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# Data Asset Ecosystem White Paper

Building a New Era Towards  
A Sustainable Digital Economy

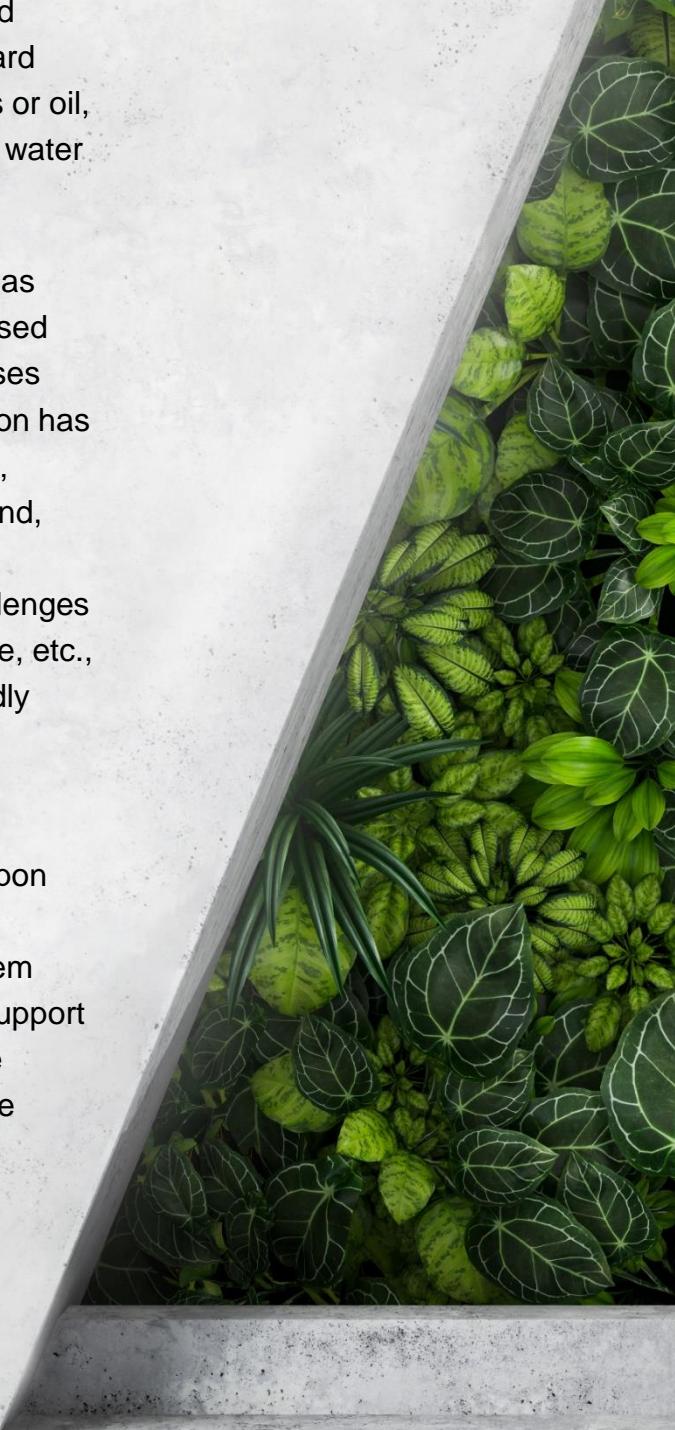


# Foreword

The value of data is introducing a quiet yet profound innovation. Data is no longer merely a straightforward representation of material wealth such as treasures or oil, but has developed into a necessity as important as water and air.

At the same time, data brings opportunities as well as challenges. On the one hand, the great value released from data connection between individuals, enterprises and government through open access and circulation has reshaped individuals' lifestyle and business models, resulting in a huge leverage effect. On the other hand, just as water and air are exposed to the threat of pollution, data also faces social and economic challenges such as unclear ownership and pricing, unfair usage, etc., and in turn this resource with infinite value can hardly satisfy demand.

As a long-term practitioner in the era of the digital economy, PwC intends to call particular attention upon major issues in the digital era, and advocate for a healthier, orderly and balanced data asset ecosystem through this white paper. Only by comprehensive support for the operations of an assetized ecosystem at the social, economic, policy and technical levels can the core value of data be fully released and a better future embraced.



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# Digital era in which data is as essential as water and air is here

Over the past decade, the development of the mobile Internet has led to an exponential accumulation of data, and antitrust regulators have also begun to limit certain groups and institutions that have an ability to control mass amounts of data. It is widely accepted that data has become the "oil" in the digital era.

However, the value of data is introducing a quiet yet profound innovation with the fast development of the digital era. Ten years ago, the general public precisely described the value of data as if they were gold-miners who struck gold, but nowadays, topics on data have gradually become rational. In a sense, the value of data is evolving into a deeper level. Compared to oil, data is becoming more like water and air which is closely related to our daily life.

Looking at the characteristics of water and air, it is very similar to data in today's social ecosystem. First of all, water and air are essential resources that are indispensable in our daily life. Although they may go unnoticed at times, if water and air is taken away from us, our bodies will collapse. In the digital era, individuals, enterprises and governments should also recognize that our daily life and productivity will not work without the support of various types of data.

Imagine a day in the life of ordinary wage-earners: on their morning commute, they will receive dozens of news feeds and ads filtered based on personal preferences. After clocking in at work, their personal information and time data will quickly link to the enterprise's management system. At lunch time, they are used to browsing dozens of data for restaurants through Dianping and make a quick decision on what to have. For dinner, they search for food among a large number of dishes recommended by their delivery platform. Even before going to bed, they are also likely to review data for sports and leisure that day through various health or information APPs. It is fair to say that data has become effective in helping us bring order into our daily life.

Enterprises will find it difficult to make decisions without the support of data. The top 5 technology giants (Google, Amazon, Apple, Facebook and Microsoft) with the highest market value in the world today seem to have strong momentum. Data is not only an engine for their profit growth, but has also become their moat - Google knows what's trending today on search, Facebook sees what's being shared, and Amazon understands what people are buying. The collected consumer data enables them to improve their quality of service, thereby increasing the barriers to entry. Small and Medium Enterprises (SME) are actively striving to digest data in their particular areas of focus through technologies such as Cloud, providing guidance for their business and truly supporting the development of their business with data.



The government also relies on data, otherwise it would be difficult to carry out a lot of its operations and organizational work. Thanks to its incredible organizational skills and competence in serving at scale, a large number of cities in China have begun to move forward with pilot projects or even partially achieved grid management, under which people's demands in every community would get a fast response with the help of perception data, covering entire links of government service from security to pension, record-keeping to implementation. As soon as the data connection between the people and its community is lost, the operation of the government and the actual situation of the public will be further separated day by day, and a service-oriented government would only be empty talk.

Secondly, water and air are a huge supply of resources found everywhere in nature. Similarly, data has also imperceptibly developed into one of the important resources available to individuals, enterprises and governments for their regular operations, affecting each individual much like water and air. Such a dynamic digital society has also contributed to massive growth in data volume in China and even around the world.

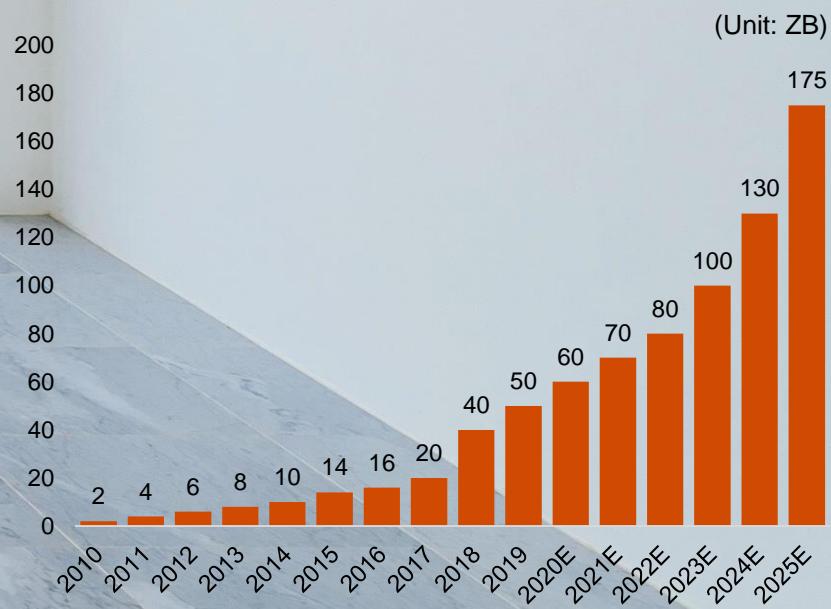
In terms of quantity of data, China is a massive generator of data. According to the research conducted by the International Data Company (IDC) on the global "Data Circle", China produced 7.6ZB of data in 2018. The agency expects that the "Data Circle" in China will expand approximately 14 times between 2018 to 2025 with an average annual growth rate rapidly increasing at 30%. China's data volume will reach 48.6ZB in 2025, equivalent to 48.6 trillion GB. By that time, China will reach the top of the "Golden Mountain" in the data circle, ranking No.1 worldwide. While the US will generate 30.6ZB of data in 2025, equivalent to 30.6 trillion GB, 18 trillion GB lower than that in China.

Based on IDC's forecast, the global data volume will reach 175ZB in 2025 (see Exhibit 1). There are several vivid metaphors that can help you understand what 175ZB is like: If 175ZB data is recorded on a regular DVD with a single disk capacity of 4.7G, the stack height of these discs is 23 times the distance from the moon to the Earth, or 222 loops along the equator around Earth. It will take 1.8 billion years to download that much data with the current average speed of 25Mb/s in the US.

### Exhibit 1: Forecast on global data volume growth

China's "Data Circle"  
2018-2025 Expanded  
approximately 14 times  
Average growth rate rapidly  
increasing at

30%  
%



Source: IDC, Report on *Data Age 2025*

**Table 1: Emerging Internet Apps driven by the growth of data integration**

	<b>Motor vehicles</b>
Mobike	25 million orders can be generated per day
Connected cars	4TB of data can be generated by running for 8 hours
	<b>Social media</b>
Wechat	1 billion users logged in, 4.5 billion messages sent and 41 million voice calls made per day
Twitter	50 million messages can be posted per day
YouTube	Length of videos uploaded per minute can be 400+ hours
Facebook	4PB can be generated per day, including 10 billion messages, 350 million photos and 100 million hours of video browsing
E-mail	300 billion E-mails can be sent and received per day
	<b>Search engine</b>
Google	40,000+ searches are processed per second
	<b>Shopping</b>
Taobao	20TB of data can be generated per day

Source: Collected and collated by PwC

Last but not least, although water and air may look cheap, it can generate long-lasting energy in combination with the relevant medium, such as hydropower. Data, although insignificant in itself, could also make qualitative changes through aggregation effect. Looking at the quality effects of data, various emerging Apps (See Table 1) driven by the integration and growth in global and Chinese data have generated a powerful hub effect through data accumulation.

The rapid growth in quantity and quality of data is making all walks of life reimagine and strategically interpret the concept of “Data”. As the “water and air” in the social and economic ecosystem, data has an overwhelming advantage as having inexhaustible supply. In the Big Data era, whoever first realizes the importance of data and makes rational use of this abundant resource, would be able to get ahead of the curve, seize opportunities in industries, and create impressive economic benefits.

Due to the connection effect of digitalization, the accumulation of data will constantly accelerate, the areas covered by data will continually expand, and the storage of data resources will be more abundant. Therefore, how to convert data from a resource to an asset shall be a major issue to be addressed by anyone with strategic vision and long-term development considerations, whether it be an enterprise, government, or even society as whole.



# 2

## Data ecosystem is slowly losing its balance

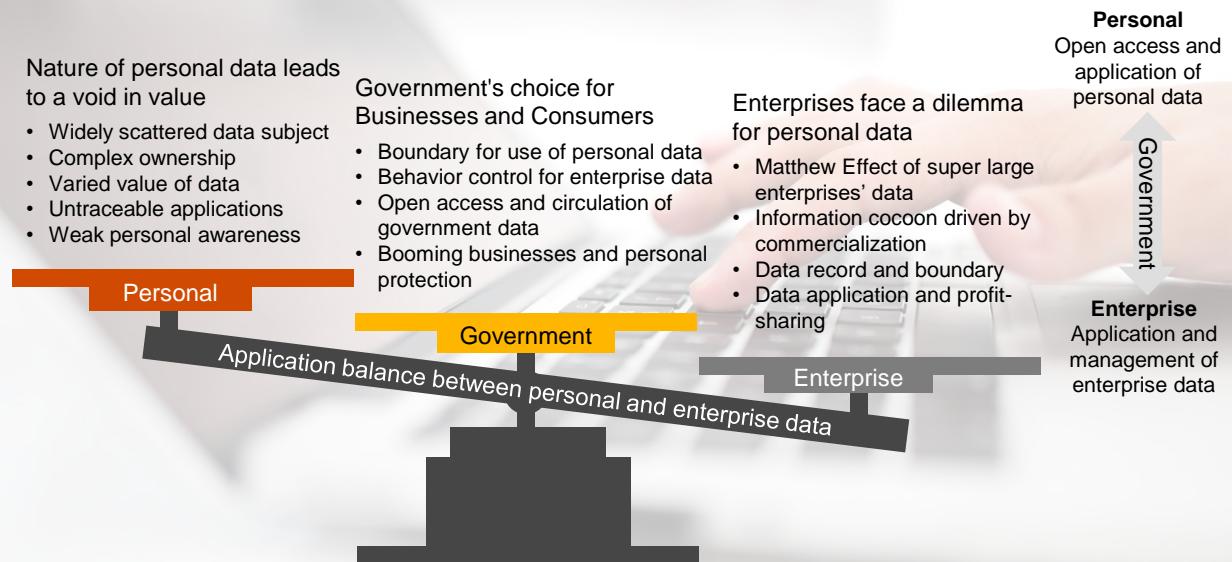
The imbalance in our natural ecosystem, such as excessive deforestation, forest clearing leading to wasteland, and logging at a rate significantly higher than their regeneration capacity, has led to significant resource depletion, soil erosion and climate change, resulting in many problems in the ecosystem and affecting various species within the ecosystem. The imbalance in the data ecosystem would similarly lead to major issues. The generation of "Digital Supremacy" is an example. These enterprises not only control massive amounts of data, but also hold unprecedented power.

On the one hand, the generation, flow, application and management of data relies on a sound ecological environment, which includes the effective segregation of labor among participants involving government, enterprises and individuals in an open and transparent mechanism. However, the major models for management and application under the current Chinese data ecosystem focus on the enterprise-centred organization, which manages, controls and uses personal data, failing to maximize the value of all parties within the ecosystem. Meanwhile, personal data is concentrated among some e-commerce and social media giants, indicating a more and more obvious integration effect. It is inevitable that there will be a lot of problems arising such as data discrimination, information cocoon, big data over charging existing clients, and privacy infringement. For enterprises that do not possess personal data, the barriers to development and competition brought by the monopolization of data will be felt. For individuals, the relatively decentralized data asset distribution and management will lead to difficulties in defending personal rights. For the government, the fairness of market resource allocation and the stability of the market economy will be difficult to manage. In the Tech industry where leading Internet giants are solidifying its market position, a small number of large Internet companies can collect and analyze data through numerous user-friendly and comprehensive service apps to understand user preferences and habits. In such cases, they can use their own strengths to instill their thoughts and objectives to consumers in a subtle way. More realistically, in the current digital age, it is impossible for people to completely disconnect from the services provided by these Internet giants. However, ordinary individuals have no knowledge of the process of big data operations, and people are restricted to the "information cocoon", and are driven to make decisions as a result of targeted advertising. Other SMEs are also unable to compete with these large companies, resulting in a few companies monopolizing the market. In addition, the boundaries of government's application of personal data in social public affairs are posing challenges such as ambiguous ownership of data and unclear distribution of wealth. More and more data are concentrated among a small number of companies, which can affect personal privacy and even national security.



Data ecosystem is slowly losing its balance (Exhibit 2), resulting in various problems and challenges.

## Exhibit 2: Application balance between personal and enterprise data from the government's perspective



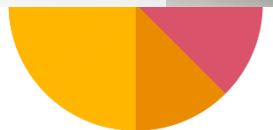
Source: PwC Analysis

On the other hand, data has been gradually considered an asset. From the current economic and legal perspective, there are three core characteristics of an asset. Firstly, an asset should be owned or controlled by a certain subject, that is, the ownership is clear. Secondly, an asset can generate existing or expected economic benefits. Thirdly, an asset is a kind of resource, which has scarcity. However, the intangible, reproducible and inexhaustible nature of data results in special characteristics of data assets: First of all, the subject of data assets may be multiple which leads to ambiguous ownership, for example, derivative data and its subject will be generated from data production to data circulation. Secondly, for data assets to be able to bring economic benefits, the basis should be on the reasonable pricing of data assets. However, the pricing for data assets depends on specific scenarios, in which pricing differs from different scenarios rather than on a uniform and general basis. Thirdly, data assets are artificially created resources, whose scarcity is a relatively dynamic concept compared with that of non-renewable resources such as oil. In a sense, data assets have an inexhaustible supply.

### Ambiguous ownership of data

On one hand, data is increasingly similar to commodities, which can be sold, transferred and applied. Nonetheless, with the improvement of cloud computing and big data technology, more and more problems are exposed. For example, when a certain content startup publishes some content on the Internet, since it can be reproduced and copied, we have no idea who the content creator is, and so some of the benefits will be stolen by the plagiarists. Therefore, data rights confirmation is becoming more and more important. The current hidden rule in this industry is "the entity who collects the data owns the data". The sales and utilization of personal data for profit, and the infringement of users' data ownership, right to know, right to privacy and right to earnings often happen. The improper collection, processing and use of personal data are hidden as business secrets.

One the other hand, currently, several data-flow platforms such as Beijing Big Data Exchange Service Platform, Global Big Data Exchange in Guiyang, Yangtze River Big Data Exchange and Shanghai Data Exchange are emerging, while data resource enterprises such as Datatang, Merit Data, and Lovedata are also developing in scale. However, the lack of specialized legislation and the ambiguity of the existing system, together with the concern about transaction risk and compliance risk of personal data, is causing China's data flow to be unsatisfactory in both "Quality" and "Quantity", which is difficult to meet the needs of the development of the digital economy. The crux of the data flow problem comes down to data rights confirmation.



## Prominent data privacy and security issues

Data security and compliance have become a requirement and foundation for data assetization due to data inclusion, respect for personal privacy and rights of the data subject, or increasingly strengthened laws, regulations and regulatory requirements. In recent years, society and enterprises have acquired relevant knowledge about data security and compliance, and are promoting relevant building of capacity. But new challenges and risks still exist in terms of security compliance governance, management and control system codata. At the societal level and industry level, there is a lack of standard for sharing, circulating and trading data; at the enterprise level, there is a general lack of principles for data rights confirmation, and there is no integrated compliance organization that combines legal, business, security compliance and IT, as well as management and control mechanisms for cross-business sectors. At the management level, there is a lack of full-life circle control of data, risk management methods suitable for the characteristics of structured data and big data, and detailed hierarchical access control. At the technical level, there is a lack of technologies and tools for data defence, awareness and response. nstruction, and technical solution implementation with massive amounts of

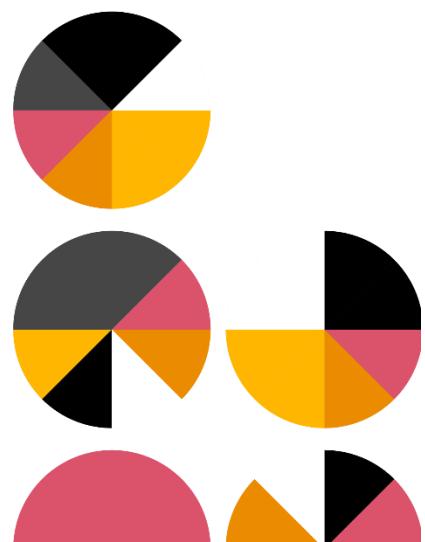
## Struggles in pricing and valuing data

Data assets are not fully consistent with the definition of intangible assets specified in the accounting standards and cannot be reflected in the financial statements of an enterprise at the moment. However, the value of data and its contribution to enterprise value creation should be recognized in terms of the recognition and measurement of data assets. Currently, research on valuation of data assets is at an early-stage and its methodology is still immature, coupled with various conditions and the nature of data itself, valuation of data assets still faces many difficulties and challenges:

1. **Variability in value of data.** The value of data varies due to its relevance, which in turn varies according to the user of data. The same data are of different value to users with different needs. At the same time, the increase in the turnover of data indicates that the speed at which data becomes obsolete is also accelerated accordingly. With the emergence of new data, the value of old data may be depreciated.
2. **Uncertainty in data value.** Issues such as regulation, global governance and privacy may have a substantial impact on the economic value of data and the extent to which companies invest in data.
3. **Infinity of data resources.** Infinity of data resources makes it difficult to measure the value of data assets.
4. **Complexity in ownership of data assets.** Ownership in this case refers to complete ownership. The nature of data assets' ownership (a kind of intangible asset) is different from tangible assets, therefore more and more complex factors need to be taken into consideration.

## Struggles in open access and circulation of data

For government departments and enterprises, the fragmentation of the collection and management of personal data have an impact on personal data circulation, sharing and usage, as well as the regulation in accordance with the law, which makes it difficult to aggregate multi-dimensional personal data including online and offline, resulting in difficulty in achieving new value-added services such as personal credit, Internet financial services, and accurate marketing of products. The economic and social value of personal data would be hard to realize as well. The realization of the current data value relies on the traditional value-added model. However, to fully unlock the value of data, what's required is not only better algorithms and faster calculation speed, but also innovative data usage and data circulation models. As China's economy enters a "new normal" with data as a new driving force for economic growth, we urgently need to explore a new model for personal data collection, management and usage, standardize value-added services and transactions of personal data, protect the privacy and security of user data, safeguard the legitimate rights and interests of user data, and continuously promote the development of relevant technologies and applications in the area of personal data.



# 3

## Building a balanced ecosystem for data assets

### Defining a balanced ecosystem for data assets

In nature, ecological balance refers to a state of high adaptability, coordination and unity between organisms and their environments, and among various species in the ecosystem over a certain period of time through energy flows, substance circulation and information transmission. When the ecosystem is in a balanced state, the components within the system maintain a certain proportion, the input and output of energy and substance are equal over a long period of time, and the structure and functions are in a relatively stable state. When external interference occurs, the components of the system can be restored to the initial stable state by self-regulated recovery. Within the ecosystem, producers, consumers and decomposers maintain a relatively stable state of energy and substance input and output dynamics over a certain period of time.

In the digital world, the only way to achieve sustainable development of the digital economy is to build a balanced data assets ecosystem centered on the data assets in the long run. PwC believes that in a balanced data assets ecosystem, the following categories of roles should be included:

**Data producers: Individuals/Enterprises - Trees:** Individuals and enterprises, as the main producers of data, are like trees in rainforests, which have a great influence as a group despite of their limited volume in size and impact individually. Therefore, a unified, efficient and consistent “rainforest” is a major contributor to the data ecosystem.

**Government-directed data rights confirmation and pricing recommendation mechanism - Photosynthesis of the sun:** Data generated by individuals cannot be directly applied by the outside world, just as rainforests can produce precious oxygen and water droplets only through photosynthesis and atmospheric circulation. Thus, the rights confirmation and pricing recommendation under government guidance is like the sun in the ecosystem that is used for photosynthesis, while scientific research institutions and academic institutions also play a crucial role.

**Data Consumers: Enterprises/Individuals - Animals:** Enterprises are like all kinds of animals in the ecosystem, which form an ecosystem along with the rainforest. The output of the rainforest produces greater levels of value which is consistent with the natural effect of the food chain being gradually enlarged. Similarly, excessive damage of animals in the rainforest will ultimately lead to the collapse of the ecosystem when lacking government-controlled management that is like the sun's radiation.

**Public data - Soil:** The integrated and open public data is like soil. The organic substance in the soil, whether animals or rainforests, is formed by decomposers under the sun, which in turn becomes an indispensable foundation for rainforest growth.

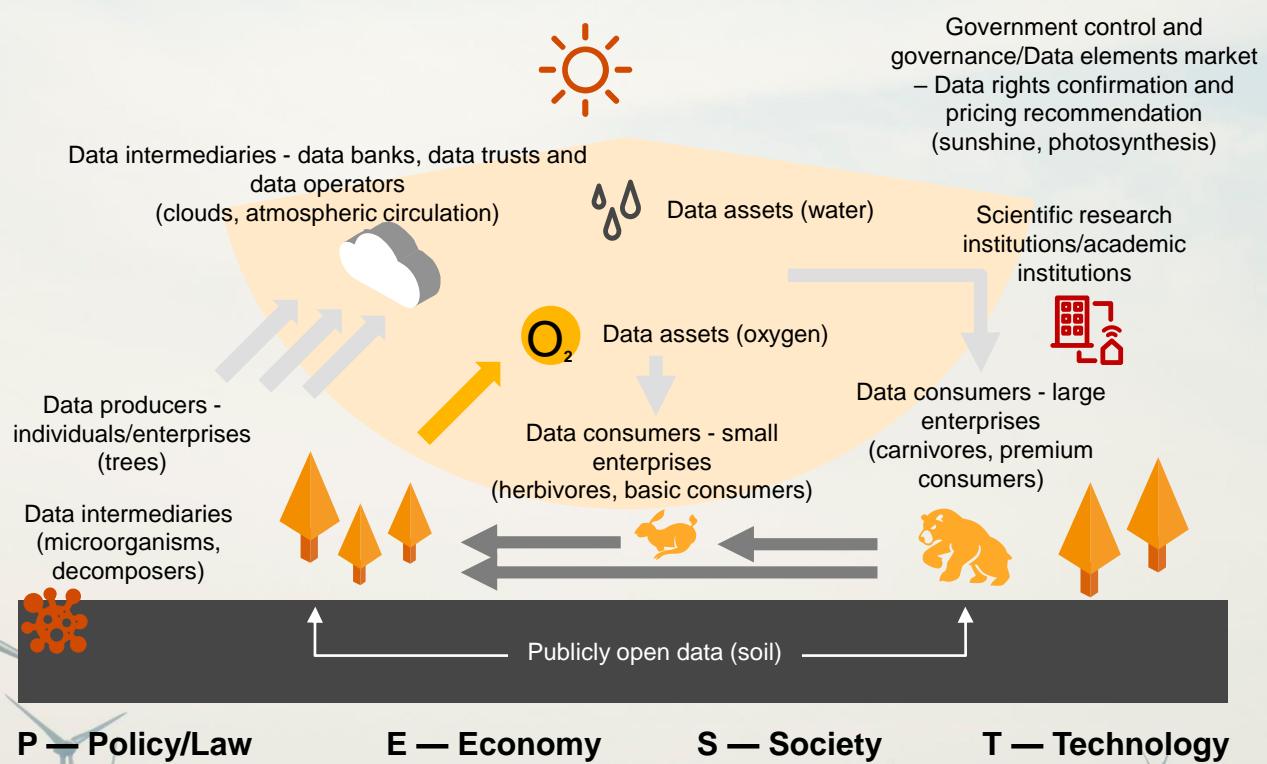
**Data intermediaries - Microorganisms:** Microorganisms are decomposers that can decompose various complex dead organic substances in an ecosystem into water, carbon dioxide, and other substances that can be reused by producers. In the data assets ecosystem, plenty of data technology companies play a similar role as microorganisms.



The core guidelines for the ecological construction of data assets are hidden in this cyclical ecosystem: Ensuring that policies and regulations are fully implemented to achieve "The Sun Illuminating the Earth", that data intermediaries become the economic foundation as "Oxygen and Water Medium", and social regulation as the core for "Rainforest Protection" (see Exhibit 3).

Therefore, the establishment of a balanced data assets ecosystem relies on four core pillars: 1) from a policy and legal perspective, it is necessary to start from the government for photosynthesis, speed up legislation, clarify the mechanism for data rights confirmation and pricing recommendation; 2) from an economic perspective, it is necessary to form a new business model focusing on data assets. Only by forming a business model can the ecosystem be established; 3) from a societal perspective, it should achieve data inclusion by fully taking social impact into consideration and avoiding data discrimination, allowing the ecosystem to benefit all participants; 4) from a technological perspective, two core issues are required to be addressed, one is the issue of safe data sharing and the other is the issue of reliable data calculation.

### Exhibit 3: A balanced ecosystem for data assets



Source: PwC Analysis

## Policy and legal perspective



### Mechanism for confirming data rights and pricing recommendations

Still in its exploratory stage, the mechanism for data elements confirmation is a rising concern among industries, academia and policy makers as rights confirmation for data elements is critical for the identification and effective allocation of data resources.

#### Data rights confirmation

For data to be defined as a digital asset, data rights confirmation is key. According to its definition, data rights include ownership, right to use, right to operate, right to know, right to be forgotten, right to rectification, right to erase, right to object, and right to restrict processing, etc.

**International data rights confirmation practice:** Internationally, there have been continuous efforts with regards to data rights confirmation. For example in Europe, the EU came out with *General Data Protection Regulation (GDPR)* and the *Regulation on a Framework for the Free Flow of Non-personal Data in the European Union*, through which, they established a dual structure of "personal data" and "non-personal data". The rights attached to any identified or identifiable "personal data" related to a natural person belong to this natural person, who is entitled to a wide range of absolute rights including the right to know and consent, right to rectify, right to erase, right to object, right to restrict processing, right to be forgotten, and right to data portability, etc. Enterprises are entitled to the "data producer rights" for "non-personal data" which does not qualify as "personal data". This attempt by the EU on data rights confirmation was unsuccessful. In practice, the definition of "personal data" and "non-personal data" was inconsistent with existing practices, as the former covers an extensive range where almost all data eventually connects to certain natural person through combining and processing in this digital world. As a result, one data set often contains both personal and non-personal data. And it would be very difficult, even if possible, to sort out the mixed data, and may lead to unexpected consequences, such as harming mature Internet businesses, hindering the development of artificial intelligence, blockchain, cloud computing and other emerging industries. Contrary to the European Union, the US has adopted a pragmatic approach to data rights confirmation. Under this approach, the US places personal data under the traditional privacy framework to mitigate the threat posed by the Internet on private information, which supplemented with industry-specific laws in finance, healthcare, communications and other sectors, as well as self-discipline mechanisms, has formed a relatively flexible system.

In China, we need to learn from the experience and lessons from Europe and the US in terms of data rights confirmation and focus on the following four "must":

1. **Must give full consideration to the different phases of digitization and particular national conditions:** Under China's new development pattern that relies on both "domestic circulation" and "dual circulations" (domestic and international circulations), the digital economy is now a major growth point and an important employment channel. China has made measurable achievements in the development of digital economy on the world stage, yet there is still a long way to go. In this context, the overriding objective ahead should be to maximize the value of data, the key productive factor for the digital economy.
2. **Must adhere to red line thinking of personal privacy and sensitive data protection:** After data rights are confirmed, the data will enter market-based transactions and circulation, and may also generate negative effects that are harmful to consumers. Therefore, when formulating a mechanism for data rights confirmation, we must adhere to the red line thinking of data privacy protection when it comes to core privacy or personal sensitive data. Only by increasing security and trust among consumers can data rights confirmation be established, and only then can the data asset ecosystem be healthy.
3. **Must make data flow and sharing the main purpose:** Data rights confirmation is to ensure legal flow and sharing of data. As the digital financial ecosystem continually opens up, data will flow and be shared among different business entities, and generate new data through regrouping, which derives new data. The rights confirmation rules will eventually be established by way of contractual allocation of rights and interests among different parties, summing up the best practices and industry standards, accompanied by the competing and evolution of rules.

#### 4. Must empower data rights confirmation through digital technology:

Traditionally, data rights were confirmed by submitting ownership certificates and expert reviews, which lack technical credibility and may be subject to uncontrollable factors such as tampering. Given the uniqueness of data assets, there are currently two types of technologies that can help facilitate data rights confirmation. Scenario 1, data that needs to be physically circulated and traded, and its ownership needs to be clarified. Blockchain is recommended for this scenario: blockchain provides tamper proof, digital signatures, consensus mechanism, smart contracts and other technologies to help confirm the rights of data, and record and monitor the generation, collection, transmission, utilization and income of data throughout the whole cycle, providing a solid technical foundation for data sharing and flow. Specifically, the owners, producers, and users of data assets are connected through blockchain as important nodes in this network, who can use the synchronous consensus function to record in detail and witness the generation, flow, and transaction of data, as well as the identity and operation log of the data subject, leaving no one to evade or deny. This method enables all participants in the ecosystem to share their data assets, and supervise the asset's movements and income allocation through smart contracts, achieving income and risk sharing that leads to smoother flow of data assets. Scenario 2, the flow and sharing of data among different business entities produces new data due to regrouping and analysis of different data, making it difficult to confirm data rights among various participants. In this scenario, the right to use and operate data is particularly important. Therefore, it is suggested to adopt Secure Multi-Party Computation (MPC), that is, to promote data flow and sharing without changing the actual possession and control of data or under unclear ownership by using MPC platforms to transfer computation to the data end in an effort to ensure corporate data security and personal privacy protection as well as facilitate the sharing and utilization of data and business innovation. At present, initial achievements in MPC have been demonstrated in joint risk control and marketing efforts among financial institutions.

Recently, the "People's Data Asset Service Platform" hosted by the People's Data Management Co., Ltd. (hereinafter referred to as "People Data") was officially launched in Beijing. This is the first national-level integrated data asset service platform in China, which uses blockchain for data rights confirmation. It is also the first platform in the industry that integrates data compliance review, publication of data rights confirmation, data flow registration, and data asset services. According to public information, the Platform consists of a data source authentication platform, a data flow registration platform, a data transaction service platform, and a data flow supervision platform. Through this Platform, it aims to connect data providers, processors, transaction platforms, users, and regulators to establish a unified system providing data authorization standards, data category management, data encryption specifications, and data flow and transaction security, and use emerging technologies such as blockchain to effectively identify the flow of legal data and illegal data, and establish industry standards and blacklist mechanisms.



## Data pricing

As the core link to releasing the value of data assets in the future, pricing data is different from pricing other assets to a large extent, as the value of data assets mainly derives from direct or indirect business income, but the non-destructive duplicability of data and the aggregation of income generated from different business scenarios allow data assets to have different value from that of traditional assets, which is a dynamic value based on different factors. The valuation of data assets can be carried out through the following dimensions (see Exhibit 4).

According to the dimensions of valuing data, currently, there are three publicly recognized pricing models.

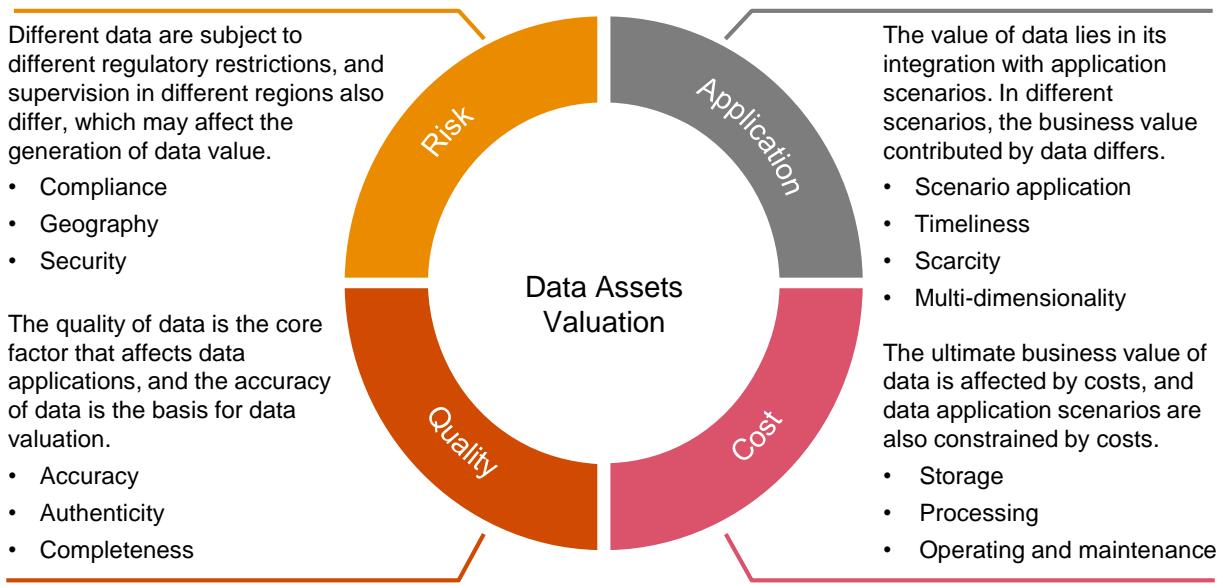
### Model 1: Cost method

**Calculation formula:** Valuation = replacement cost \* depreciation coefficient \* expected return coefficient

**Replacement cost** comprises of storage cost, processing cost, as well as operating and maintenance cost.

- Storage cost: The cost of infrastructure (computer rooms, cabinets, storage devices, etc.) for data storage based on data capacity;
- Processing cost: Materials (servers, software, etc.) and labor (employee costs, subcontractor costs, project costs, etc.) involved in data processing;
- Operating and maintenance cost: Materials (servers, software, etc.) and labor (employee costs) required for regular and reliable data services.

### Exhibit 4: Data valuation dimensions



**Depreciation coefficient** is the timeliness coefficient multiplied by the lifetime coefficient:

- Timeliness coefficient: Determined by the timeliness of data processing/updating (real-time, quasi-real-time, hours, days, weeks and months), and falls between (0-1);
- Lifetime coefficient: The adjustment coefficient for the percentage of the remaining time period of data to its total lifetime.

**Expected return coefficient** is the expected additional income of data to be obtained in internal accounting and external transactions, which is  $\geq 1$ .



## Model 2: Income method

**Calculation formula:** Valuation =  $\sum_1^n$  excess business income

Excess business income shall be calculated according to the various categories of data assets:

- For modelling analysis: Use the model to evaluate the business value contribution after putting data into production, and allocate equally to all data asset items that are ultimately included hereof, and calculate over the lifetime of the model on an ongoing basis;
- For reporting: Set assumed business value of each report based on the level of the report users, allocate on a weighted basis to the data asset items in the report in line with asset levels, and calculate each time based on volume viewed;
- For data access: Determine pricing for each data access based on the number of items, asset level, and total size of data assets requested, and calculate based on the returned data set of each access request.

## Model 3: Market method

**Calculation formula:** Valuation = comparable data asset turnover \* correction coefficient

The pricing calculation involves:

- Comparable data asset turnover: The transaction amount of the same or similar data assets in the open trading market;
- Correction coefficient: It is used to correct the difference between the underlying data asset and comparables.

The three pricing models above have their own pros and cons, and relevant entities can choose one model based on their actual situation and demands (see Table 2 and Table 3). In addition to these three pricing models, the industry is also exploring new pricing methods, including studying the valuation model for intellectual property rights.

**Table 2: Comparative analysis of the three data value pricing models**

	<b>Pros</b>	<b>Cons</b>
<b>Cost method</b>	<ul style="list-style-type: none"> <li>Simple to calculate</li> <li>Easy to understand</li> </ul>	<ul style="list-style-type: none"> <li>Difficult to accurately calculate and measure the replacement cost</li> <li>Fails to reflect the direct and indirect business value of data</li> </ul>
<b>Income method</b>	<ul style="list-style-type: none"> <li>Reflects the impact of data assets on business income</li> <li>Intuitive and easy to understand</li> </ul>	<ul style="list-style-type: none"> <li>Difficult to accurately measure excess income</li> <li>Difficult to allocate the excess income to individual data asset as the income is usually generated by application of a group of data assets</li> </ul>
<b>Market method</b>	<ul style="list-style-type: none"> <li>Objectively reflects the market condition of assets</li> </ul>	<ul style="list-style-type: none"> <li>Lack sufficient fundamentals for open market trading</li> <li>The value of data assets need to be separately analyzed based on different transaction scenarios</li> </ul>

**Table 3: Data valuation methods in different scenarios**

<b>Application scenarios</b>	<b>Valuation method</b>
Virtual accounting for internal data asset sharing	Cost method (expected return coefficient close to 1)
External data exchange/transaction	Cost method (reasonable expected return coefficient)
Evaluating the contribution of data assets to businesses in a certain industry	Income method
Pricing on data products	Cost method (reasonable expected return coefficient)

## Economic Perspective



### Exploring business models for data assets

In the early formative days of the mobile Internet era, a large number of Chinese technology companies began to realize the importance of personal data to product and enterprise development. However, the absence of specific business models and unclear division of rights and responsibilities made data-based commercialization tremendously difficult. Therefore, the early data flow in China was mostly driven through the authorization-based barter model, that is, users authorize operators to use the user's data in exchange for its services. Strictly speaking, this model lacks the scale effect of commercialization.

According to the definition of data ecosystem, a balanced and healthy ecosystem must be equipped with a sound business model. In the digital economy era, the economic value of data will be fully released, which will derive diversified business models with gradually clearer data rights confirmation and pricing methods. In the future, the commercialization of data assets will gradually sink to the consumers represented by individuals to form a series of models including data transaction, data bank, data trust, and data intermediary that connects Government, Businesses and Consumers.

**Business model 1: Data platform transaction model.** Since 2014, China's mobile Internet has entered a stage of rapid development, and the value of data has been continuously recognized by the business world. Take a data service company as an example. The company is exploring new business models, such as online data crowdsourcing. The platform explicitly prices a specific data set and trades with related suppliers. This model attempts to explore a business model aimed at data monetization, and clearly puts forward the business judgement that data has corresponding value. Since then, the government-led data exchange models have emerged in cities with an active data ecosystem such as Guiyang and Shanghai. This platform provides a transaction platform that bridges data supply and demand, and is supported by third-party professional technologies and government supervision, to eventually realize the transaction and flow of data. This model has resolved the main issues in terms of mutual trust of data, data protection, and data supply and demand, and is conducive for a large number of industries to develop data labelling and products through platform accumulation. In 2019, Tim Cook, CEO of Apple, said, "The Federal Trade Commission should establish a new data-broker clearinghouse, requiring all data brokers to register, enabling consumers to track the transactions that have bundled and sold their data from place to place, and giving users the power to delete their data on demand, freely, easily and online, once and for all."

PwC believes that the data platform transaction model will continue to gain attention in the future and become one of the key business models for data flow. The *Measures for Data Security Management (Draft for Comments)* in China requires network operators to publish their "rules for data collection and usage", and prohibit network operators from forcing or misleading data subjects to consent to the collection of their personal data through default authorization or bundled functions, and also set forth the specific requirements of "anonymization". From a macro perspective, the measures do not encourage data oligarchs with an oligopoly. Internet and industrial giants will form specialized data businesses in the future, which will further highlight the importance of open and transparent data flow between each other. Therefore, the data transaction platform will play a more important role in the process of commercialization, and give birth to segmented business models such as data intermediary or data brokerage.

In the future, the data platform transaction model will make further evolution to be more precise, more diversified, and more applicable.



**More precise** means that the matching of the supply and demand in future data flow will develop deeper data insights and enable better understanding of demands along with the accumulation of current platform-based transactions. Compared to the current business model that relies heavily on platform matching, the future data-driven matching model with decentralized supply and demand distribution will help lift the efficiency of data commercialization. **More diversified** means that, on top of government and enterprises, individuals as the largest creator and user of data will also be included in the business ecosystem. According to China's plan for personal data legislation, individuals will acquire more proactive rights to use data, and even be the initiators of social data supply and demand in the future. **More applicable** means that more value-adds will be cultivated in the further development of data-backed services based on the current transaction structure focusing on data aggregation and inquiry. Take bank payment data as an example, it is possible to develop a product through data integration solutions with data desensitization, which can help a large number of enterprises and individuals complete one-stop credit evaluation. The future data flow business model will get rid of the current profit distribution model dominated by commission-driven matchmaking, and enhance the potential of business models through value-added services.

**Business model 2: Data bank model.** Since personal data assets and monetary assets share some common features in nature, personal data is part of one's personal property, just like deposits in a bank. Therefore, in short, personal data assets can be managed and operated similar to the banking model, which can not only achieve centralized and effective management of personal data, but also realize the added value and smooth flow of personal data, bringing certain benefits to individuals, that is, personal data banking. Based on the bank's management and operating model of personal monetary assets, the personal data bank focuses on the protection of the users' ownership, right to know, privacy and income rights to their personal data, and establishes a comprehensive service system for the management and operation of personal big data assets, including data rights confirmation, aggregation, management, transaction and value-added services and other functions<sup>1</sup>.

**Business model 3: Data trust model.** According to the trust law, the institutional arrangement of trust property ownership has a structural characteristic, that is, the trustee is entitled to the legal ownership of the trust property, and the beneficiary enjoys the benefits derived from the trust property, which is also known as "dual ownership of the trust property". What's different for data assets is that the owners of personal data may be isolated from the controllers and beneficiaries of "big data".

Therefore, the separation of rights and functions such as the ownership, right to use, and right to benefits of data assets adequately matches the composite arrangement of trust property rights and ownership. This allows data assets as a trust property to be reasonable and operational in terms of right content and institutional arrangement, and the trust property system enables effective design and implementation of various rights and functions for data assets. When a data asset becomes a trust property, it can meet the commercial and business requirements of the data asset. More importantly, innovation in the trust business can create broader applicable scenarios for data assets.

As data trust is a forward-looking and innovative business in both theoretical exploration and application, trust companies are still in the stage of exploration and trial for its data trust business. In practice, AVIC Trust pioneered the issuance of the first data trust product with a product scale of RMB 30 million<sup>2</sup>.

**Business model 4: Data intermediary model.** In this digital age where winner-takes-all, several platforms with technology giants as the main subject have been fostered. These platforms will inevitably result in excessive concentration of power, which is not conducive to market competition and social openness. Individuals are also unable to obtain data dignity on their own. Even if they petition the government, it will not work, because the network effect gives the platforms too much power, and the complexity of the digital economy makes it impossible for supervision into particular details. In order to achieve data dignity, we need a medium-sized peripheral organization to narrow the gap. These organizations and business activities are called "Mediator of Individual Data" (MID). MID strives for the greatest interests of data creators and obtains reasonable commission based on the benefits obtained. The existence of MID will have a certain impact on the data-based profit model of technology giants, but in the long run, technology giants should readily accept the future led by MID, and their platforms will also benefit from it<sup>3</sup>.



<sup>1</sup> Personal Data Bank - A New Model for Personal Big Data Asset Management and Value-Added Services Based on Bank Structure, Chinese Journal of Computers, January 2017

<sup>2</sup> The Age of Big Data, "Data Assets" and Financial Application Prospects, AVIC Trust

<sup>3</sup> Blueprint for a Prospective Digital Society, Harvard Business Review Chinese Edition, February 2019

## Societal Perspective



### Avoiding data discrimination and achieving data inclusion

Nowadays, constant releasing of the value of data assets has not only created a new driving force for the economy, but is also indirectly reshaping social relations, developing a brand new understanding of social issues. As data becomes an asset with market value, the Chinese society should reconsider individual's tolerance for the use of data, anti-discrimination of data value, and the inclusive goal of data application.

In terms of tolerance for the use of personal data, the Chinese society will gradually increase awareness of the storage, management, and utilization of personal data in the future. The sense of absence in short-term execution will emerge while calling for the enforcement of legislation. Therefore, society-wide measures for personal data management, tracking and authorization will be initiated through technical means to ensure active management in line with national policies.

In terms of anti-discrimination of data value, differences in data value due to differences in personal attributes will exist for a long time to come. However, the Chinese government and enterprises will work hard to remove value discrimination as a result of data availability, and fully implement the establishment of digital archives in healthcare, education and other industries to ensure the release of personal data value and realization of corresponding value, and promote the equal rights for the population with lower living security to obtain corresponding services and even commercial benefits through personal data.

With regards to the inclusion of data application, it has become a consensus of the Chinese government and enterprises to drive the reform of data application by improving the service efficiency in industries and creating social value through the integration of personal data and enterprise data. Shanghai has provided a perfect example by integrating government data with enterprise data to support banks to improve the efficiency and quality of inclusive financial services. PwC predicts that, in the future, large data-dependent industries such as trade and materials will take precedence to benefit from digital inclusion, forming a solution platform that benefits multiple parties.

### Data usage tolerance

The tolerance of the public towards the scope and means of data usage determines the development direction of the application of data assets. At present, tolerance of personal data has gradually become a global issue. High priority placed on the topic will lead to the rapid implementation of policies and administrative measures at the national level to resolve social issues caused by data abuse. Data transparency may become an important goal for China to work on in the next five years.

With the continuous evolution of the digital society, Chinese people's tolerance to data usage has experienced four stages: indifference, education, concern and anxiousness. The maturity of the mobile Internet era and the increased discourse power of the Z generation have ultimately led to better acceptance from all segments of society on the concept of data rights ownership. EU has issued the *General Data Protection Regulations* and China has improved the management measures for data security, which have raised great concern from society on the protection and usage of personal data.

According to the *2019 General Report on Netizens' Satisfaction towards Cybersecurity* conducted by China Computer Society Computer Security Professional Committee, 37.4% of the respondents believe that there are too much or quite a lot of personal information leakage on the Internet. The outbreak of COVID-19 in 2020 has triggered the concern for personal data tolerance to a certain extent. While ensuring their own security, many people have promoted the transparency of data usage during the epidemic. They will also continuously pay attention to data management in the post COVID-19 era.

From another perspective, although relevant laws and regulations have been launched successively to define the needs for protection of industry practices such as data collection, anonymization and targeted marketing, the transition from legislation to enforcement still needs time and needs implementing of subsequent management measures. During the transitional period from legislation to implementation, greater challenges will emerge in terms of the public's tolerance, which will generate the calls for the transparency of personal data.

## REPORT

PwC believes that, in response to the increasing data tolerance, with joint efforts from the Chinese government and enterprises, the construction of a transparent platform for the usage of personal data information will be gradually explored in the future to form a data asset platform in which individual users can actively inquire and manage data.

Technically, the maturity of technologies such as blockchain have provided support for decentralized data tracking and control. The personal data asset management platform built based on blockchain will become an important support for the management of personal data in society. For example, in 2018, MedRec, a medical archive project developed by MIT, created a system for managing medical records using the Ethereum blockchain in the US, which allows individual users to access their medical records and manage the usage of their medical data, benefiting both healthcare and medical research.

At the national level, in accordance to central deployment, all provinces and cities regard the promotion of governments' rational governance on data and the flow of key elements as their main work at present. A number of provinces and cities, including Guangdong and Fujian, have carried out the checking and reviewing of internal data generated within governments and from government-enterprise cooperations. The construction of the individual data usage tracking and management platform will essentially help facilitate the completion of data processing and usage management through the allocation of rights and responsibilities.

### Data discrimination

With data becoming increasingly rich and diversified, various governments and enterprises within the digital economy have begun to apply data to all aspects of daily operations. From another perspective, the application of a large amount of personal data has led to the reconstruction of the business relationship between enterprises and individuals. Enterprises will provide corresponding value for users while using their personal data. Therefore, from the perspective of social consensus, it is an important direction of social development to eliminate discrimination to ensure that data value is fairly measured and that more people are benefited.

Objectively speaking, differences exists naturally in the data value of different groups of people in certain industry scenarios. Taking the data of retail consumption as an example, for e-commerce websites that need to analyze users' purchase behaviors through data to improve its business experience, data value of daily consumption of the wealthy is higher than that of wage earners and people living in rural areas. Essentially, the difference in value of such data is closely related to the difference in the social and economic attributes of these groups of people, and it is difficult to change such differences in the long term, even in the future.

However, on the other hand, data value discrimination in some industry scenarios is not derived from the natural data value of people groups, but from the obtainable value. Taking industries such as healthcare and education as an example as its applicable to all people, the industry data from high income groups and low income groups both have high analytical and application values. However, due to the fact that some low income groups have limited access to data, complete data assets are unable to be formed.

Therefore, the discrimination of data value still exists objectively in the short term, but industries relevant to all people with sound data infrastructure will gradually eliminate this social problem. Taking the healthcare industry as an example, China issued the *Outline for the Promotion of High-quality Development of the Health Industry (2019-2022)* in September 2019, which clearly states that at present the headline project of Internet + Healthcare will start with the construction of a health information platform for all people, and stresses the building of digital archives connecting all people. In the long run, medical data of all groups of people in the future will be gradually accumulated to form digital archives, which will help eliminate digital discrimination.

## Data inclusion

Data application has continued to spread from technology pioneers to the general public, transforming from a commercial application of some forerunners to exploring the possibility of serving the overall interests of society as a whole. Based on the needs of the state and society, digital inclusion that serves the interests of the public coincides with China's development concept that calls on mutual winning in the digital society. In some industries, best practices have been formed.

Mindful of the limitations of data application in the current society, China has also made great efforts in bridging the digital gap, which is the key to accelerating the resolution of imbalanced and insufficient development issues and promoting data inclusion. At present, China is committed to bridging the "medium gap" in network facilities, the "usage gap" between people groups and individuals, and the "knowledge gap" between the forerunners of digital technology and the public. Some regions have begun to take pilot measures to explore practicing data inclusion in areas such as finance.

As we all know, in recent years, under the guidance of national policies, the banking industry has formed a professional financial credit force to support the rapid development of medium-sized, small and micro enterprises. However, at the same time, it has also faced the high financial credit risk caused by the unstable development of SMEs.

Therefore, inclusive finance has long been in an awkward situation of being pushed to advance by national policies. In October 2019, in order to promote inclusive finance to support the development of a large number of enterprises and reduce the business risks of banks, Shanghai organized data resources of various government departments to be made available. Through the dual management of systems and technology, this public data has been conditionally opened to social enterprises in a secure, compliant and efficient manner, which has formed a pilot application towards inclusive finance.

Banks participating in the pilot project treats public data as information resources for risk control of medium-sized, small and micro enterprises in inclusive finance, which has enhanced the ability of automated risk control, effectively reducing the cost in the credit business with these enterprises, and improving business efficiency, forming socially utilized value of public data resources. As of July 2020, 18 Shanghai commercial banks have connected with the government's open platform for public data, which has provided banks with information related to 5,711 enterprises in seven industries, with the cumulative balance of credit approved of over RMB 3 billion.

Taking Shanghai as a successful example, the government has been organizing individual and industry data to form large numbers of industry scenarios, which has enabled overall application solutions for the industry and improved the operational efficiency of social services. Under the current development trends, inclusive trade, inclusive healthcare, inclusive logistics and other areas have also made great progress. PwC believes that in the future, industries relying on individual data to improve the industry's efficiency for the long term will be the first to benefit. Enterprises with improved efficiency will form more procedural data fusion through better experience, which will eventually form a number of industry-oriented inclusive solutions and provide practical experience for the integration of enterprise and individual data.



## Establishing a technical system for the management and application of data assets

According to the above analysis, after considering the uniqueness of data assets, in order to empower the establishment of data assets ecosystem and solve the problems in data rights confirmation, data pricing, data transaction, data circulation, data privacy and business models, two core issues need to be solved technically: secure data sharing and trusted data computing, so as to form the technical ecosystem of data assets.

### Secure data sharing - the combination of on-chain and off-chain storage

In this era of the Internet and digitization, the magnitude of data is growing rapidly, and the daily increase in data worldwide is measured in ZB terms. Each subject in the data ecosystem applies various models to store data locally. At present, it is unnecessary or impossible to connect the data of each subject in the data ecosystem to integrate all data. Thus, there is an urgent need for a certain technology that can not only support the local storage of massive amounts of data at present, but also realize connection and sharing. The combination of “on-chain” and “off-chain” blockchain storage may be applied to address this need, which only stores data signatures, transaction summary data and lightweight intelligent contract logic “on the chain”, and stores the data itself on the local data platform “off the chain”.

The Merkle Tree storage structure of blockchain can well complete the integration between the blocks and the distributed storage of big data (see Exhibit 5).

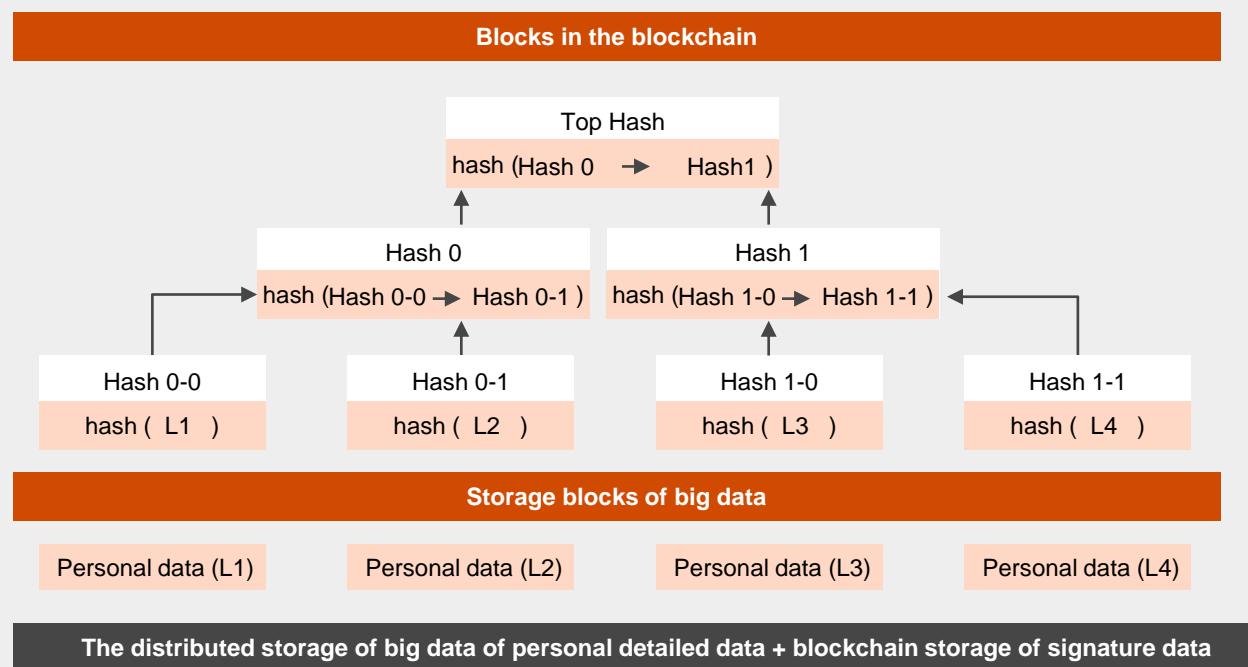
### Trusted data computing - secure multi-party computing and trusted computing

When data is securely stored using blockchain technology, the problem that arises in data co-production is an untrusted environment which may be solved by transferring the computational logic without transferring the data. Technically, confidential computing or secure multi-party computing (MPC) or trusted computing (TC) environments may be considered applicable.

## Technological Perspective



**Exhibit 5: Illustration of the Merkle Tree storage structure of blockchain**



Source: Information on blockchain from the Internet

- **Confidential computing**

Confidential computing is an emerging multi-party computing approach, which can protect the data in use. It is based on the trusted execution environment (TEE) which is directly supported by hardware, providing confidential support for the data computed. In 2019, Intel, Microsoft, Redhat, Alibaba, Arm, Huawei, IBM and Google jointly founded the Confidential Computing Consortium. The goal of the consortium is to define industry-wide standards and provide support at the enterprise-level to turn confidential computing into a product. In contrast to TC, confidential computing provides a fully independent trusted computing environment in a traditional server environment. When computing is run in this environment, the data used can receive real-time protection, providing unencrypted or unblocked raw data for the algorithm while ensuring data confidentiality. The multi-party computing solution based on confidential computing can not only protect the confidentiality of the data, but also guard against external invasion and internal leakage, as well as protect the intellectual property of the algorithm.

- **Secure multi-party computing**

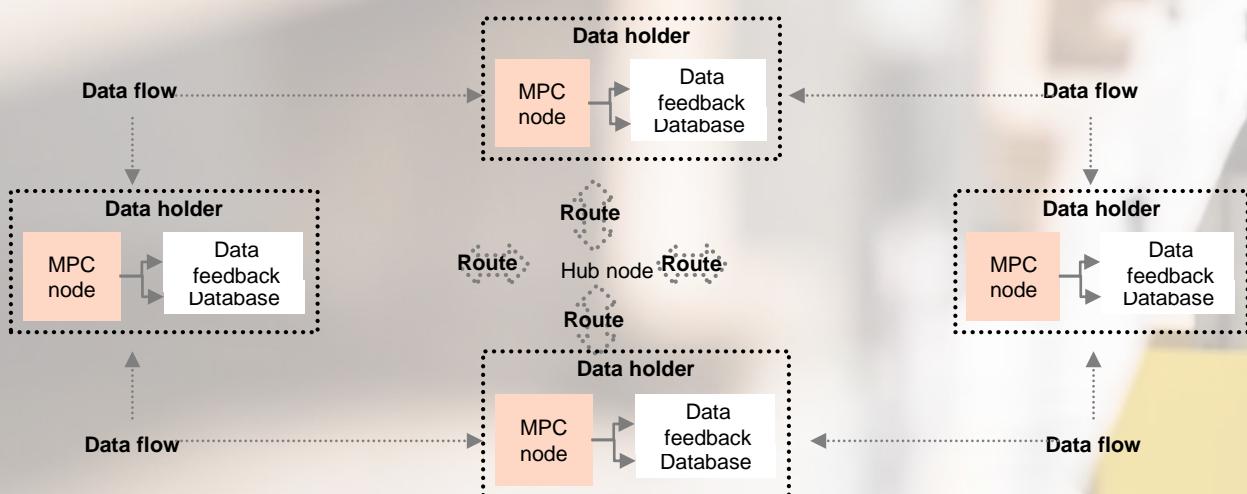
Secure multi-party computing means that in a distributed network, there is no trusted third party, and multiple participating parties input confidential data they hold, working together to complete a computing and obtain the results without revealing their input information to other participating parties (see Exhibit 6).

During the secure multi-party computing process, each data holder can initiate collaborative computing tasks, route addresses through hub nodes, and select data holders with similar data class to conduct collaborative secure computing. The participating nodes of multiple data holders involved in collaborative computing inquire the required data from the local database according to the computing logic and jointly carry out collaborative computing among dense data streams to accomplish secure multi-party computing tasks. During the whole process, the plaintext data of each party is stored locally and is not available to other nodes. On the premise of ensuring data privacy, the central node outputs the computing results to the whole computing task system, so that all parties can obtain the correct data results.

Three main features of secure multi-party computing are:

- Excellent performance in privacy. The main purpose of secure multi-party computing is to find ways to protect the private data of the participants in collaborative computing, which means that during the computing, all parties must ensure that the private input is independent and the local data is not disclosed.
- High accuracy. Participants in multi-party computing initiate computing tasks through the secure multi-party computing protocol to carry out collaborative computing, so that the results of the computing data are correct.
- Delegation of authority. In secure multi-party computing, all participants are equal, there are no privileged participants or third parties, which provides a distributed computing model.

### Exhibit 6: Technology framework of secure multi-party computing



Source: *Key Technologies for Data Circulation*, China Academy of Information and Communications Technology

- **Trusted computing (TC)**

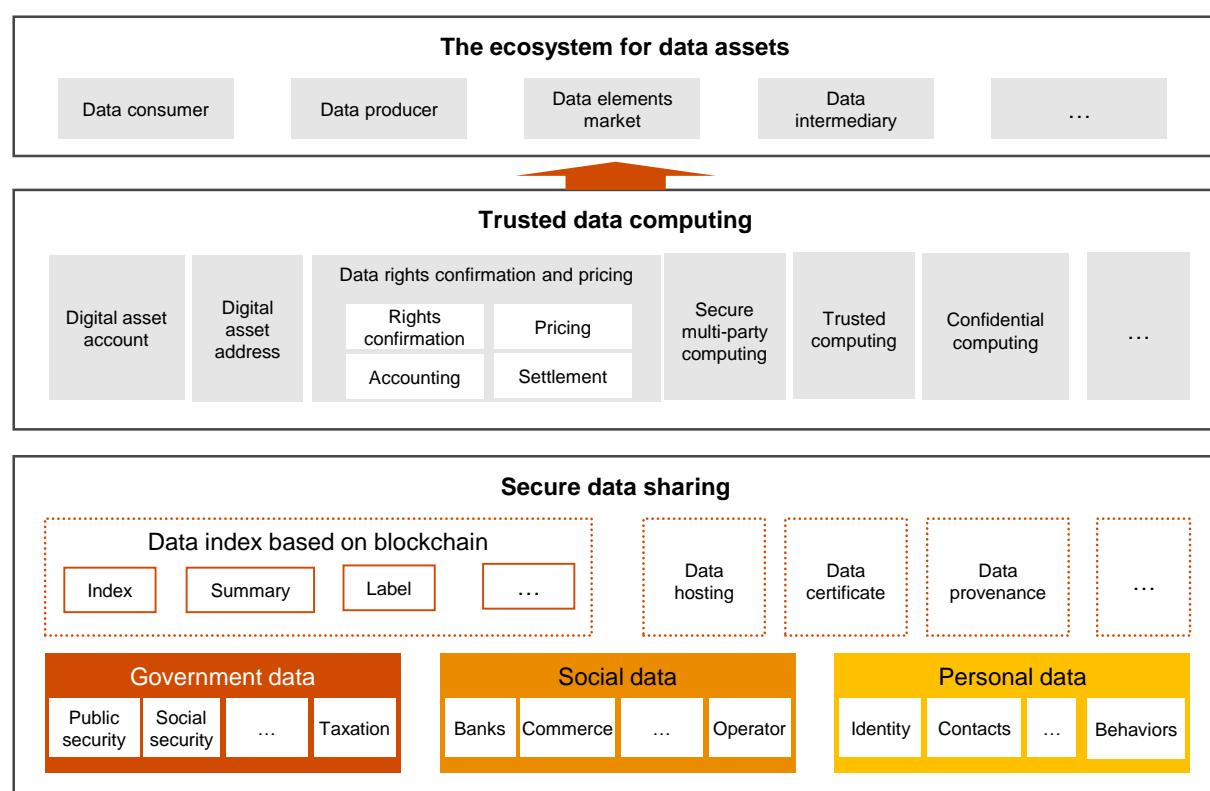
Trusted computing refers to the trust in computing behaviors, where the computing behaviors of the platform to achieve specific goals are consistent with expectations, which is free from various malicious acts. The main standard of trusted computing is TPM2.0, which is defined by Trusted Computing Group (TCG). In China, there are China TCM Unit (TCMU) and Trusted Cryptography Module (TCM). The goal of TMP (Trusted Mobile Platform) and TCM is to establish a set of systems to ensure the security of data from storage, calculation to transmission.

Public trust institutions of governments can establish a set of trusted data computing environments based on the trusted computing platform. Data approved by the data owner and with specific right-to-use attributes (including data scope, data timeliness, and number of times used) is computed in this environment. The computing results are distributed to the participants according to the ownership. Relevant data is destroyed regularly according to the requirements of the right-to-use attributes.

### The technical ecosystem for data assets

Based on the above data, the system architecture for the management and application of data assets may be established to realize ownership recognition and secure usage of personal data (see Exhibit 7).

#### Exhibit 7: “Three-in-one” reference architecture for data assets



Source: PwC Analysis

# 4

## Ecological vision and value of balanced data assets

Along with the development of China's digital economy, the importance and versatility of data as core elements continue to increase. Data assetization has a far-reaching impact on national governance, market allocation, enterprise operations and individual rights. PwC believes that data assetization has become an important trend where China drives social development through data, and the current direction of various stakeholders is to eliminate obstacles for this process.

### Promoting the development of a sustainable digital economy

On the topic of digital economy, governments and enterprises around China have already actively put in a lot of work, and have realized the innovation, upgrading and reengineering of the existing business models based on data usage and data circulation. Furthermore, a balanced data ecosystem will further improve the vitality of the digital economy in many aspects, so as to strengthen the sustainability of the development of the digital economy.

Firstly, personal data is integrated, managed and authorized through organizations and channels with credibility, which has removed the difficulty of lack of control over personal data, liberating individuals as an independent economic participant in the digital economy to make contributions and interactions, and replenishing the source of data creation for the long term. Secondly, enterprises complete a more detailed part of the work in the data market and carry out work under legislative supervision, which eliminates unreasonable competition that violates market principles, so as to improve the efficiency of the overall market. Finally, under the management radius of proactive rights confirmation, the government can improve services and optimize the market with data.

### Improving the social governance of a nation

At the moment, China is comprehensively promoting refined city governance based on grid management, relying on the implementation of governance driven by large amounts of data from the government, enterprises and individuals. Therefore, rights confirmation and legal application of data will become the core demand for city governance operations. With this background, the state is promoting data assetization in combination with governance applications, which can further optimize data rights confirmation, and eventually form a data application and coordination system recognized by multiple parties, so as to promote the evolution of refined national governance to the next stage.

PwC Observation: in June 2019, the *Data asset evaluation index system for e-commerce* compiled under the leadership of the China National Institute of Standardization was officially released. As the first official document related to data assetization released by the state, the index system fills the standard gap in the field of data assets in China and reflects the nation's great determination to promote the development of data assetization. At the same time, this move will also accelerate the process of data assetization, promoting the confirmation of data rights.



## Achieving optimal market resource allocation

As the core element in the digital economy, data is regarded as the water and air in the new economy. With the demand of the increasing social segregation of labor, there is a natural demand for transaction circulation, while assetization provides the basis of resource allocation for data circulation. Only when data becomes an asset and the asset value and asset ownership rights of the data in circulation are clearly defined can this element circulation model of the digital economy be established.

PwC Observation: Since 2014, China has successively set up national and local data trading centers represented by the Global Big Data Exchange in Guiyang and Shanghai Data Exchange Centre, which aim to promote open access and circulation of data with a market allocation model, further exploring best practices for the pricing and ownership rights confirmation of data as an asset.

In the long run, as the legislation becomes clearer at the national level and the circulation practice is strengthened, data assetization will become an important foundation for data acquisition, exchange and usage to form a fair and reasonable circulation model, which will lay a solid foundation for cross-end circulation and multi-party application in the future.

## Empowering enterprises for digital transformation

The digital economy is driving the digital transformation and upgrading of industries. A large number of leading enterprises have improved their business efficiency and even developed new businesses through data-driven solutions. Thus, data has become a productive resource. When promoting overall digitization, enterprises need to maintain, utilize, exchange and even consume data based on business demands. Therefore, data assetization will become the premise for enterprises to use the element reasonably and in compliance.

PwC Observation: According to PwC's 2019 CEO Survey, over 72% of business leaders agreed that data would create new businesses. The traditional view of "business generating data" has begun to evolve to "data generating business". In order to protect their own business model formed based on data and strengthen data usage and interaction, a large number of innovative enterprises have begun to record their own data as an asset. They have also called on accelerating the process of data assetization so that there is full awareness of the value of an enterprise in the digital economy and to protect the rights and interests of related enterprises.

## Unifying personal privacy and digital convenience

As digital applications continue to increase in all aspects of life, the general public has received large amounts of education from the market organized by service-oriented enterprises and public institutions, gradually raising concerns about the misuse of private data. In the digital age, the loss, leakage and illegal stealing of personal data are emerging endlessly, which has a serious impact on people's data security and even their personal safety. Additionally, individuals are constrained by their share of voice in the market, making it difficult for them to effectively protect their rights and interests. In essence, data assetization acts as a protective function for asset attributes of data from the aspects of legislation and social education, satisfying the fundamental demand of the protection of individual rights and interests.

PwC Observation: Since the outbreak of COVID-19 in 2020, national and regional governments around the world have relied on summarizing personal data to develop an efficient prevention and control system. A global survey shows that more than 70% of people are willing to provide data to governments in response to the epidemic. At the same time, the flow, aggregation and application of a large amount of personal data have aroused the public's concern about their own data security. The Ministry of Industry and Information Technology of the People's Republic of China has also issued clear instructions on personal data protection after the epidemic. Data assetization is an important action item to effectively ensure data security.



# 5

## Conclusion

In the digital era, the establishment of a balanced data asset ecosystem is the key to meeting the challenge of further application, open access and integration of data.

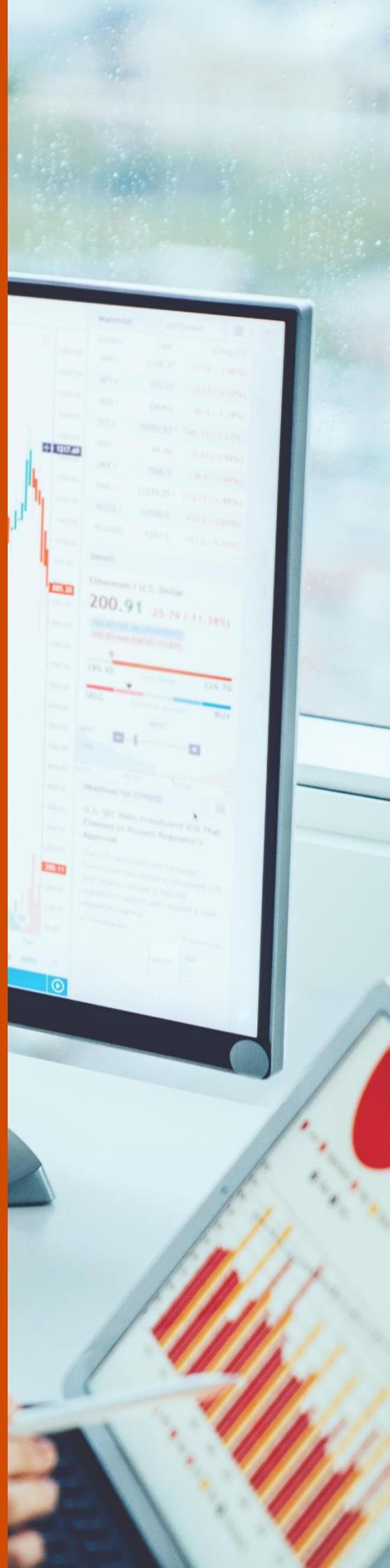
Restricted by major challenges such as ambiguous ownership rights, prominent privacy and security issues, struggles in pricing and valuation, decentralized governance, and difficulty in open access and circulation, it has been difficult for data to achieve a market-led balance between the supply and demand side. PwC believes that the greatest root cause lies in the fact that at present the ecosystem of data assets is in a state of imbalance, and the absence of core roles and key action items is preventing data from maximizing its value.

In addition to traditional data producers and consumers understood by the public, a balanced data asset ecosystem also includes data intermediaries which balances data oligopoly, government-led data rights confirmation and pricing mechanisms, and various business models for data assets.

In order to achieve a healthy data asset ecosystem, PwC calls on the implementation of complementary work in the following areas, including but not limited to:

- Improving the ownership rights system of data through policies and regulations;
- Exploring the business models of data assets through enterprise innovation;
- Calling on the implementation of data inclusion through social forces;
- Establishing a management and application system for data assets based on technical specifications.

With the support of top-level planning and implementation of supporting activities, the ecosystem of data assets will gradually grow from a profit-driven, short-sighted and unbalanced “dark forest” to a “tropical rainforest” with mutual support, circular development, vitality and sustainable development. China will usher in the release of value in data by fully opening access and integrating with the digital era, making data everywhere a “new productive factor” that drives development.



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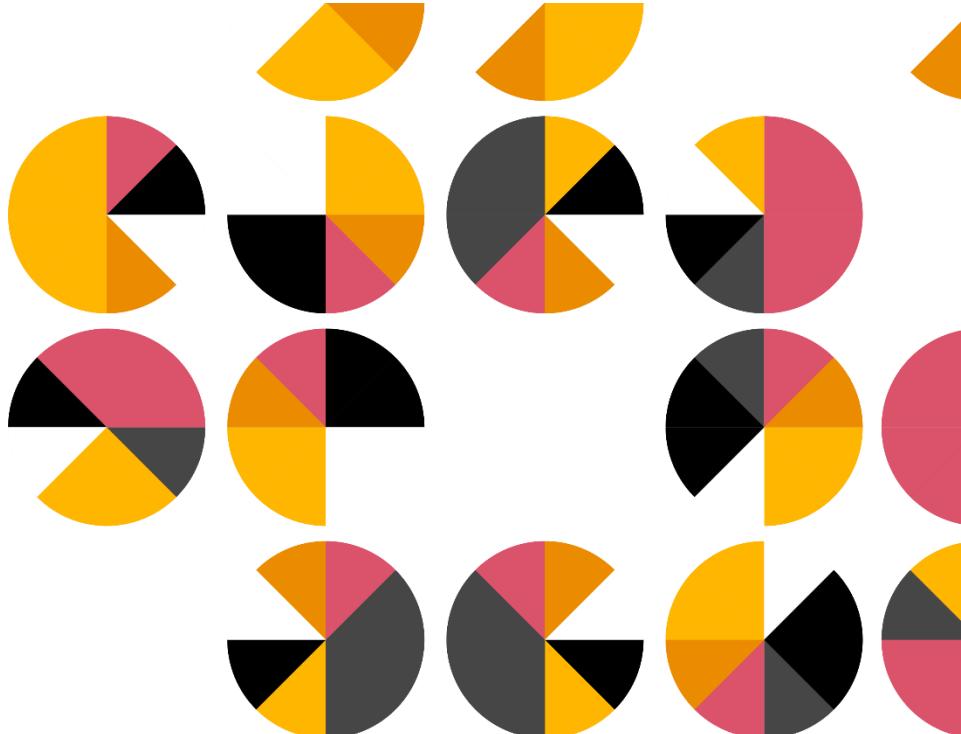
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