Equipment Value in the Digital Economy

Director/Professor Ouyang Jinsong

February 2022

Instrumentation Technology and Economy Institute

Contents

01 Equipment development history

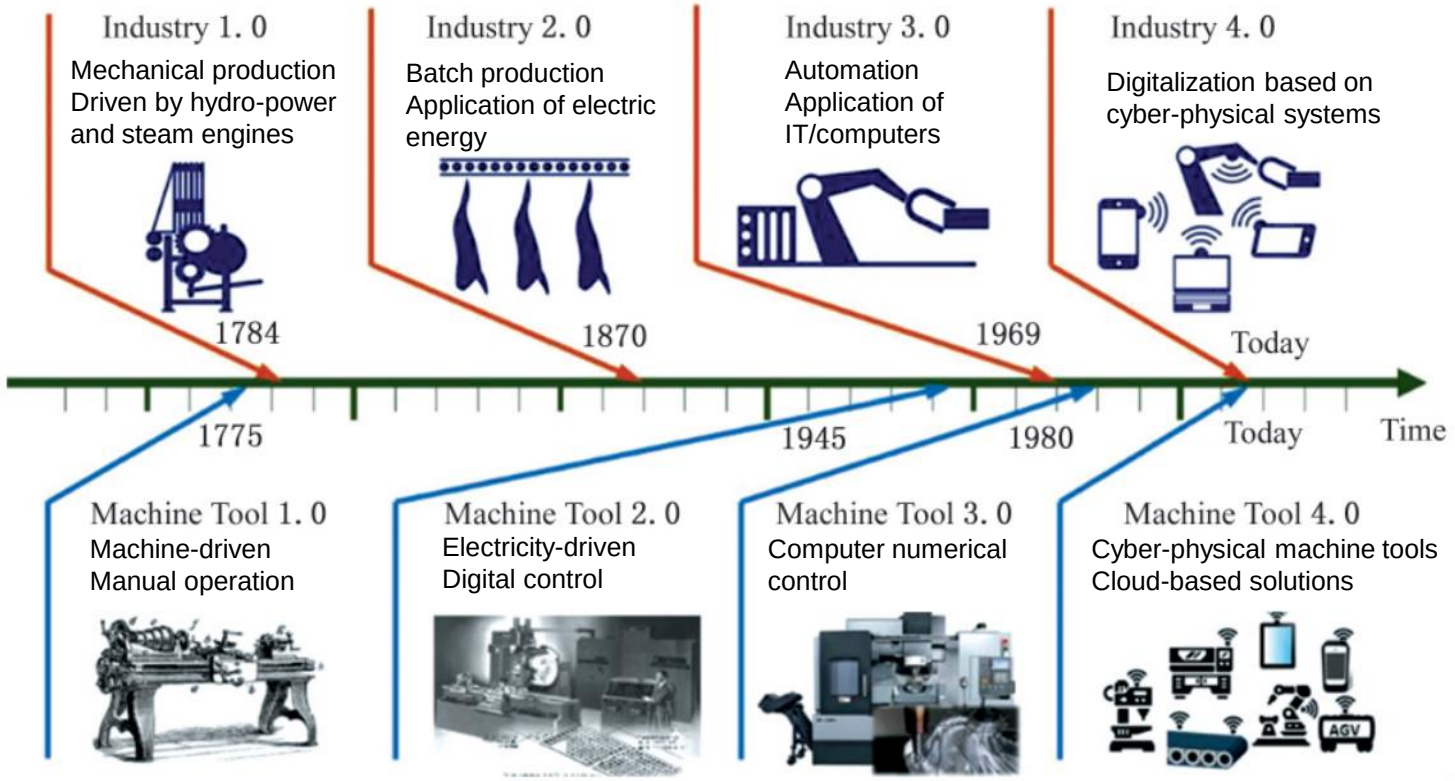
02 New intelligent equipment

03 New value system

04 New models and scenarios

1. Equipment development history

From the perspective of production tool transformation, equipment has gone through four stages of development: **mechanized**, **electromechanical**, **numerical control**, **and digital/intelligent**.



Mechanized development | **Electromechanical development** | **Numerical control** | **Digital/Intelligent development**

Take the evolution of machine tools as an example
—Professor Liu Qiang, The Development History and Future Trends of CNC Machine Tools

We are entering an era in which all things are intelligent and connected, characterized by equipment digitalization and the convergence of humans, machines and things. Intelligent equipment will inevitably see widespread use as new production tools, transforming how we produce and live.

2. New intelligent equipment

Equipment digitalization

Equipment + digitalization → **Intelligent production** → **Intelligent equipment**

- **The equipment itself**
- **Digital technologies:** intelligent sensing, Internet, big data, Digital Twin, artificial intelligence, blockchain, etc.

Intelligent equipment

New features:	**State awareness, ubiquitous interconnection, decision-making optimization, autonomous execution, virtual-real convergence, and energy efficiency**
New capabilities:	**Performance, function, efficiency, and intelligence**
New value:	**Physical equipment + data assets New value system**

- **Equipment digitalization** deeply integrates digital and equipment technologies, promotes the transformation of equipment R&D, production, and services, and develops **intelligent equipment** with features such as state awareness, ubiquitous interconnection, decision-making optimization, autonomous execution, virtual-real convergence, and high energy efficiency, building a **new value system** of physical equipment and data assets.

2. New intelligent equipment

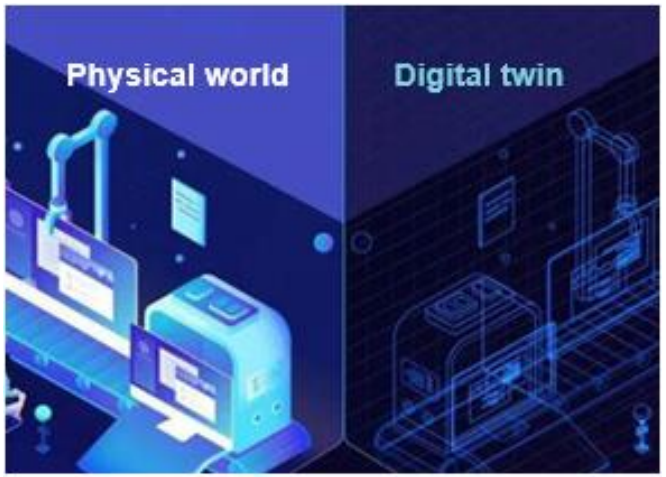
The most substantial feature - constructing physical + digital twin featuring virtual and real convergence

Physical entities

- Status awareness
- Ubiquitous interconnection
- Decision-making optimization
- Autonomous execution

- Performance and efficiency improvements
- Function expansion
- Structural optimization

Operation data real-time collection



State prediction optimization and adjustment

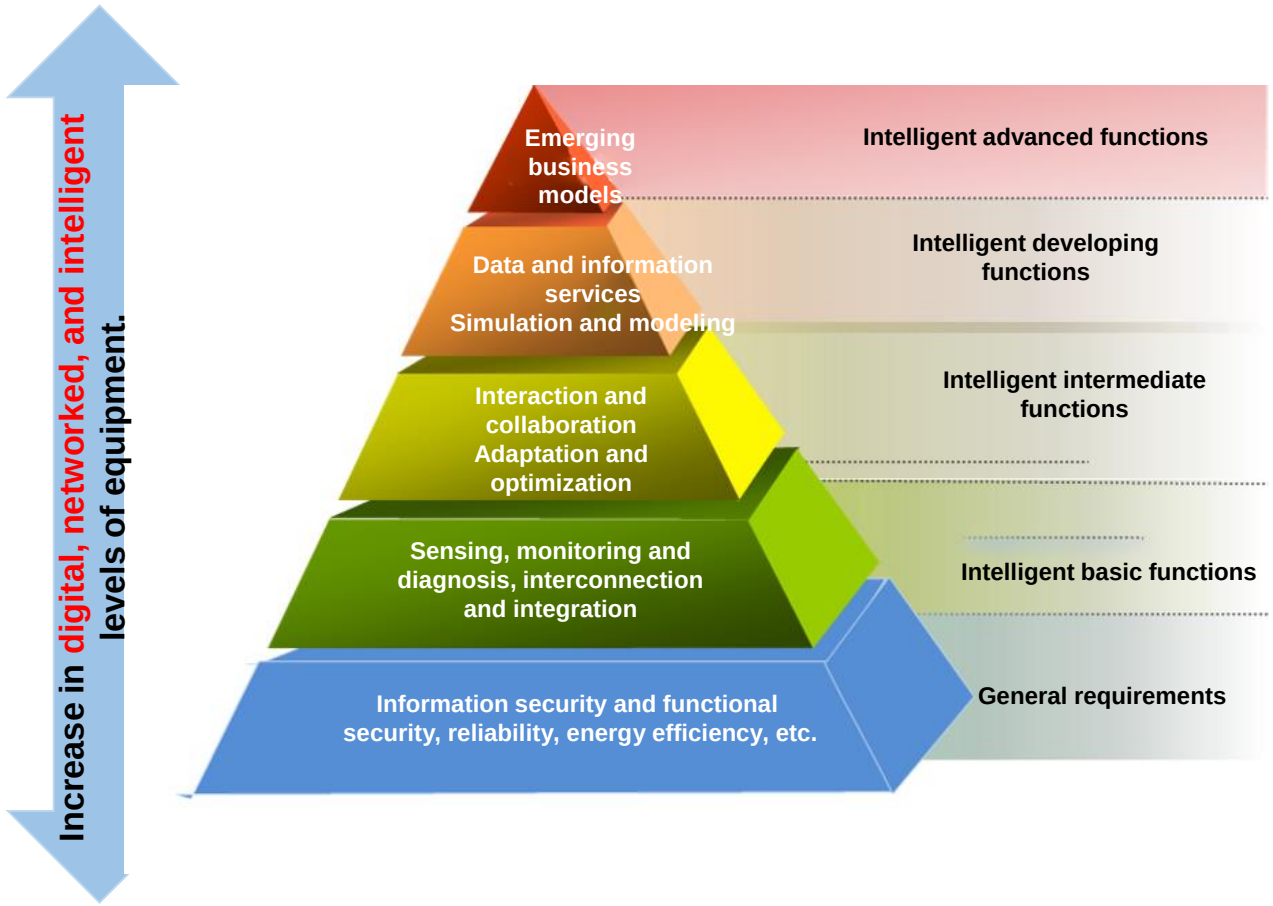
Digital Twin

- 3D models
- Information models
- Mechanistic models
- Fault models
- Health models
- Operation knowledge bases
- More

Full life cycle data

R&D → Validation → Production → Application → Service → Recycling

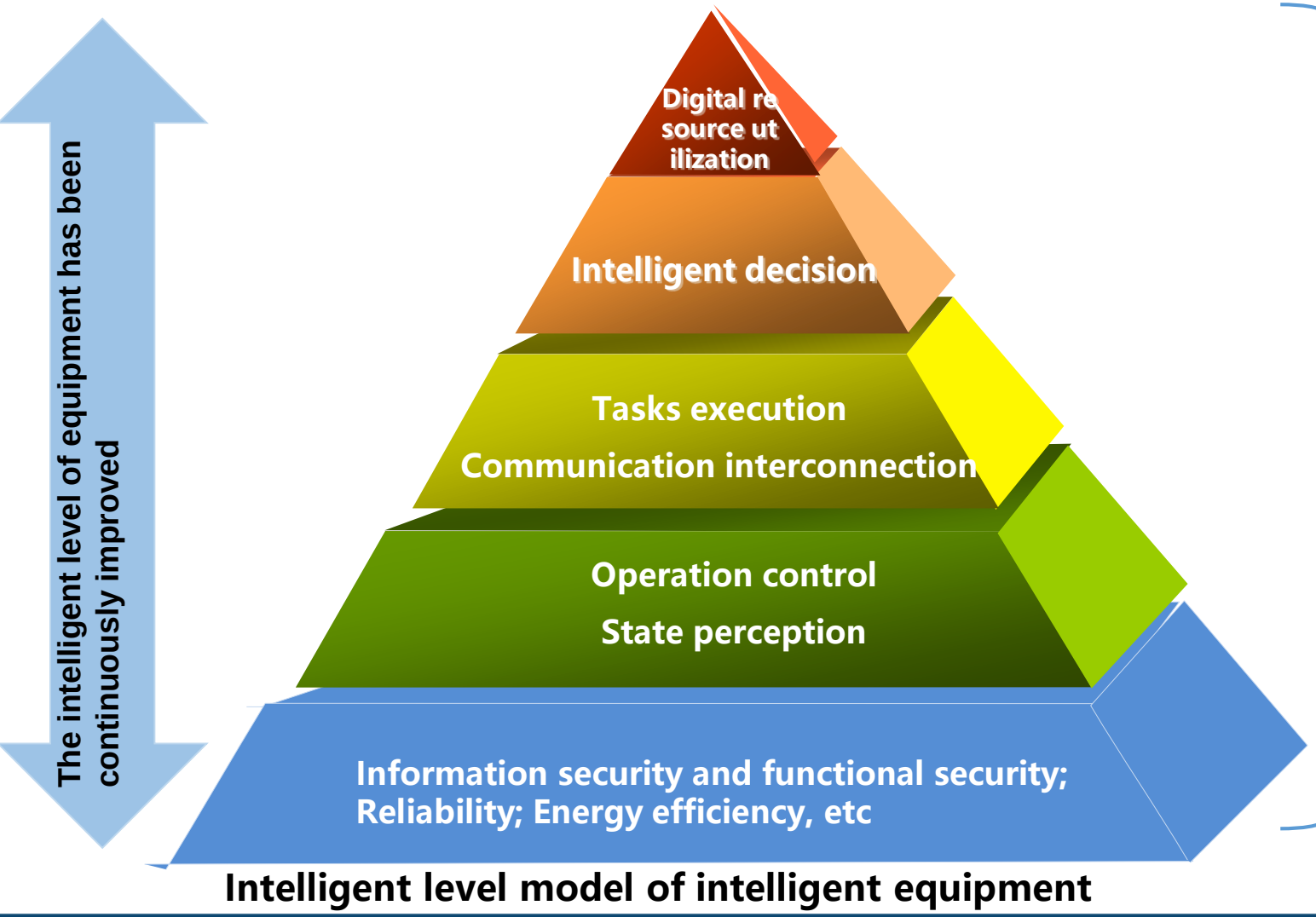
2. New intelligent equipment



Equipment IQ evaluation index system (the top two levels of indicators)

Intelligent Feature	Level-1 Indicator	Level-2 Indicator
Awareness	Status awareness	Intelligent sensing
Interconnection and integration	Communication interconnection	Communication interfaces
		Networking capability
Monitoring	Operation control	Operation monitoring
		Digital control
		Remote control
Adaptation and optimization	Analysis and decision-making	Fault diagnosis
		Predictive maintenance
Adaptation and optimization, and interaction and collaboration	Operation execution	Fault tolerance capability
		Adaptive operation execution
		Autonomous operation execution
Simulation and modeling, and interconnection and integration	Manufacturing processes	Digital design
		IT-based production
Data and information services, and emerging business models	Digital resources	Digital delivery
		Digital Twin
		Software-based knowledge
		Data resource collection
Other	Other	Other

二、New intelligent equipment



Intelligent level model of intelligent equipment

New business mode

- **Digital resource utilization**
  - Digital delivery
  - Digital twin
  - Knowledge software…
- **Intelligent decision**
  - Fault analysis
  - Predictive maintenance…
- **Tasks execution**
  - Fault tolerance
  - Autonomous tasks execution…
- **Communication interconnection**
  - Communication interface
  - Networking capability……
- **Operation control**
  - Operation monitoring
  - Digital control
  - Remote control……
- **State perception**
  - Ubiquitous data acquisition
  - Intelligent perception……

3. New value system

With the rapid development of the digital economy, data has become a new production factor. Data inevitably becomes an asset.

Real world (physical space)

Physical entity

Generated during the production process

Value: **physical (equipment) assets** (tangible, finite)

Digital world (cyber space)

Digital Twin

Generated throughout the life cycle **(models, data, knowledge, software)**

Value: **data assets** (intangible, infinite)

New value system

3. New value system

The value of equipment has evolved from that of equipment itself, supplemented by value of services, to a new value system of "physical equipment + data assets".

Expanding equipment value

- **Retrofitting and replacement of equipment**
  - Continuous improvement of equipment IQ
  - Innovation in equipment structure and function
  - Performance and efficiency improvements
  - → **Improved value of equipment itself**
- **Intelligent services for equipment**
  - Intelligent O&M
  - Software subscription upgrade
  - Precise recycling
  - Digital engineering development
  - → **Value generated by services**

Unlocking data value

- **Forming data assets**
  - Mechanistic model
  - Information model
  - Knowledge base
  - Real-time data
  - More
  - Indirect value → **Value generated by services**
  - Direct value → **Value generated by data transactions**
- **Exploring innovative applications: reflection**

New value system

Physical equipment

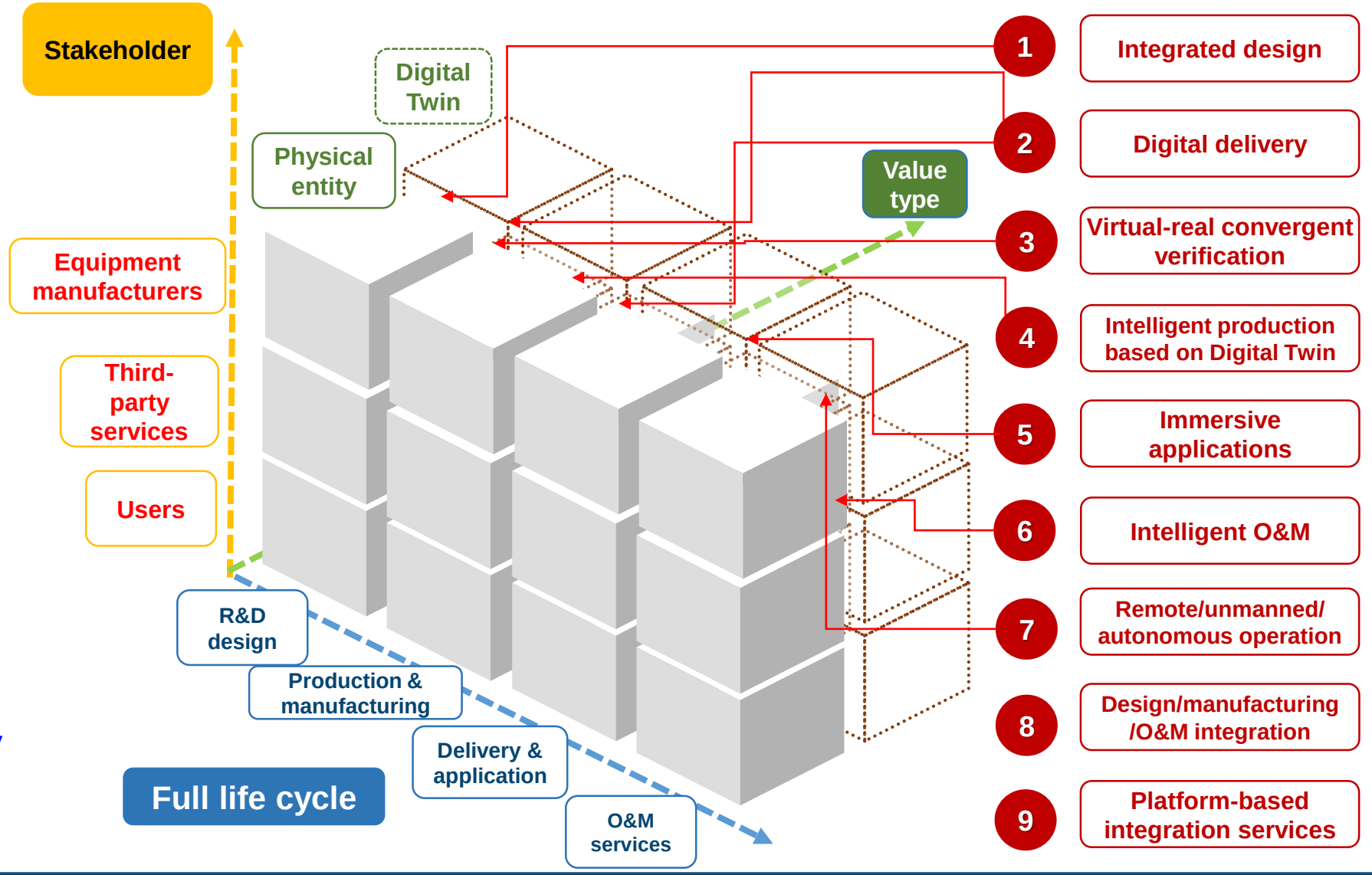
+

Data assets

4. New models and scenarios

New models and new business forms

- **Essence:** new management models and new service forms derived from the convergence of new technologies
- **Coverage of entire product lifecycle:** R&D, manufacturing, application, service, and cross-phase
- **Stakeholders:** equipment manufacturers, users, and third-party services
- **Value type:** value of physical entity and value of Digital Twin



4. New models and scenarios

Typical digital application scenarios

Smart manufacturing, smart transportation, smart energy, smart agriculture, smart healthcare, smart engineering and other scenarios

Smart manufacturing

- Man-machine interaction
- Device health management
- Smart warehousing and logistics
- Smart detection and traceability
- Remote O&M
- More

- Autonomous operation of ports
- Autonomous driving in campuses
- Airport V2X
- Material control on trunk lines
- More

Smart transportation

Smart energy

- Smart wind power
- Unmanned oil production
- Smart mining
- More

Smart agriculture

- Precision seeding
- Smart crop management
- Weather forecast
- More

Smart healthcare

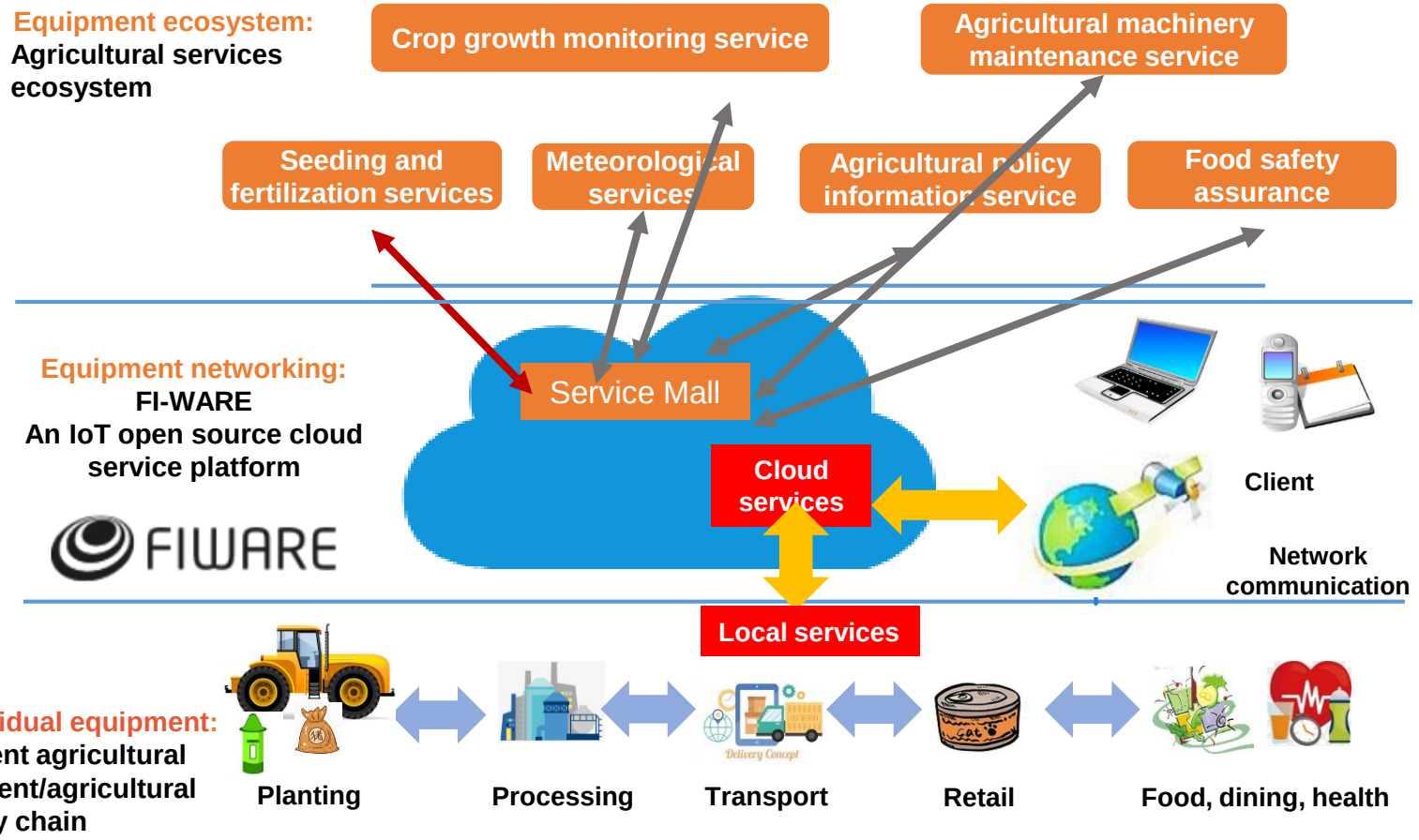
- Clinical auxiliary diagnosis
- Remote consultation
- Smart health management
- More

Smart engineering

- Remote control
- Smart construction
- Predictive maintenance
- More

4. New models and scenarios

- **An innovative business model based on intelligent equipment – the agricultural services ecosystem of John Deere, an American company**



Thank you!

Instrumentation Technology and Economy Institute (ITEI)

Address: No.397, Guang'anmenwai Street, Xicheng District, Beijing

Tel: 010 - 63261819

Fax: 010 - 63262677

Website: http://www.itei.cn

Website

Official WeChat account