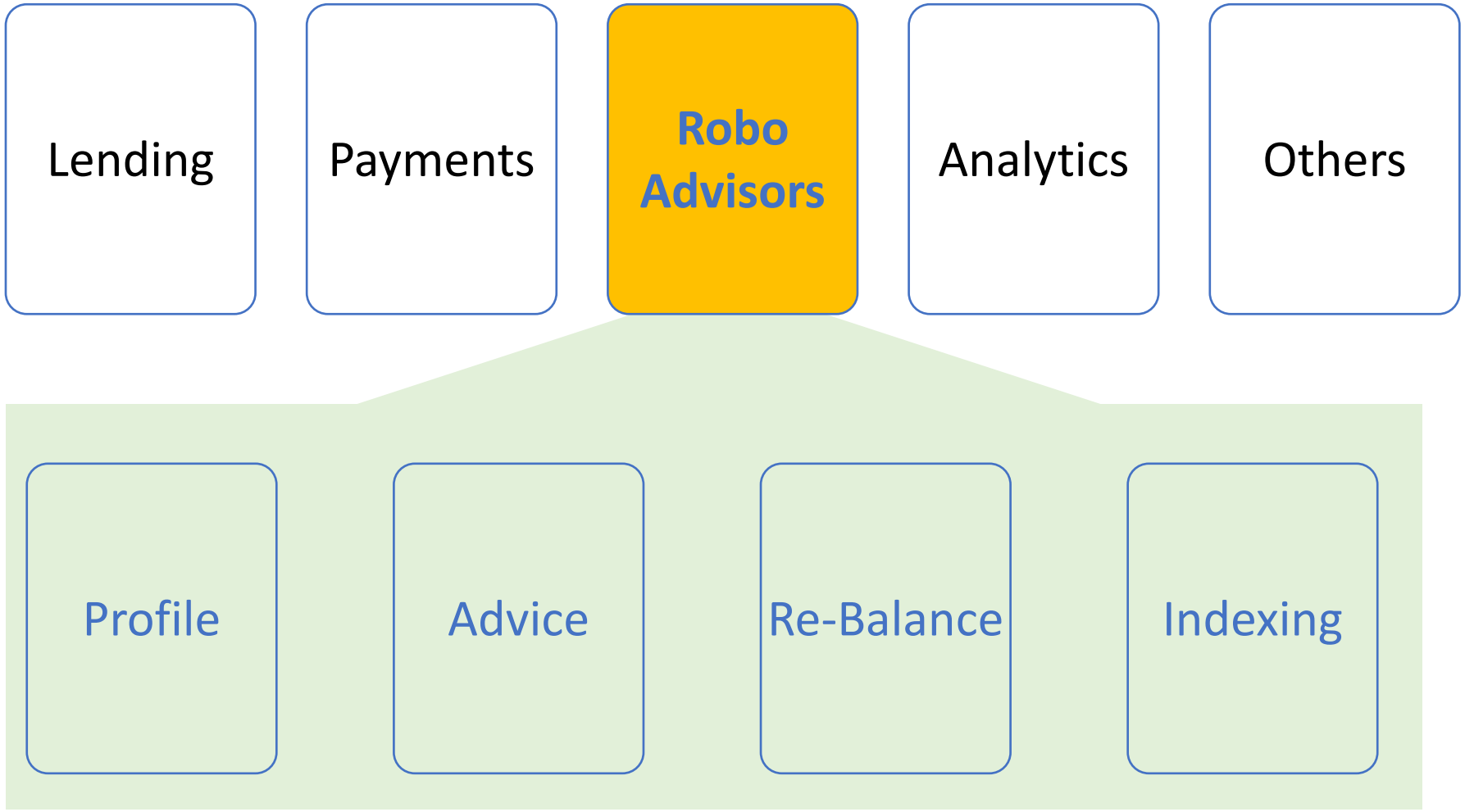
Source: Parma Bains, Mohamed Diaby, Dimitris Drakopoulos, Julia Faltermeier, Federico Grinberg, Evan Papageorgiou, Dmitri Petrov, Patrick Schneider, and Nobu Sugimoto (2021), The Crypto Ecosystem and Financial Stability Challenges, International Monetary Fund, October 2021

Financial Services

Technology Innovation

FinTech Innovation

FinTech high-level classification

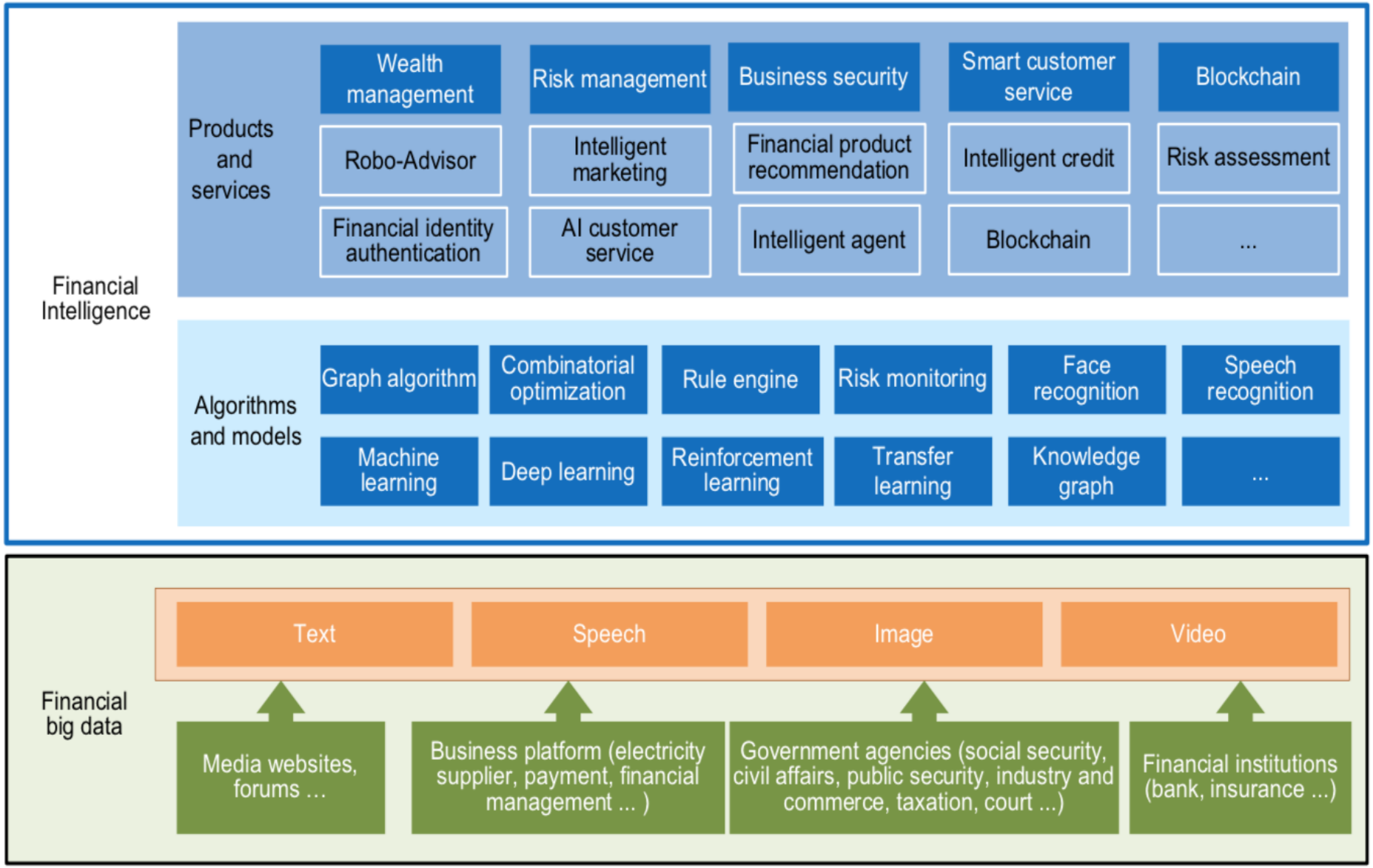


Source: Paolo Sironi (2016), "FinTech Innovation: From Robo-Advisors to Goal Based Investing and Gamification", Wiley.

Technology-driven Financial Industry Development

FinBrain: when Finance meets AI 2.0

(Zheng et al., 2019)



Source: Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924

AI 2.0

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

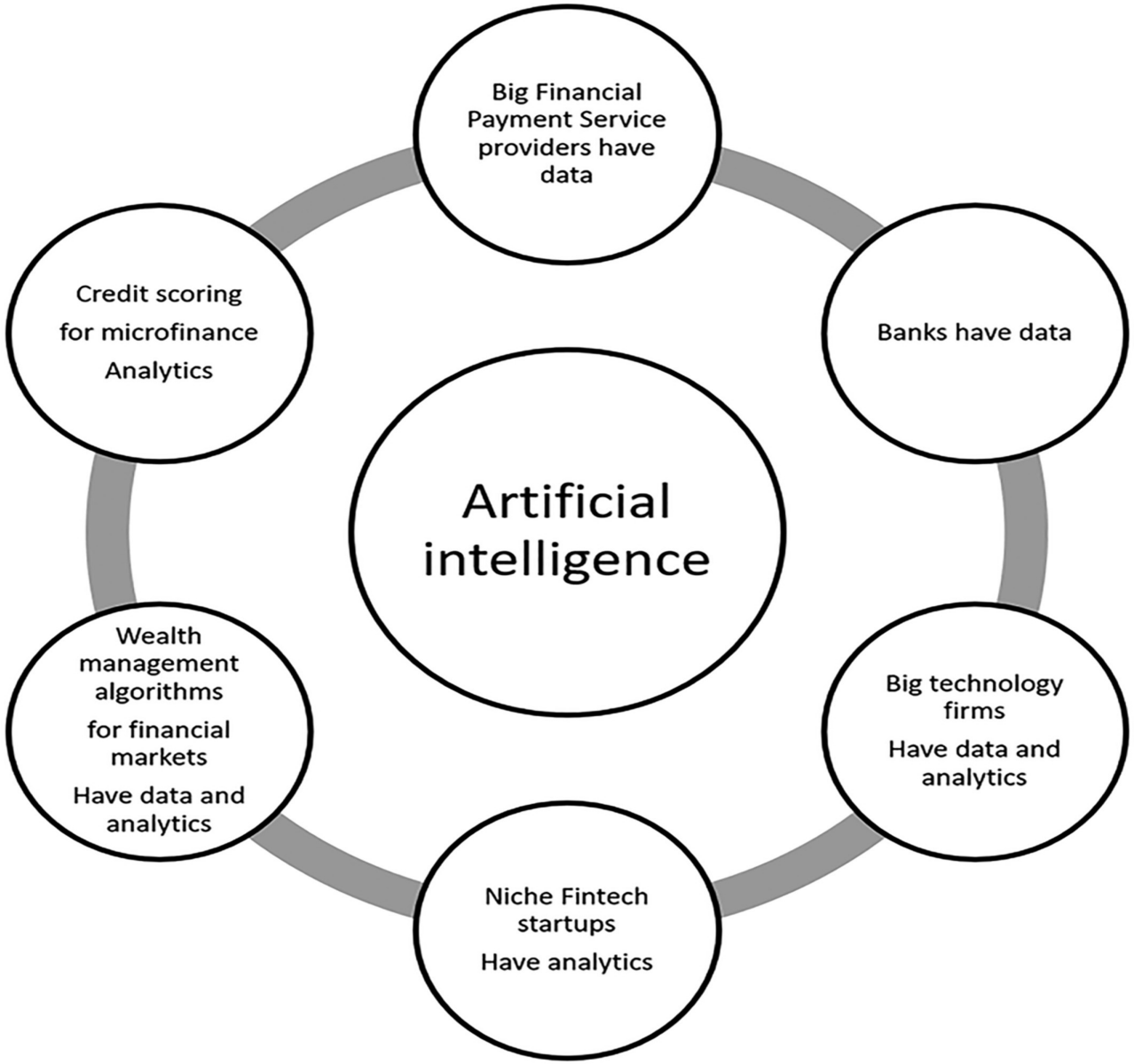
Yunhe Pan (2016), "Heading toward artificial intelligence 2.0." Engineering 2, no. 4, 409-413.

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

Source: Xiao-lin Zheng, Meng-ying Zhu, Qi-bing Li, Chao-chao Chen, and Yan-chao Tan (2019), "Finbrain: When finance meets AI 2.0." Frontiers of Information Technology & Electronic Engineering 20, no. 7, pp. 914-924

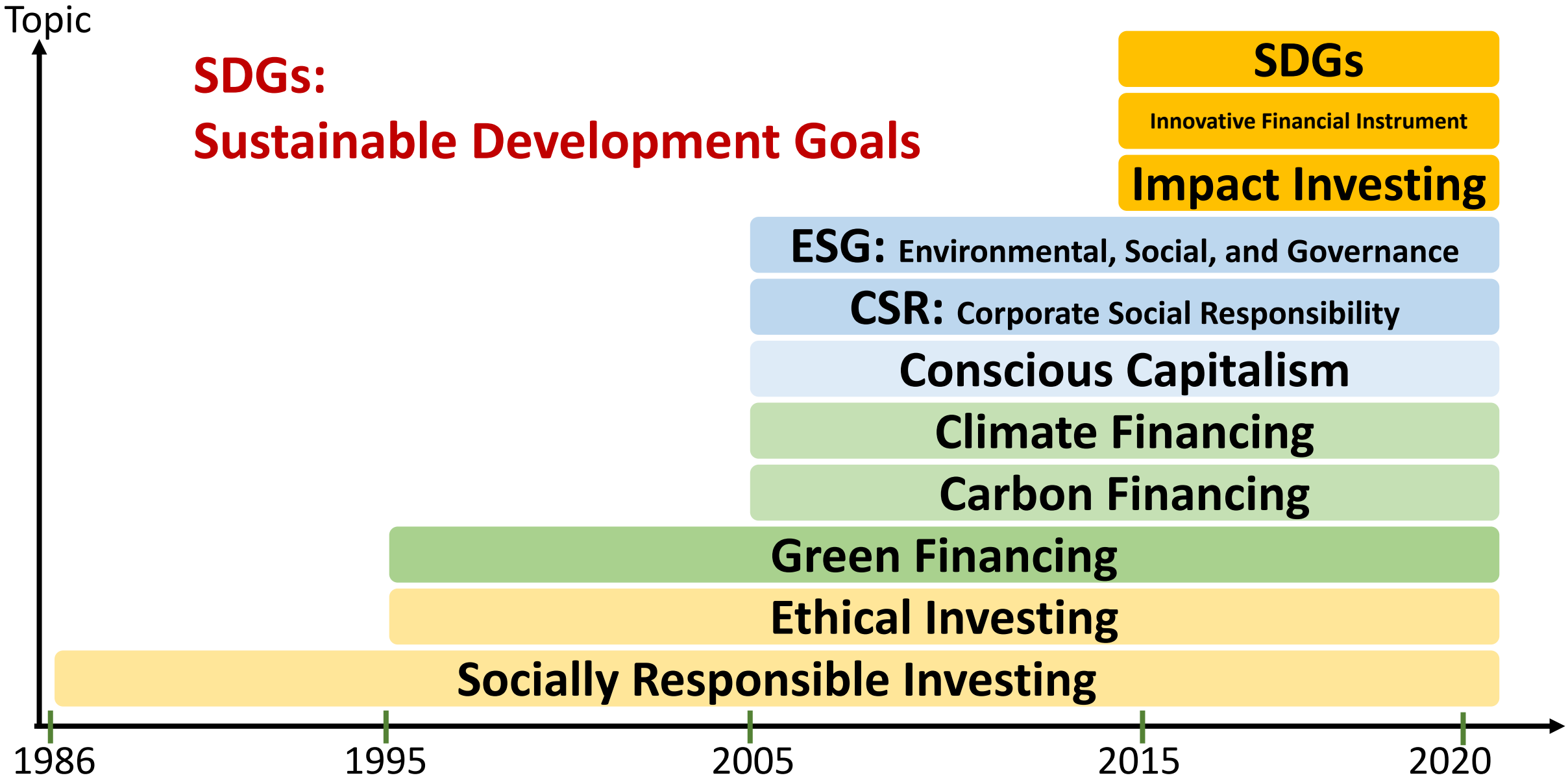
Artificial Intelligence in the Financial Markets



Source: Ashta, Arvind, and Heinz Herrmann (2021). "Artificial intelligence and fintech: An overview of opportunities and risks for banking, investments, and microfinance." Strategic Change 30, no. 3 (2021): 211-222.

Green Finance
and
Sustainable Finance

Evolution of Sustainable Finance Research



Source: Kumar, S., Sharma, D., Rao, S., Lim, W. M., & Mangla, S. K. (2022). Past, present, and future of sustainable finance: Insights from big data analytics through machine learning of scholarly research. Annals of Operations Research, 1-44.

AI for Environmental, Social, and Governance (AI4ESG)

Source: Nenad Tomašev, Julien Cornebise, Frank Hutter, Shakir Mohamed, Angela Picciariello, Bec Connelly, Danielle Belgrave et al. (2020) "AI for social good: unlocking the opportunity for positive impact." Nature Communications 11, no. 1: 1-6.

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

Source: Folke, Carl, Reinette Biggs, Albert V. Norström, Belinda Reyers, and Johan Rockström. "Social-ecological resilience and biosphere-based sustainability science."Ecology and Society 21, no. 3 (2016).

Green Finance

Generic term
implying use or diversion
of financial resources
to deploy and support projects
with long term positive impact
on the environment

Source: Bhattacharyya, Rupsha. "Green finance for energy transition, climate action and sustainable development: overview of concepts, applications, implementation and challenges." Green Finance 4, no. 1 (2022): 1-35.

Sustainable Finance

Finances

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

Source: Bhattacharyya, Rupsha. "Green finance for energy transition, climate action and sustainable development: overview of concepts, applications, implementation and challenges." Green Finance 4, no. 1 (2022): 1-35.

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

Source: Bhattacharyya, Rupsha. "Green finance for energy transition, climate action and sustainable development: overview of concepts, applications, implementation and challenges." Green Finance 4, no. 1 (2022): 1-35.

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

Source: Bhattacharyya, Rupsha. "Green finance for energy transition, climate action and sustainable development: overview of concepts, applications, implementation and challenges." Green Finance 4, no. 1 (2022): 1-35.

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

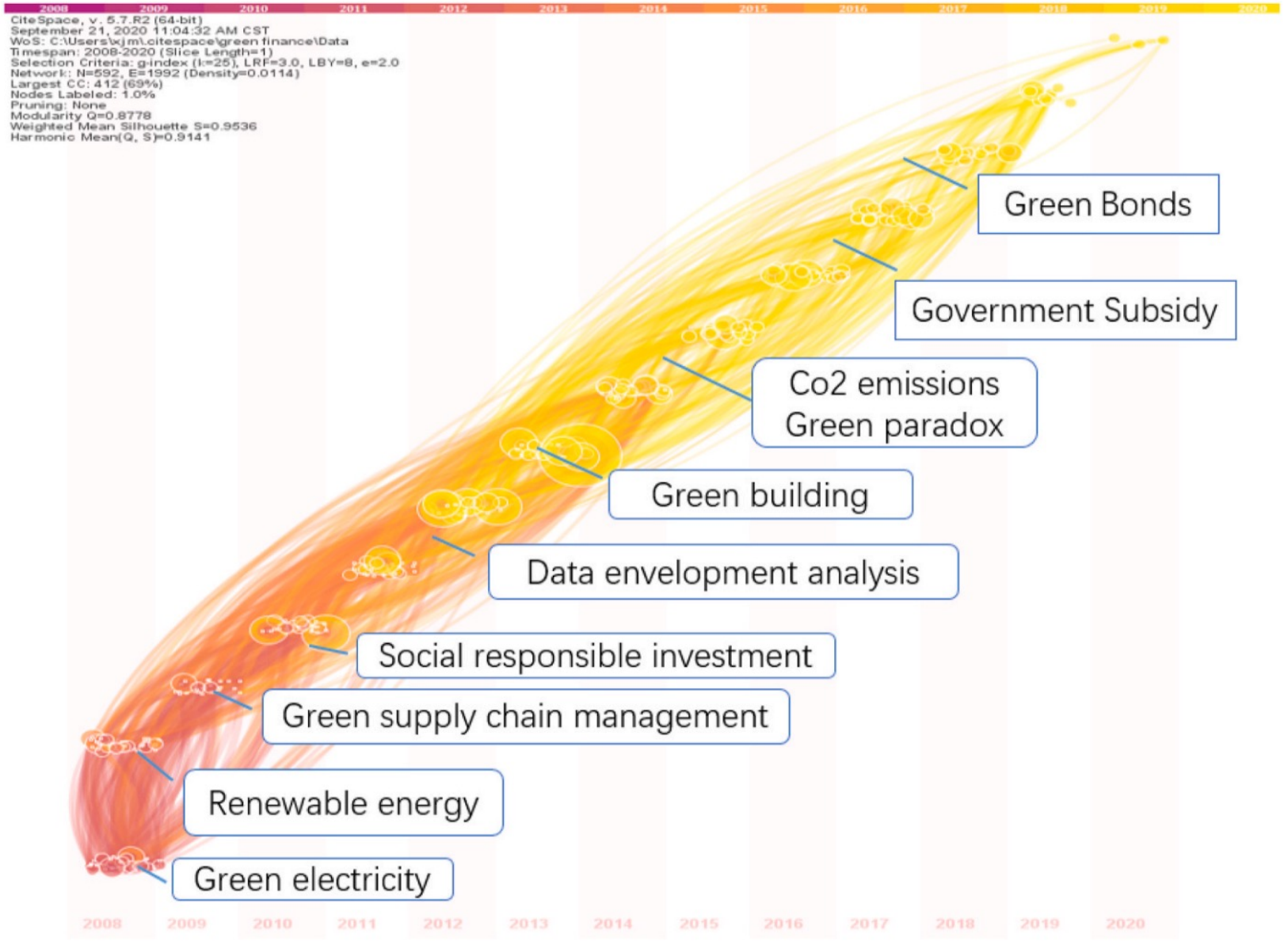
Source: Bhattacharyya, Rupsha. "Green finance for energy transition, climate action and sustainable development: overview of concepts, applications, implementation and challenges." Green Finance 4, no. 1 (2022): 1-35.

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

Source: Bhattacharyya, Rupsha. "Green finance for energy transition, climate action and sustainable development: overview of concepts, applications, implementation and challenges." Green Finance 4, no. 1 (2022): 1-35.

Dynamic Trends of Green Finance and Energy Policy



Source: Wang, Moran, Xuerong Li, and Shouyang Wang. (2021) "Discovering research trends and opportunities of green finance and energy policy: A data-driven scientometric analysis." Energy Policy 154 (2021): 112295.

AI and Sustainability Development Goals (SDGs)

SDGs	1 No poverty	2 Zero hunger	3 Good health and well-being	4 Quality education	5 Gender equality	6 Clean water and sanitation	7 Affordable and clean energy	8 Decent work and economic growth	9 Industry, innovation and infrastructure	10 Reduces inequalities	11 Sustainable cities and communities	12 Responsible consumption and production	13 Climate action	14 Life below water	15 Life on land	16 Peace, justice and strong institutions	17 Partnerships for the goals
Economic								●	●	●	○						●
Ecological		○					○				○	○	●	●	●		
Social	●	●	●	●	●	●	●				●	●				●	
Positive impact of AI*	100%	76%	69%	10%0	56%	100%	100%	92%	100%	90%	100%	82%	80%	90%	100%	58%	26%

Note: ● adopted from Vinuesa et al. (2020), ○ added based on our analysis.
*The assessment of AI's possible positive impact is based on a consensus-based expert elicitation process (Vinuesa et al., 2020).

Source: Schoormann, T., Strobel, G., Möller, F., Petrik, D., & Zschech, P. (2023). Artificial Intelligence for Sustainability—A Systematic Review of Information Systems Literature. Communications of the Association for Information Systems, 52(1), 8.

AI for Sustainability

Dimension	Code characteristics					
Primary objective[1]	Develop new (AI) methods *(11/95)*	Compare (AI) methods *(39/95)*	Apply (AI) methods *(53/95)*	Develop new system *(20/95)*	Other objective *(4/95)*	
Sustainability dimension	Economic *(23/95)*		Ecological *(17/95)*		Social *(72/95)*	
Sustainable Development Goals (SDGs)	SDG 1 *(0/95)*	SDG 2 *(2/95)*	SDG 3 *(55/95)*	SDG 4 *(6/95)*	SDG 5 *(0/95)*	SDG 6 *(0/95)*
	SDG 7 *(9/95)*	SDG 8 *(7/95)*	SDG 9 *(8/95)*	SDG 10 *(1/95)*	SDG 11 *(9/95)*	SDG 12 *(8/95)*
	SDG 13 *(2/95)*	SDG 14 *(0/95)*	SDG 15 *(2/95)*	SDG 16 *(11/95)*	SDG 17 *(0/95)*	
Data source	Reviews *(12/95)*	Social media/ Online forums *(31/95)*	Health records *(21/95)*	Environment/ Weather *(10/95)*	Energy *(5/95)*	
Data source plurality	Single source *(50/95)*		Multiple sources *(44/95)*		N/A *(1/95)*	
Data sensitivity	Publicly available data *(64/95)*		Internal data *(16/95)*	Other *(11/95)*	N/A *(9/95)*	
Manual labeling	Yes *(32/95)*			No *(63/95)*		
Technology	ML *(91/95)*		NLP *(42/95)*	CV *(12/95)*	Other *(21/95)*	
Type of learning for ML approach	Supervised learning *(85/95)*			Unsupervised learning *(23/95)*		
Neural vs. non-neural	Non-neural *(45/95)*		Neural *(50/95)*		Deep learning *(38/95)*	
Evaluation	Technical evaluation *(83/95)*			Domain evaluation *(25/95)*		
Paradigm	DSR/ADR *(30/95)*			Non-DSR/ADR *(64/95)*		

	0-9	10-29	30-54	55-69	70-95

Notes: Code dimensions are not mutually exclusive; one article can be classified into one or more code characteristics; [1] 'Compare' does include 'apply'.

Source: Schoormann, T., Strobel, G., Möller, F., Petrik, D., & Zschech, P. (2023). Artificial Intelligence for Sustainability—A Systematic Review of Information Systems Literature. Communications of the Association for Information Systems, 52(1), 8.

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

Summary

- **Web 3.0**
- **Big Data Analysis**
- **Fintech**
- **Green and Sustainable Finance**

References

- Thorsten Schoormann, Gero Strobel, Frederik Möller, Dimitri Petrik, and Patrick Zschech (2023). "Artificial Intelligence for Sustainability—A Systematic Review of Information Systems Literature." Communications of the Association for Information Systems 52, no. 1 (2023): 8.
- Morshadul Hasan, Ariful Hoque, Mohammad Zoynul Abedin, and Dominic Gasbarro (2024). "FinTech and sustainable development: A systematic thematic analysis using human-and machine-generated processing." International Review of Financial Analysis 95 (2024): 103473.
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