

Pengyan Zhang, Kai Jiang, Liu Zheng, Xiaonan Kang

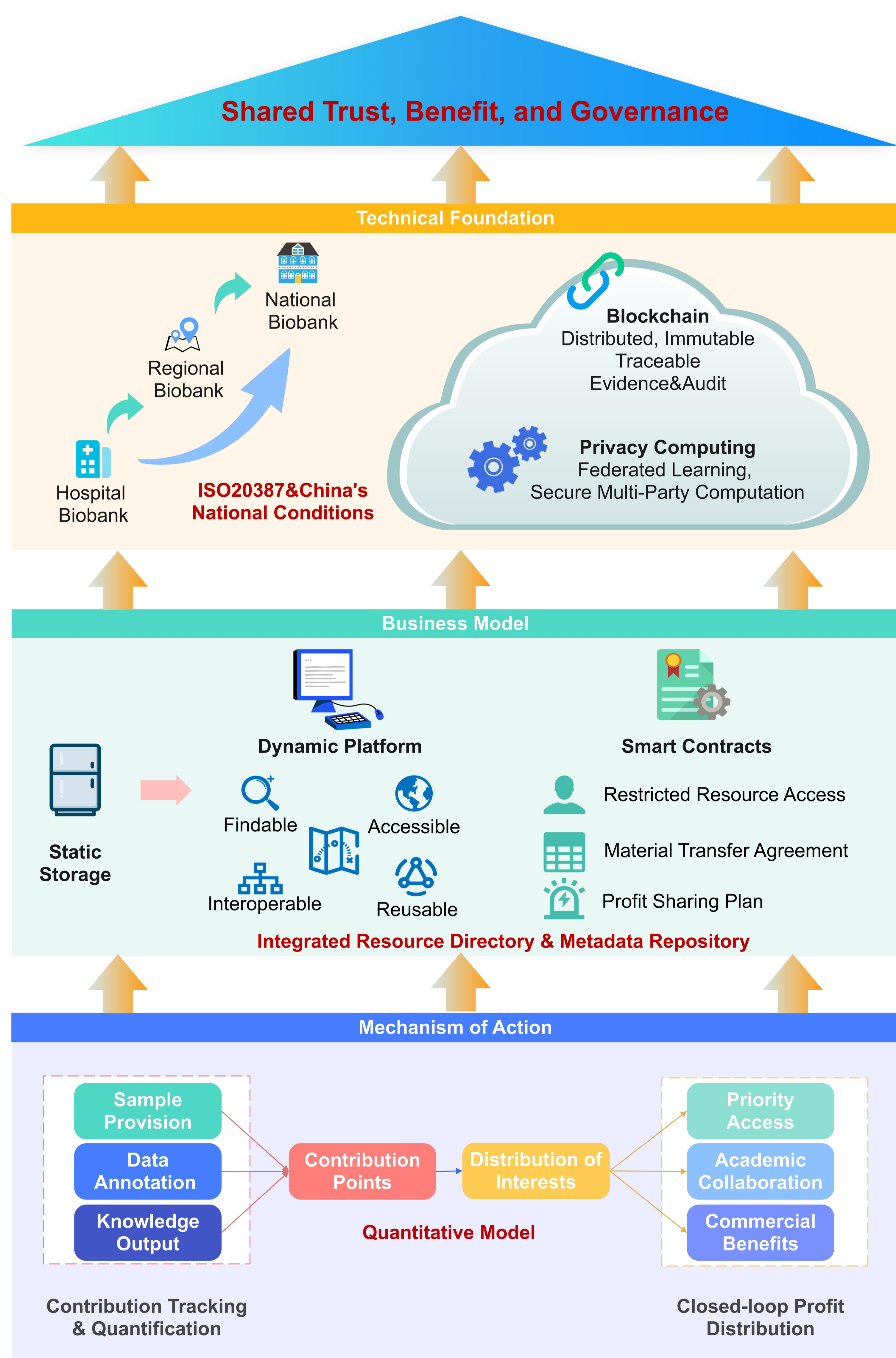
Renji Hospital Biobank, Shanghai Jiao Tong University School of Medicine, Shanghai, China.

Statement of the Problem

China's research hospital biobanks have achieved scale advantages but face challenges in transitioning to value creation.

Systemic Silos	Lack of Trust and Security	Lack of incentives	Practices at the Renji Hospital Biobank
Significant differences across hospitals in management systems, technical standards, and ethical guidelines hinder cross-regional integration, creating resource barriers.	As sample data is highly sensitive with growing privacy concerns, the traditional centralized model struggles to resolve unclear ownership and profit distribution.	A mutually beneficial partnership has yet to be established among contributors, administrators, and researchers, leaving high-quality samples in a "dormant" state.	Renji's biobank advanced digitalization: LIMS-based standardization, project-driven optimization, and tiered access with ethics. Yet these rely on manual and centralized management—unable to support the shared ecosystem for modern multi-center research.

Biobank Sharing Ecosystem



Proposed Solution

We propose a next-generation sharing ecosystem based on "shared trust, benefits, and governance". Firstly, we aim to refine the existing system through technological and institutional innovation. A standardized hospital-regional-national framework aligns with international standards and local contexts. **Blockchain** technology ensures data sovereignty and transparency, while privacy-preserving computation balances data utility and security. Secondly, at the operational level, an integrated resource catalogue and metadata repository enable the implementation of FAIR principles within a dynamic platform. **Smart contracts** can automatically handle resource access, material transfer, and revenue distribution, enhancing efficiency and reducing manual intervention. Thirdly, a **contribution-based valuation system** (see Table 1) quantifies inputs at each stage of the sample and data lifecycle (from data provision and quality control to annotation, analysis, and knowledge generation). These contributions are linked to resource access priority, collaboration opportunities, authorship, and revenue sharing, activating ecosystem-wide participation.

Table 1 A contribution-based valuation system

Dimension	Content	Score
Sample Quality	Compliance with collection protocols	10
	Sample storage conditions	6
	Sample pass rate	6
Data Integrity	Completeness of clinical information	10
	Multi-omics data coverage	6
	Degree of data standardization	6
Translation of Research	Number of supporting publications	10
	Patent Applications or Grants	5
	Clinical Translation Outcomes	5
Technology Development	New Sample Processing Methods	4
	Development of Data Quality Control Tools	3
	Functional Optimization of Information Systems	3
Governance & Collaboration	role in multicenter research projects	6
	Promotion of standard development	5
	Exemplary practices in ethics	5
Resource Sharing	External sharing of samples or data	5
	Contributions to expanding collaborative networks	5

Conclusions

- I. This study proposes a blockchain and smart contract-based ecosystem for biobank sharing, addressing challenges in utilising China's biological sample resources.
- II. It facilitates cross-institutional and regional aggregation of samples and data, creating economies of scale and providing big data support for elucidating major disease mechanisms, accelerating drug development, and enabling precision medicine.
- III. The mature model can extend from research hospitals to a national-level network, offering a Chinese solution for global biobank sharing.

