

# Towards a Data Economy: An enabling framework

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# A Note from the Data for Common Purpose Initiative



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Data impacts everyone, regardless of industry, geography or type of entity. Accelerating the responsible exchange and use of data can solve critical challenges and fuel innovation for society. Whether the purpose is to provide better outcomes in agriculture, health, mobility or other sectors, organizations and governments can sponsor changes to enable data economies and leverage data.

This publication, led by the Centre for the Fourth Industrial Revolution India, is part of the World Economic Forum Data for Common Purpose Initiative (DCPI). A global initiative, DCPI explores data exchanges and marketplaces as means to exchange data assets for the common good and to promote the transition to a data-driven economy. A global multistakeholder community of more than 50 global partners in 20 countries, including seven countries, DCPI focuses on exploring data governance models that allow data from personal, commercial and/or government sources to be combined, while still respecting rights.

Presented here is a critical enabling framework to allow stakeholders across the data ecosystem to take data exchanges from concept to reality. It lays the groundwork in India and elsewhere for those poised to explore, develop and realize the benefits of a data exchange to accelerate a transition to a data-driven economy.

Exploration of the topics in this paper resulted from collaboration with the DCPI community and the wider Centre for the Fourth Industrial Revolution Global Network (C4IR Network). This is to ensure a broad and global view providing the greatest opportunity to ensure the rights of stakeholders and the equitable allocation of benefits and

risks to all. Much needs to be considered in any discussion on data exchanges and marketplaces including cultural beliefs, philosophies and industry nuance. For this reason, the focus in DCPI remains on global approaches, to realize the potential of these interoperable systems, while respecting individualized and localized notions. This global initiative also serves as a space for further discussion on efforts to source greater trust and transparency for economic benefit. The Centre for the Fourth Industrial Revolution India, among others in the Network, is a major contributor to this initiative.

An introduction to the potential of data exchanges, [Data-driven Economies: Foundations for Our Common Future](#), was published in April 2021.

This idea has gone from being a concept to active development, though it is in its early adolescence. The Centre for the Fourth Industrial Revolution India is sharing its vision in this white paper and a starting point for a potential data exchange. These white papers and frameworks are the first of many deliverables of this multi-year initiative to explore policy, technical and commercial enablers for a flexible data governance framework for a data exchange. Collectively and individually, they offer insights into and thorough examinations of, specific considerations for decision-makers.

In developing governance for data exchanges, collaboration as well as a systematic and inclusive approach are critical. With thanks to the Centre for the Fourth Industrial Revolution India for sharing their insights, now published for the first time, we hope that those interested in building a robust data ecosystem find the framework useful and look forward to incorporating feedback and continuing the dialogue on this important topic.

# Foreword



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Rapid digitalization has not only helped India achieve inclusive growth with improved governance but also poised it globally as a data-rich country. As per a McKinsey report<sup>1</sup>, *Digital India: Technology to transform a connected nation*, increased digitalization in sectors like agriculture, education, energy, financial services, healthcare, logistics, retail, as well as government services and labour markets, could each create \$10 billion to \$150 billion of incremental economic value by 2025. This impact would be a direct result of increased digital applications that would help raise output, save costs and time, reduce fraud and improve the matching of demand and supply.

As India moves from being data-rich to data-intelligent, it will use machine learning and artificial intelligence to find solutions for a vast number of the challenges faced by our country. Access to high-quality, reliable data along with appropriate mark-ups would be a primary driver for developing artificial intelligence. Appropriate handling of data, ensuring privacy and security are of equal importance. The seminal work done by the Justice Srikrishna Committee on data protection law lays the groundwork for a robust and responsible data-usage framework. The seven core principles of data protection and privacy – informed consent, technology agnosticism, data controller accountability, data minimization, holistic application, deterrent penalties and structured enforcement – will provide a strong privacy protection regime in the country once enacted.

The National Strategy for Artificial Intelligence released by NITI Aayog in 2018 proposes the development of a data marketplace to enable easy access to quality data, provide a more level playing field, equitable access to new data sources and frameworks to incentivize data sharing in a responsible manner.

The Data Empowerment and Protection Architecture (DEPA) released by NITI Aayog in collaboration with iSPIRT is truly futuristic, providing data empowerment to the common citizen in the most comprehensive and transparent manner. A similar approach for developing data platforms through unique public-private partnership that moves data out of siloes would help in data-driven decision-making for organizations and data-driven policy-making for the government.

[NITI Aayog](#) has collaborated with the World Economic Forum to prepare this paper on data exchange (DEX), technical and commercial enablers for a flexible data governance framework. A data exchange allows data to be leveraged for broader sets of social outcomes and can play a pivotal role in unlocking the potential of a data economy.

This paper is a critical step towards a data-driven economy and invites a dialogue on exploring government-led data exchanges for citizen services.

For a data exchange to be effective, sector-specific models and use cases need to be designed and developed. NITI Aayog and the World Economic Forum endeavour to release a second part of this paper with a focus on the approach for developing Logistics Data Exchange (LDEX), a framework for data exchange of public- and private-sector data in the logistics sector.

We acknowledge the World Economic Forum team and NITI Aayog collaborators for their initiative and effort in preparing this white paper.

# Preface

The intersection of technology and data presents a huge opportunity to address various social, environmental and economic issues



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The rapid advancement of technologies is resulting in the collection, processing and analysis of huge volumes of data. This data can be harnessed for the benefit of the society. However, access, availability and enabling discovery of data remain key challenges. Data remains siloed, fragmented across the public and private sectors, inhibiting the transition to a data-driven economy where the rights of all stakeholders are respected in a trusted environment.

The intersection of technology and data presents a huge opportunity to address various social, environmental and economic issues. Efforts are ongoing to leverage use of data for the well-being of the society in various domains, such as agriculture, financial services, logistics, health and mobility, among others

This white paper, a result of multistakeholder consultation between the public and private sectors in India and globally, sheds light on data exchanges as a data-sharing mechanism applicable to both the public and private sectors. It harmonizes various perspectives – economic, technical, on innovation and regulatory – to accelerate the move to a data economy.

Any such framework will have to establish an environment of trust in the governance of data ecosystems and embed security and privacy in its design. For a data exchange to be effective, it would have to assure the quality of datasets provided, conform to open, interoperable standards and support the data needs of emerging technologies. While many issues surrounding data and data sharing remain open, this paper presents various approaches that could be valuable in addressing such concerns. Given the nascent stage of the concept of data economy, this paper recommends following the principle – “Think big, Start small, Scale fast.”. We hope it generates thought and action in our journey towards a data economy.

# Executive summary



# Data economy – the unrealized potential

In India, value from integrated data use is estimated at about \$500 billion.<sup>2</sup> To realize this potential and the benefits of data, certain building blocks of a data economy need to be put in place in the form of functional technology systems, robust governance frameworks and a self-sustainable

mechanism for incentivizing data sharing. Data exchange can play a pivotal role in the growth of a data economy when facilitated for common purposes among various stakeholders and participants.

## Functional architecture of data exchange

This paper proposes a five-layer data-exchange ecosystem, comprising data, consent, data provisioning, exchange and consumption layers. The core layer - data exchange is based on a

set of technological and governance principles and facilitates exchange of data between data providers and consumers in a trusted, legally compliant environment.

## Governance of data exchange

Building upon current governance frameworks, a 3P-approach – Protect, Prevent, Promote – is recommended to help define the governance that can accelerate the evolution of a data economy in India. The core aims of such a framework are **protection** of personal data, privacy-by-design,

data rights management, **prevention** of anti-competitive practices and misuse of data and **promotion** of innovation and development of standards and protocols. The 3P framework is adduced more as a necessity of the data ecosystem, than as an “imposition”.

## Incentivizing data sharing

Data, being a unique asset, presents unique challenges in determining its value. This paper explores various factors that impact the value of data and the various incentivization mechanisms

that may be deployed to encourage stakeholders to exchange data for common purposes through a data-exchange ecosystem.

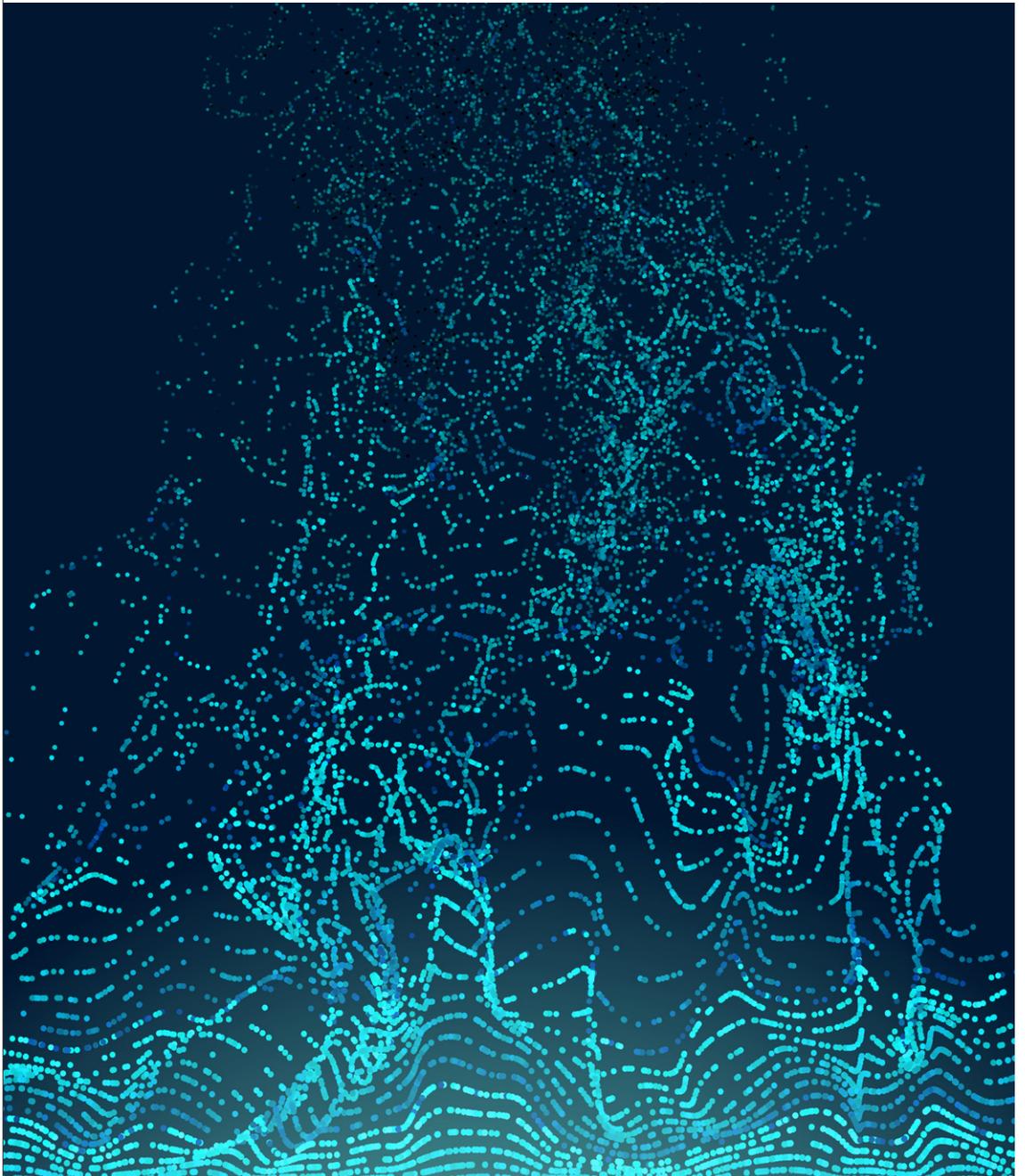
## Enablers of data exchange

Due to the nascent stage of development of data exchanges, five enablers are proposed, namely – **availability** of datasets in the ecosystem, **usability** of the datasets, an environment of **trust**, effective **governance** and a **multistakeholder** approach that will accelerate the growth of data exchanges and help realize the untapped potential.

Above all, the paper recommends adoption of a calibrated approach to establishing the data exchanges that balances the needs of innovation and protection and follows the principle – “Think big, Start small, Scale fast.”.

1

# The Data Economy: An imperative





**India has an opportunity to create a trillion-dollar digital economy by 2025, benefiting all sectors and people. For this, both data and technology will be key enablers. Steps we take today will determine the trajectory of the data economy. This paper is a multi-stakeholder effort that explores the concept of data exchanges to harness the potential of data.”**

Ajay Prakash Sawhney, Secretary, Ministry of Electronics and Information Technology, India

Data is a valuable resource. Just as traditional economies are based on the production and consumption of goods and services, the data economy will be based on generation and use, re-use of data. Data has the power to solve some of the most pressing challenges facing governments, societies, businesses and science. The World Economic Forum’s [Data-driven Economies: Foundation for Our Common Future](#)<sup>3</sup>, developed in collaboration with a global community and published in April 2021, presents multiple use cases that illustrate how accelerating the responsible exchange and use of data can solve critical challenges and fuel innovation for society. Leveraging emerging technologies to derive value from the relevant data in a responsible manner will form the bedrock of a data economy.

This white paper is a part of the World Economic Forum Data for Common Purposes Initiative (DCPI), to which the Centre for the Fourth Industrial Revolution India is a major contributor. It aims to facilitate understanding of how data exchanges (DExs) as a data-sharing mechanism can responsibly play a pivotal role in unlocking the potential of a data economy.

The Centre for the Fourth Industrial Revolution India, in collaboration with the Ministry of Agriculture, NITI Aayog, the Ministry of Electronics and Information Technology and the Government of Telangana’s Centre for Responsible Deployment of Emerging Technologies, in August 2020, launched the [Artificial Intelligence for Agriculture Innovation](#) initiative, examining how emerging technology solutions can be scaled and adopted across agriculture systems.<sup>4</sup> A core pillar of this initiative is the role of data exchanges/ marketplaces in the agricultural sector. Through a multistakeholder consultative process that included government departments, academia, industry stakeholders, start-up communities and experts in the domain of data and technology, the concepts and frameworks explored in this white paper on data economy have been shaped to enable and accelerate the growth of a data economy in India. To this end, this paper, while still at early stages of the data economy journey, delves into various themes relevant to

the evolution of a data economy, while rooted in ethical and responsible frameworks:

- A reference model that lays down the functional capabilities of a DEX
- Requirements of data governance that balance the need for innovation with regulation
- Methods to incentivize data sharing to ensure it is a self-sustainable model
- Five enablers, imperative for DEXs, to be enabled and promoted

This paper is intended for policy-makers, industry leaders, start-ups and academic/research institutions to kindle the idea of data exchanges that can make data easily available for common purposes. The proposed frameworks presented will help organizations and policy-makers steer forward-looking, interoperable and innovative approaches to allow use of data from personal, commercial and/or government sources, while respecting rights. It aims to accelerate the responsible use of data, including recognizing and apportioning rights, risks and rewards in an equitable manner. While numerous examples and illustrations cited in this paper are specific to India, the various ideas, insights and suggestions may be applied by other organizations and governments globally as well.

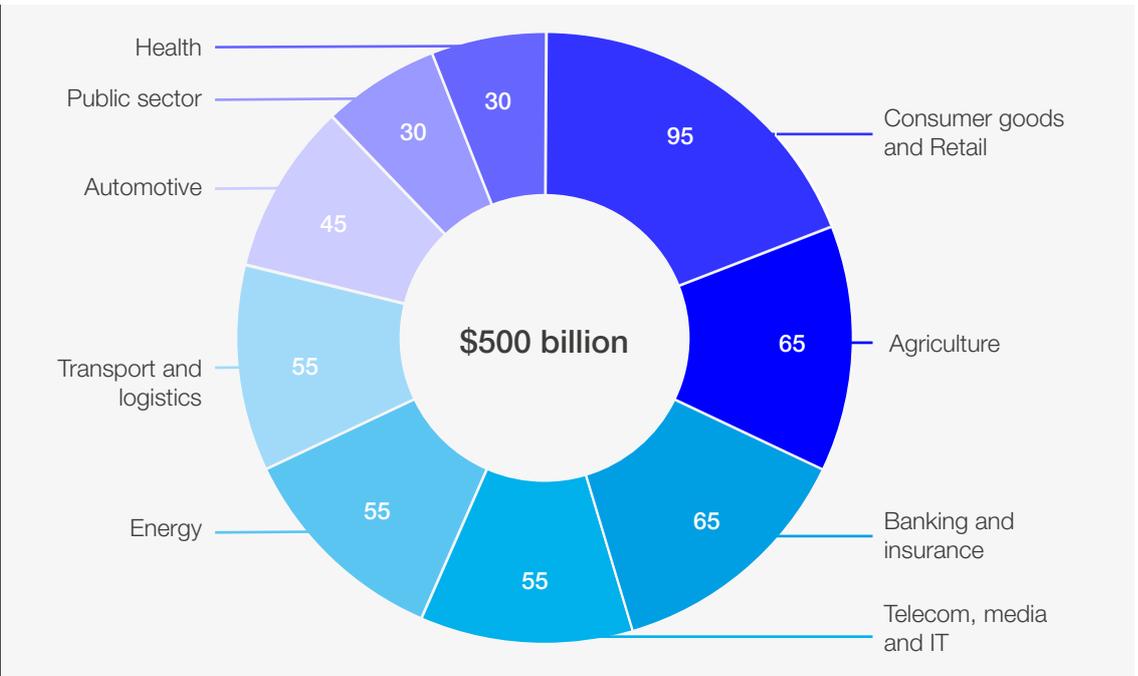
Data sharing is subject to multiple views and assumptions that stem from the relative infancy of the concept. Quite often the uncertainty arises from the fact that even the terms “data exchange” and/or “data marketplace” mean different things to different people. Much needs to be considered in any discussion on “exchanging data”, “data exchanges” and “data interoperability”, including cultural beliefs, philosophies, industry-specific needs and other nuances, which, it is important to acknowledge, differ among people, organizations and geographies. This paper acknowledges these nuances and the importance of respecting the individualized and localized notions of the concepts presented.

## 1.1 Data economy

A National Association of Software and Service Companies (NASSCOM) report<sup>5</sup> assessed the value of integrated data use in the major sectors

of India to be in the order of \$500 billion, which constitutes about 10% of India’s aspirations to become a \$5 trillion economy by 2025.

FIGURE 1.1 Potential of a data economy by sector in India by 2025 (in \$ billion)



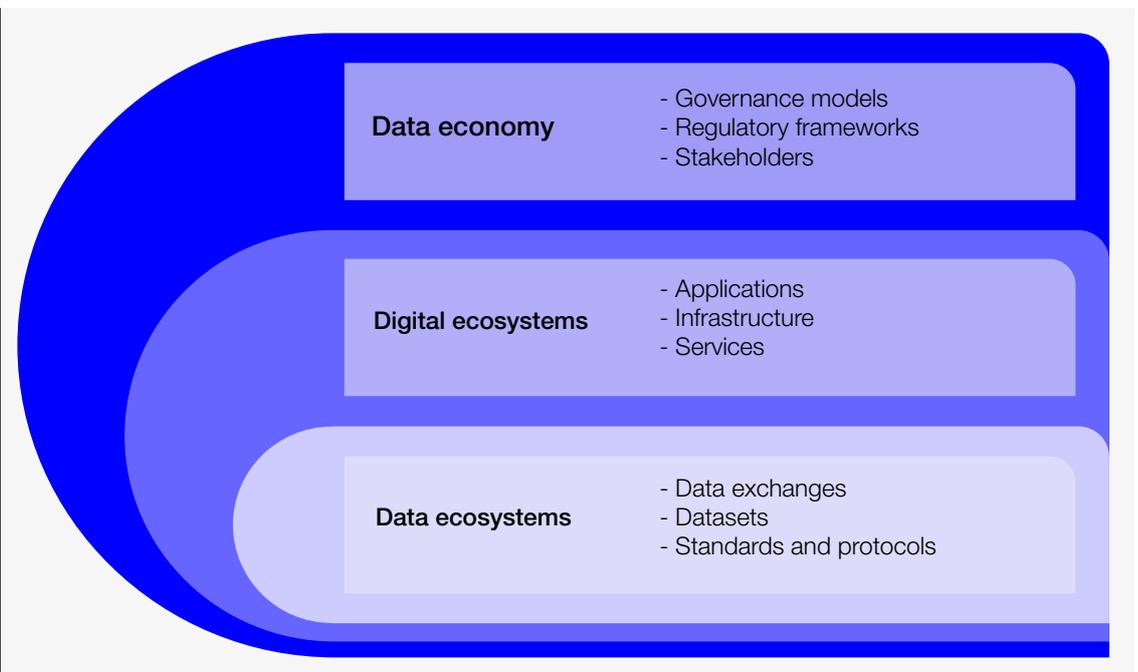
Source: NASSCOM, Unlocking Value from Data and AI: The India Opportunity, August 2020

Data economy assumes a special significance in the context of emerging technologies, also referred to as Fourth Industrial Revolution (4IR) technologies. This is because they produce and consume big data – in terms of volume, velocity, variety and veracity. IoT devices, sensors, drones and biotechnologies generate huge volumes of data at an unprecedented velocity, while

technologies like artificial intelligence (AI), machine learning (ML), distributed ledger technologies (DLT) and precision medicine consume huge volumes of data to produce reliable and meaningful results.

Figure 1.2 illustrates how a data economy can be envisaged as comprising several digital ecosystems, which in turn consist of many data ecosystems.

FIGURE 1.2 Data economy, digital ecosystems and data ecosystems



Source: World Economic Forum

**Digital ecosystems** - In India, digital ecosystems are emerging based on the National Open Digital Ecosystems (NODEs)<sup>6</sup> and India Enterprise Architecture (IndEA)<sup>7</sup>, both initiatives promoted by the Ministry of Electronics and Information Technology, Government of India (GoI).

A National Digital Health Mission (NDHM) has been formulated by the Ministry of Health and Family Welfare with the aim to create a national digital health ecosystem<sup>8</sup>. Similar efforts are in the offing in areas like agriculture (IDEA – India Digital Ecosystem of Agriculture<sup>9</sup>), finance (UPI - Unified Payments

Interface), education (NDEAR - National Digital Education Architecture<sup>10</sup>) and smart cities (Smart Cities Mission<sup>11</sup>). The evolution of digital ecosystems is one of the key requisites for the systematic and organic growth of the data economy.

**Data ecosystems** - Data ecosystems are sub-elements of more comprehensive digital ecosystems, comprising not only data, but also

the standards for the creation and interoperability of datasets, applications, services and payment mechanisms, besides the protocols for interacting with other digital ecosystems. Such data ecosystems, which span across public and private sectors and encompass end-to-end view of data value chains, are expected to play a pivotal role in the speedy evolution of a data economy in India.

## 1.2 Barriers to realizing a data economy

Volume, velocity, variety and veracity are the attributes of data in the new age. However, the potential of a data economy remains locked due to several existing challenges, not limited to:

1. **Unavailability of data** – The potential of a data economy can be realized only if the data is available. Data is a ubiquitous resource. Its availability and accessibility remain a challenge. Aside from the government, much of the data being generated today remains with the private sector, siloed and unavailable for use for common purposes.
2. **Low quality of available data** – Even where datasets may be available, if they are incomplete, mislabelled or in an unstructured format (such as portable document format (PDF)/paper records, etc.), significant effort is required to clean, scrub or digitize data to derive potential or intended value.

3. **Lack of interoperability of datasets** – Where data from different sources is required to be shared/analysed/integrated, lack of uniform standards and protocols is a barrier in making sense out of data. For example, in healthcare, the fact that different health service providers may be recording health records of a patient in different formats, makes data portability arduous.
4. **Regulatory uncertainty with respect to data protection and privacy** – Laws pertaining to data privacy are evolving. Issues relating to data ownership and ease of compliance with data protection laws hinders effective data sharing.

As such, there is a need for data-sharing mechanisms that can unlock the potential of data for common purposes, bringing public and private stakeholders together to share their data, in a trusted environment in which rights are respected.

## 1.3 Data exchanges to enable a data economy

A data exchange (DEX) is one such mechanism where seamless exchange of data for value can operate. Within an exchange, businesses, governments and citizens/residents will have the opportunity to access data for specified purposes. While doing so, however, it is imperative to ensure that the rights of all stakeholders and participants are recognized and protected. Data should be exchanged in a trusted, secure and efficient manner and should not be misused.

A DEX offers the following benefits in unlocking data for common purposes:

- **Data discoverability:** A DEX platform facilitates discoverability of data. On a single platform, mechanisms to access datasets may be made available by multiple data providers to be shared with multiple data users to identify and operationalize mutually beneficial data-sharing deals. Without this kind of a platform, the cost

of discovery and negotiation in bilateral deals may be too high and inefficient.

- **Unlock the combinatorial power of data:** Timely and effortless access to the right datasets would create the ability to provide value-added, integrated and end-to-end services to the beneficiaries, using the combinatorial power of different datasets obtained from multiple sources.
- **Data availability:** Creating demand for good-quality datasets from trusted sources will lead to an increase in equivalent supply from data providers, thus creating a virtuous cycle of data availability and use.
- **Data discipline:** The rigorous quality requirements imposed by the market dynamics will inculcate data discipline among various stakeholders in their effort to participate actively and derive benefits in a DEX ecosystem.

- **Transparency:** Enhanced transparency would be established in public and private sector through analysis of data and deriving insights into the functioning and performance of various entities.
- **Accelerates research:** Research would be accelerated in areas of public interest like health, education, agriculture and environment.

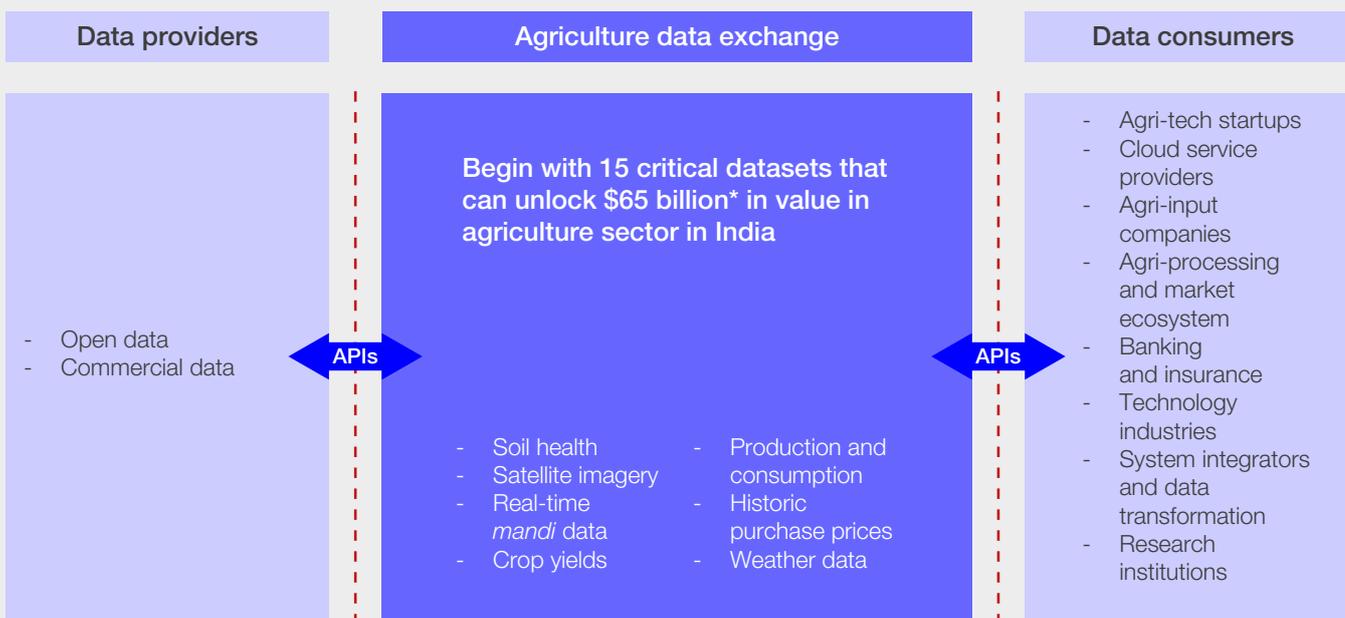
### BOX 1 Shaping the future of agriculture and food: An agriculture data exchange

The case for an agriculture data exchange is based on its potential to create social and economic value for the various stakeholders of an ecosystem including farmers, farmer cooperatives, government, start-up ecosystems, agricultural input and output industries, logistics, the banking and insurance sector and consumers/society. Such value can materialize in multiple forms: economic, social and environmental.

According to research conducted by NASSCOM, an Indian non-profit organization, there is a \$65 billion opportunity in India alone to be realized through unlocking 15 critical datasets in agriculture.<sup>12</sup> The critical datasets identified were: soil health, satellite imagery, real-time data on agricultural markets, crop yields, production and consumption data, weather data, irrigation maps, storage network details, warehouse details, commodity profile data, digital land records registry, defect and pest images, network import-export volume details, historical purchase prices for crops. These datasets were analysed on parameters of availability, quality and data usability across multiple technology innovation-led use cases.

While bilateral commercial deals on data sharing already occur, to obtain the true benefit of data in this ecosystem what is required is the ability of multiple data holders to interact with multiple data users to identify and operationalize mutually profitable data-sharing deals. This requires a platform. Without one, the cost of discovery and negotiation in bilateral deals would be too high to allow the market to develop efficiently.

[A recent project report](#)<sup>13</sup> released by the World Economic Forum identified **30 use cases** leveraging emerging technologies through an extensive engagement with over 70 agri-tech organizations. These use cases can be delivered by start-ups and industry stakeholders using an agri-data stack as a key enabler. The Ministry of Agriculture and Farmer Welfare, Government of India, has also released a proposal IDEA (India Digital Ecosystem of Agriculture)<sup>14</sup> for public consultation which will unlock this huge opportunity by enabling an agri-data stack for innovation.



Source: World Economic Forum

\*NASSCOM, *Unlocking Value from Data and AI: The India Opportunity*, August 2020

For example, access to institutional credit for farmers remains a challenge. One of the reasons is unavailability of information which can help a non-banking financial company (NBFC) to manage its risk in providing appropriate financing. However, NBFCs can procure datasets relating to soil health, historical crop yield in a specific geographic area, historical and forecasted weather data, high-resolution satellite images and real-time data of energy consumption and agriculture inputs (seeds, fertilizer, pesticides) and combine with output measurement mechanisms like electronic warehousing receipts (eWHR) to determine a risk matrix and provide credit on custom terms and conditions through fintech companies/start-ups. Affordable and easy availability of multiple datasets – both historic and near-real-time – is critical to determining risk management for NBFCs. Herein lies the value of a data exchange, which creates the conducive

technological, regulatory and commercial environment in an integrated manner for making available the requisite data.

Availability of and accessibility to critical datasets can also benefit in the following ways:

1. In the preparation stage, accurate predictions about the weather and future commodity prices could allow better coordination and planning among farmers.
2. In the sowing and production stage, information on soil quality, weather, and other factors could enable the farmer to optimally apply various inputs into the production process.
3. Accurate information about current prices available for their produce in various agriculture markets, can allow the farmer to realize the best possible returns for their yield.

# 1.4 Industry shifts powered by a data economy

Data disrupts the industry structure, enables new opportunities for existing and new players and allows companies to transcend industry boundaries. While there are innumerable possibilities, few patterns that may be visible pertain to:

- **Existing industries:** There may be opportunities for existing products/services to shift to smart products/solutions. Data may also be used within the same industry to extend its position or transcend industry borders (for example, a medical devices company may position itself

as a care provider; competitors could become collaborators to solve a bigger problem).

- **New industries:** Digital products, data-driven products and services (for example, patient health management using digital watches) and growing data ecosystems will likely attract new entrants that provide customized services for collecting, owning, processing and/or distributing data. This would enable propagation of data across industries making it easier for existing and new players to disrupt their industries and innovate.

FIGURE 1.3 Cross-industry value proposition for a data economy

Data economy – benefits to industry				
Existing industries	Retail	Manufacturing	Healthcare	Financial services
<b>Smarter products</b>	- Instant product and package customization	- Connected products / services - Smart components and spares	- Personalized diagnosis and health planning - Blockchain-based electronic health record EHR storage and access	- Personal investment democratization - Personalized wealth management - Social banking and investment
<b>Extending positioning within industry</b>	- Boundaryless retail network	- Product traceability and tracking - Connected contract factories and quick service stations	- Micro health hub management network	- Data powered micro and startup accelerator hub
<b>Transcend industry borders</b>	- Connected store powered by 5G data - hyper home , health and media hub	- Digital manufacturing from design to delivery - Drop shipping	- Connected medicare and insurance network	- Connected health and wealth estate management
New industries	FoodTech/ AgriTech	FinTech	HealthTech	LogisticsTech
<b>Digital products</b>	- Digital diet and meal planning - Digital pet care - Digital pulse /diary farm	- Behaviour-drive insurance - Micro subscription-based loan - Digital growth bank	- Personalized health assistant - Digital nurse / nutritionist - Digital disease & medicine simulator	- Digital mobility pass - Digital truck
<b>New data-driven products and services</b>	- Preventive crop care and cultivation - Produce F2M (farm to market) network	- Digital BNPL (personal lending on digital and purchase behavior) - Digital currency products and exchange	- Personalized drug formulation	- Connected logistic network
<b>Transcend industry borders</b>	- Micro agri net to drive local community market and finance	- Micro risk and investment district (e.g., people who transact with credit cards likely to default on home loans)	- Health plan & benefits	- Logistics index exchange
<b>Governance controls</b>	Privacy and regulation   data governance framework   application layer governance and data level governance			
<b>Role in the economy</b>	Operate the economy   participate in the economy   monetize data in the economy			

2

# Functional Architecture of a Data Exchange

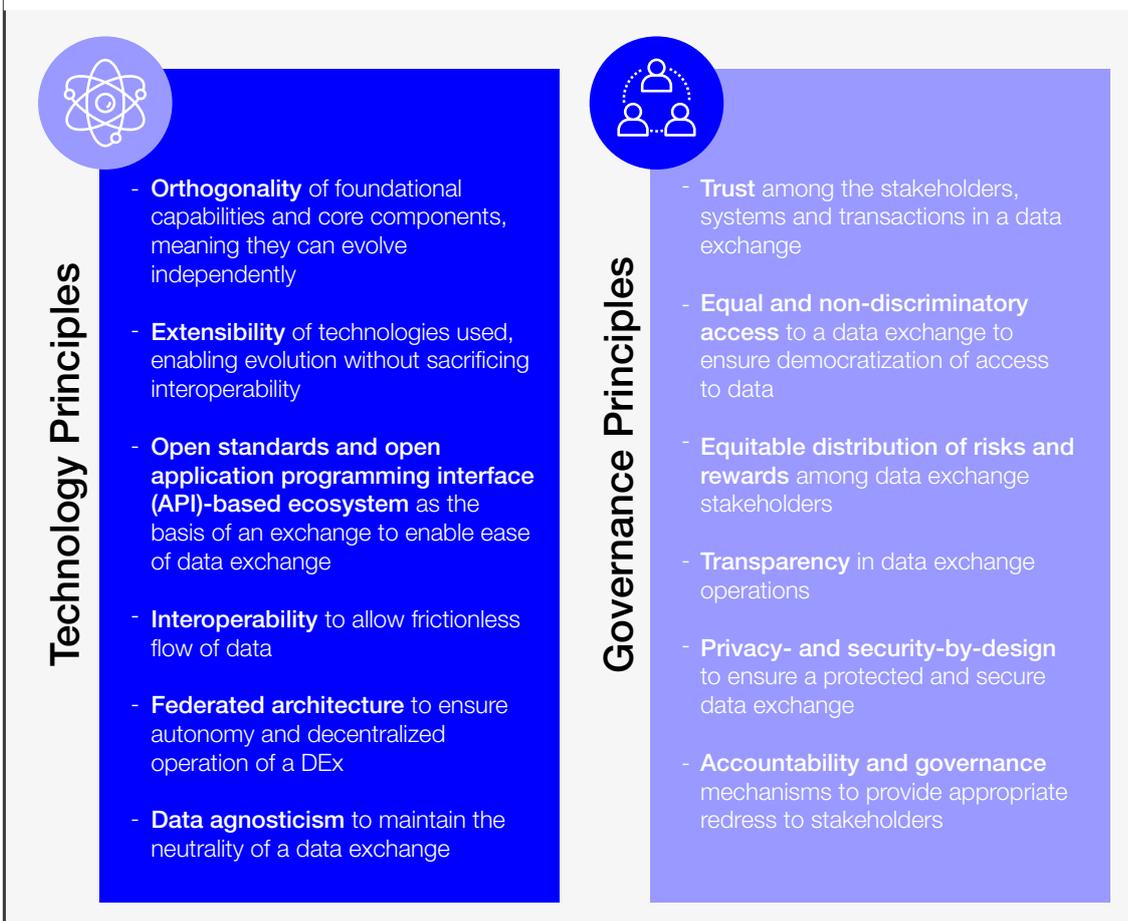


## 2.1 Principles for data exchange

For a forward-looking data economy and data ecosystems to flourish, functionally efficient, technologically robust, legally compliant and

commercially viable DEXs are a key requisite. Figure 2.1 illustrates the principles which should be considered in the design of a DEX.

FIGURE 2.1 Technology and governance principles for DEX design



Source: World Economic Forum

## 2.2 Capabilities and functionalities of DEX ecosystem layers

A DEX ecosystem is conceptualized to consist of five layers: Data, Consent, Data Provisioning, Exchange and Consumption. The capabilities and functionalities particular to each layer are listed in Figure 2.2. Each layer is envisaged such that it can evolve independently, as per the technology principles in Figure 2.1.

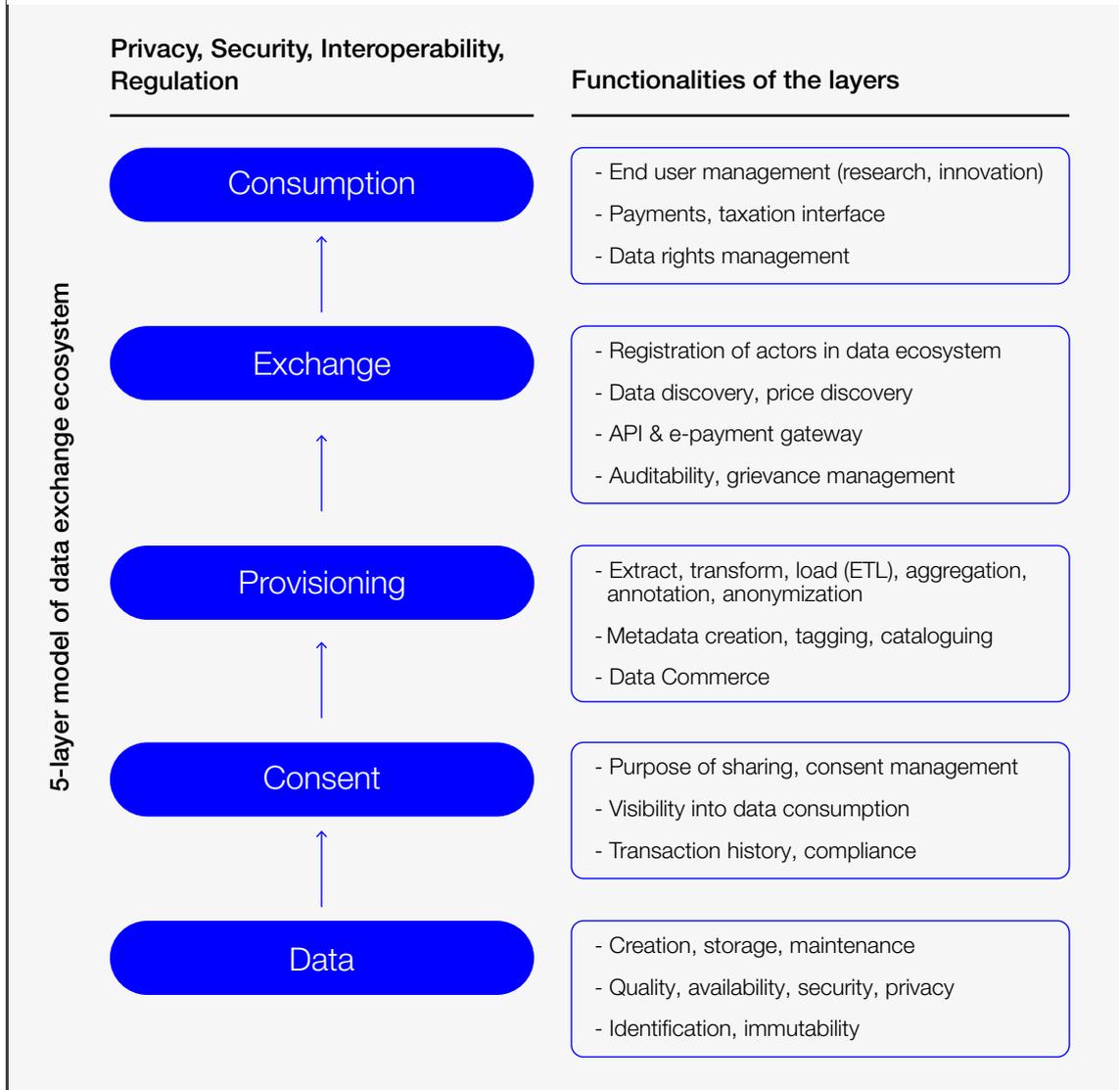
### In Figure 2.2:

- **Data layer** refers to data held by data owners/providers
- **Consent layer** enables consent management, adherence to purpose of sharing as specified by the data provider/owner and appropriate

techno-legal solutions to validate the same

- **Provisioning layer** enriches the data by various methods such as aggregation, annotation, metadata creation, tagging, cataloguing and anonymization, where necessary
- **Exchange layer** is presented in detail in Section 2.3
- **Consumption layer** refers to the point where data is used by data consumers and economic value from data is realized for common purpose.

FIGURE 2.2 | A DEX ecosystem



Source: World Economic Forum

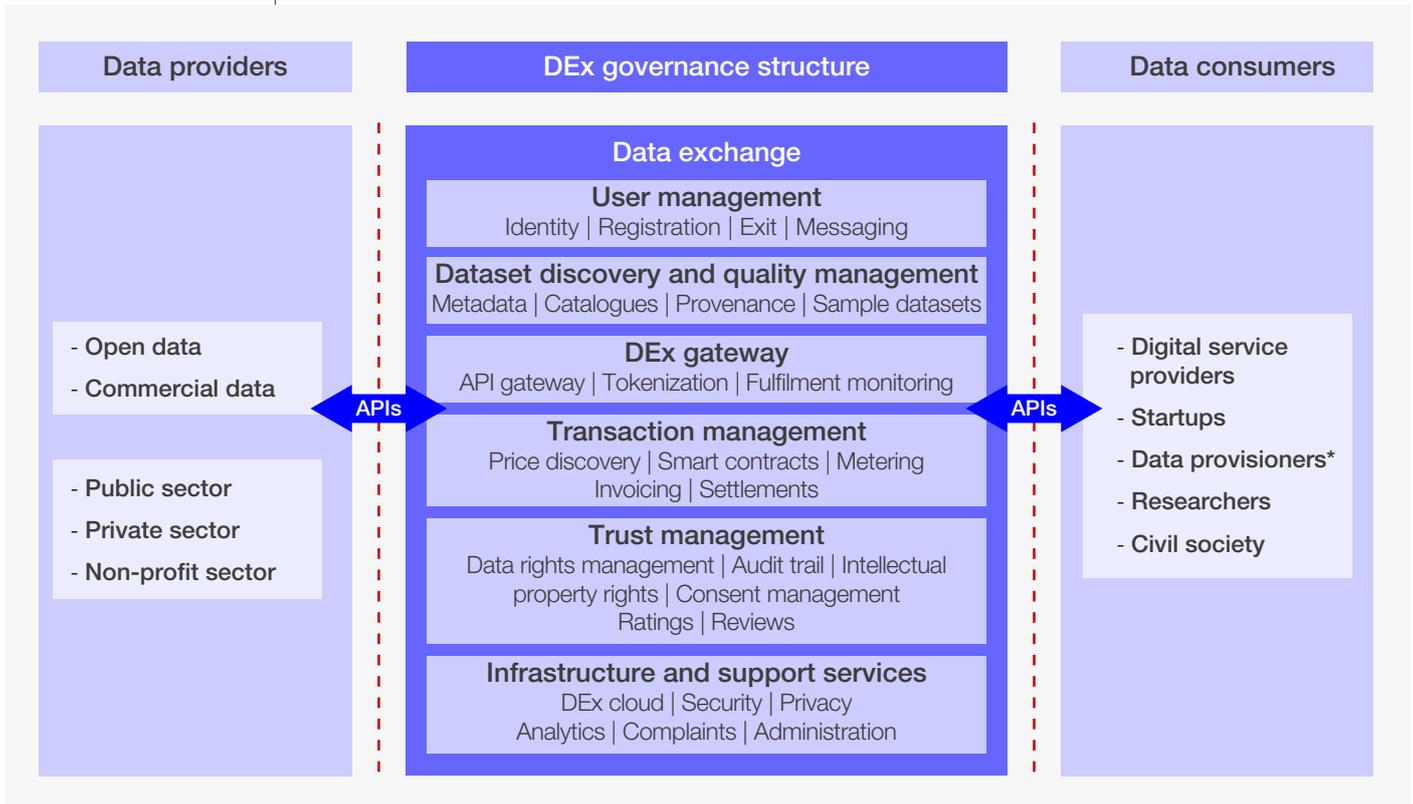
## 2.3 Reference model of a DEX

Central to a DEX ecosystem is the “exchange” layer. Figure 2.3 provides a DEX reference model. The layers are conceptualized using the technology and governance principles highlighted in this Section. The six functionalities represent capabilities in the areas of technology, regulation and management.

### Major functionalities of a DEX

1. **Identity management:** A DEX enables identification, authentication and authorization of the providers and consumers of data intending to transact on the platform. Trust in a platform is linked to the rigour with which these three functions (identification, authentication and authorization) are performed by a DEX.
2. **Dataset discovery and quality management:** A DEX does not store data but facilitates peer to peer exchange of data between data providers and data consumers. Various datasets should be organized in a logical structure or taxonomy to help data consumers search the exchange easily and find what they are looking for. Sample datasets may also provide live testing capabilities in a controlled environment. Solutions may be built on top of open source as well as proprietary software.
3. **DEX gateway:** A DEX gateway facilitates secure exchange of datasets between data providers and consumers. This layer provides opportunities for service providers in the space of integration platform as a service and API management.

FIGURE 2.3 | A DEX reference model



Source: World Economic Forum

\*Data provisioners enrich data and make it marketable in compliance with data regulations.

They act as a bridge between data providers and data consumers.

- Transaction management:** The transaction-management system should be simple, with least number of steps, intuitive and frictionless. The processes should be secure and fool-proof to prevent fraudulent transactions.
- Trust management:** Among other features, immutable audit trail and authentication of data origin will add to the trust in the platform. Deployment of distributed ledger technologies

(DLT) could be a viable option. A ratings and reviews mechanism helps attract more consumers to use the exchange and identify the most popular and trustworthy datasets.

- Infrastructure and support services:** Various infrastructure and support services including, but not limited to, an effective grievance redressal system would enhance user confidence and increase transparency.

## 2.4 Distinctive characteristics of a DEX

There are multiple frameworks, technologies and tools for exchanging data, each driven by a different aim and focus. DEX is one such mechanism with a focus on unlocking data to create economic value in a rights-respecting and trusted environment. The distinctive characteristics of a DEX are described below:

- DEX is more than data-sharing:** A DEX platform offers a wide range of services that precede and succeed the actual data-sharing. While frameworks, technologies and tools used for data sharing can be leveraged by a DEX, several services specific to a DEX may have to be provided for in a DEX platform itself. For instance, while leading API gateways provide functionalities relating to user management, API management, authentication, authorization and metrics, they may not sufficiently address issues relating to data exploration and discovery or consent management. Likewise, some of the frameworks

are designed for use cases where the nature and format of data and the purpose and process for its sharing are deterministic. In respect of a DEX, on the other hand, 1. the architecture needs to be optimized for a wide range of use cases where the data is yet to be discovered, 2. the manner of its use is dependent on the nature of innovation, and 3. the terms of data exchange need to be agreed upon between multiple parties.

- Minimum viable product (MVP) of a DEX:** It may be impractical to design and develop the entire range of features and services of a DEX upfront. A DEX should evolve with time. It is therefore appropriate that the core features of the platform are built as an MVP. These features should be such as to enable exchange of data relating to a specific sector and for purposes of innovation in identified segments of the related value chains, in compliance with applicable regulations.

3. **Interoperability of DEX with external platforms:** A DEX is conceptualized as a multi-layer system with the capabilities of each layer well-defined. The functionalities of some of the layers have already been built by commercial platforms in different scenarios like e-commerce and open data initiatives. Such platforms can deliver part of the functionality envisaged by a DEX. With

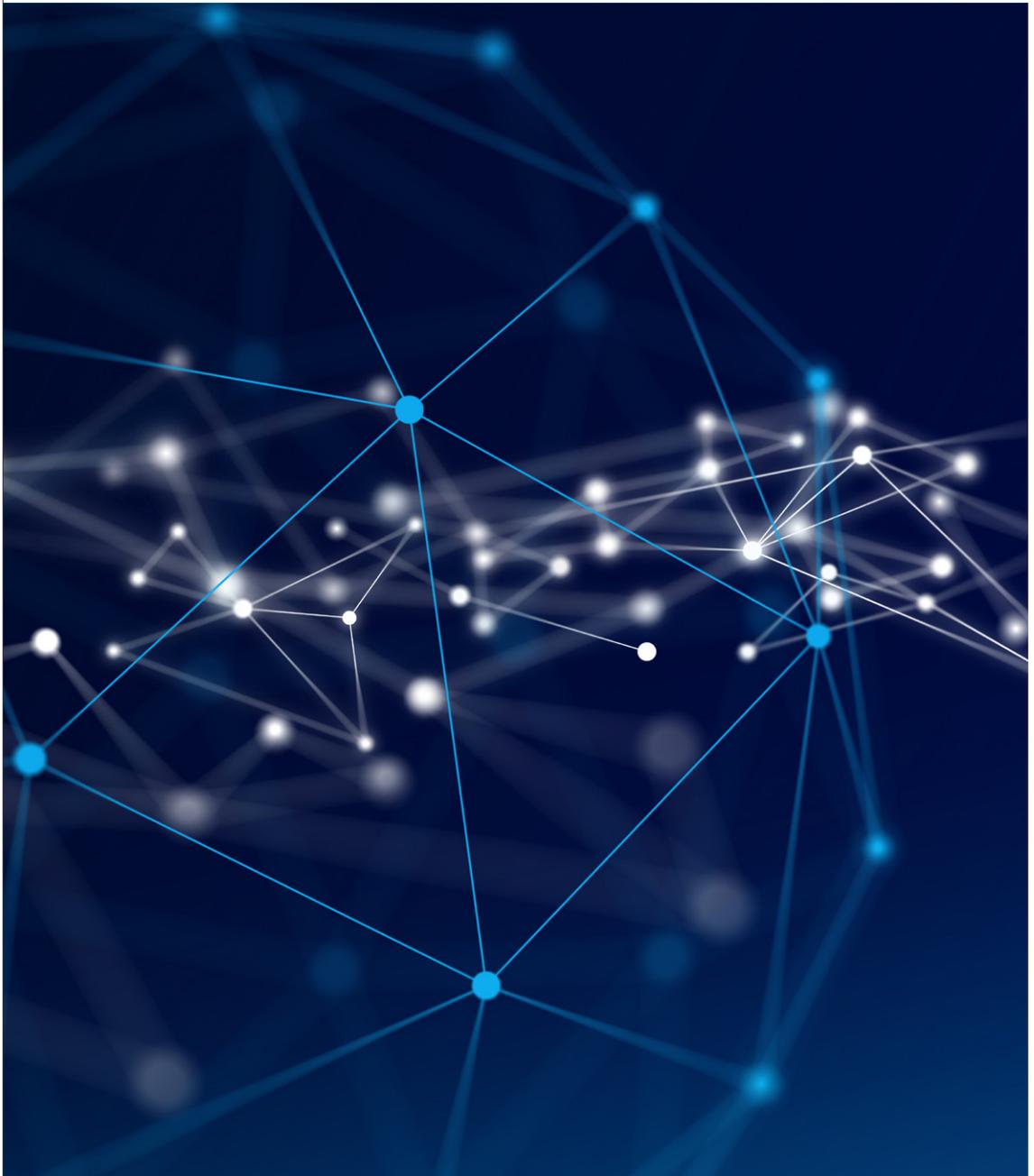
this in mind, the technology architecture of a DEX needs to be designed in a modular and interoperable manner, using open standards and open-source products and components. This will allow external platforms to plug into a DEX platform with relatively less effort and carry the footprint of their existing users to a DEX environment.

TABLE 2 **A sampling of data exchange technologies and/or platforms includes:**

Data exchanges (non-exhaustive)	
1.	<b>Dawex</b> <sup>15</sup> – a data exchange and data marketplace technology company
2.	<b>DATA for GOOD Foundation</b> <sup>16</sup> – enables consensual sharing of GDPR regulated data
3.	<b>Indian Urban Data Exchange</b> <sup>17</sup> – open-source software platform for data exchange in smart cities
4.	<b>Elastos</b> <sup>18</sup> – a platform that enables data ownership, decentralized data exchanges and data monetization by offering an array of open-source developer services
5.	<b>Databroker</b> <sup>19</sup> – a blockchain-supported exchange for data
6.	<b>One Creation</b> <sup>20</sup> – a platform providing a decentralized digital rights exchange fabric (DDREF) with tools to control, enforce and monetize data digital rights

3

# Governance of a Data Exchange



Both the public and private sectors hold large amounts of data, which remain siloed and inaccessible to be used for common purposes. Even where such datasets are made available (open data, etc.), data governance models do not allow data from personal, commercial and/or government sources to be combined. If effectively leveraged, both public- and private-sector data have the potential to solve complex challenges, while still respecting rights.

Data sharing comes with its own set of challenges, however. These include issues relating to privacy,

security, protection of commercially sensitive/confidential/legally protected data, trust and compliance requirements in cross-border data flows. While these issues and risks are common to organizations and governments around the globe, development of an appropriate governance framework remains specific to each industry and jurisdiction. A balanced approach that recognizes the trade-off between opportunity and challenges needs to be adopted by the various stakeholders. This section surveys the governance landscape and identifies the requirements that can facilitate the evolution of data economy in India.

### 3.1 Data governance

Data governance frameworks, including but not limited to policies, regulations, formal and informal standards and rules, are rooted in and arise out of privacy concerns and the need to protect personal information of individuals from unauthorized access or use. In India, data ecosystems are regulated by a set of regulations, general and specific to data protection. The laws

and regulations (current and proposed), bearing upon the exchange of data in India are listed in Table 3.1. Exchange of data in other jurisdictions will have their specific data regulations to consider and comply with. The need and extent of regulation of data exchanges remains debatable, with various views across the spectrum.

TABLE 3.1 The existing (and proposed) data governance frameworks in India

Regulation	Description
<b>Information Technology (IT) Act 2000 and IT (Reasonable security practices and procedures and sensitive personal data or information) Rules, 2011</b>	The IT Act of India was enacted as an enabler of e-commerce. It provides legal recognition of electronic records, authentication of electronic records by public key infrastructure (PKI)-based digital signatures, delivery of electronic services and notably, execution of contracts electronically. Electronic contract can be considered a distant forerunner of smart contract, which is essential for the evolution of a data economy. The Rules notified in 2011 under the IT Act provide for protection of sensitive personal information.
<b>National Data Sharing and Accessibility Policy (NDSAP), 2012</b>	NDSAP is applicable to all non-sensitive shareable data available in digital/analog form but generated using public funds by various ministries/ departments/ agencies/organizations of the Government of India. It called upon the government to proactively share open data and was followed by the launch of the open data government portal (data.gov.in)
<b>Law on copyright and trade secrets</b>	In India, the Copyright Act 1957 provides copyright protection to “original literary works” <sup>21</sup> , among other classes of works. “Literary works” <sup>22</sup> include compilations of data and the Indian courts have viewed “originality” as requiring a “minimum level of creativity”. <sup>23</sup> As such, data in raw form may not be copyrighted. However, if some level of skill and creativity has been exercised in compilation of a datasets/database to make it usable, it may be protected under Indian law.  There is no statutory protection afforded to trade secrets in India. However, trade secrets are recognized and protected by way of judicial rulings and contractual arrangements. Secret information has a commercial value and steps taken to keep it secret usually fall within the ambit of a trade secret. Contracts with confidentiality obligations can be entered into between parties to protect disclosure of data (including trade secrets).

Regulation	Description
<b>The Competition Act, 2002</b>	<p>Data is a substantial intangible asset used for value creation, comparable to copyright, patents, intellectual capital, or goodwill. This is leading to a situation where a few large platforms have become the new gatekeepers to the internet. In this context, it is essential that a regulatory framework for DEXs should not only support innovation, but also provide effective safeguards from potential harm to competition and consumer welfare.</p> <p>The Competition Act 2002 provides some safeguards to mitigate risks associated with data-driven economies. Amendments may be required, however, to strengthen the existing provisions to deal with likely infringement of competition laws specifically in the context of data economy, to curb restrictive and unfair practices such as abuse of dominant position, online vertical restraints, anti-competitive licensing agreements, commercial arrangements, mergers and acquisitions.<sup>24</sup></p>
<b>The Personal Data Protection Bill (PDP Bill), 2019</b>	<p>At the time of writing this paper, the PDP Bill is under consideration in the Indian Parliament. It seeks to lay down a comprehensive framework for personal data protection. The Bill provides for 1. obligations of data fiduciaries that determine the purpose and means of processing personal data; 2. rights of data principals (natural persons to whom the personal data relates); 3. establishment of a Data Protection Authority in India; and 4. penalties and compensation for contravention of certain provisions of the law. The Bill balances the needs of data economy with the responsibility of data protection with respect to personal data.</p>
<b>Report of Committee of Experts on Non-Personal Data Governance Framework<sup>25</sup></b>	<p>The report of the Expert Committee constituted by the Government of India has proposed a framework for use of non-personal data (NPD), which includes the salient features below:</p> <ol style="list-style-type: none"> <li>1. Recommends establishing a legal basis for asserting the rights of India and its citizens over non-personal data</li> <li>2. Outlines a framework for generating economic benefits from non-personal data for India and its people</li> <li>3. Provides an illustrative architecture of NPD exchange</li> <li>4. Defines and identifies certain categories of data as High-Value Datasets (HVDs), to be used for public good</li> <li>5. Provides recommendations on data sharing in the context of public good purposes</li> </ol>
<b>Data Empowerment and Protection Architecture (DEPA)<sup>26</sup></b>	<p>The National Institution for Transforming India (NITI) Aayog, the national body responsible for planning national development designed the DEPA framework to catalyse activities in the data economy. DEPA introduces the concept of a consent manager which would enable individuals to control their data and to consent to share it with third party institutions.</p> <p>In the financial sector, DEPA has been formalized through the Account Aggregator<sup>27</sup> framework, for which directions were notified by the Reserve Bank of India. Under this framework, a new class of non-banking financial companies are being licensed to allow data owners to share their financial data, which may be siloed in banks with third party applications.</p> <p>DEPA is a powerful instrument that builds on the time-tested architecture/principles of Unified Payments Interface (UPI) in India. It provides guidance in the design of some of the core components of a DEX.</p>

## 3.2 DEx stakeholders

There are several stakeholders in a DEx ecosystem. Table 3.2 lists the roles of various stakeholders. These might be further reimagined and redefined as technology, regulation and

commercial models evolve. They are likely to be explored and tested, set within parameters for responsible, fair and ethical use of data.

TABLE 3.2 Table 3.2 – DEx stakeholders

Stakeholder	Role
<b>Government</b> 	<ol style="list-style-type: none"> <li>1. Amend and/or enact legislation, regulations, policies to facilitate development of DExs</li> <li>2. Promote use of data for common purposes to create value by the public and private sectors</li> <li>3. Establish new regulatory authorities or extend authority of existing regulatory authorities for redress of grievances and effective enforcement of laws relating to data ecosystems</li> </ol>
<b>Regulators</b> 	<ol style="list-style-type: none"> <li>1. Protect interests of DEx participants and stakeholders</li> <li>2. Promote development and adoption of technology standards, specifications and best practices in DExs</li> <li>3. Establish infrastructure like regulatory sandboxes to accelerate and promote innovation</li> </ol>
<b>DEx platform</b> 	<ol style="list-style-type: none"> <li>1. Connect data providers and consumers in a trusted environment in compliance with applicable regulations</li> <li>2. Register, identify and authenticate DEx users</li> <li>3. Specify the rules of engagement for DEx users</li> <li>4. Enable discovery of datasets</li> <li>5. Establish secure systems that ensure security, privacy and consent management</li> </ol>
<b>Data provisioners<sup>28</sup></b> 	<ol style="list-style-type: none"> <li>1. Enhance value of raw data by adding value to it, providing a range of data-processing services to ensure that the data is usable, interoperable and transformed into a format required by the data provider/consumer</li> <li>2. Establish a trust mechanism between data providers and consumers with respect to data quality</li> <li>3. Provide consent management and contract management services, if needed</li> </ol>
<b>Data providers</b> 	<ol style="list-style-type: none"> <li>1. Data providers are public- or private-sector entities (government, business, non-profit organizations or individuals) that create, provide, update, secure and maintain data (both personal and non-personal)</li> <li>2. Exercise effective control over their data and provide consent in accordance with applicable regulations, which is critical for building a trusted environment</li> <li>3. Proactively assert their rights where needed, especially in areas relating to personal data protection and equitable distribution of value, aiming for the long-term stability and sustainability of data ecosystems</li> </ol>
<b>Business enterprises</b> 	<ol style="list-style-type: none"> <li>1. In addition to being data providers, businesses should adopt best practices in data governance to ensure availability and management of real-time, high-quality secure datasets</li> <li>2. Fund research in applied data science and application of emerging technologies within the enterprise and beyond</li> <li>3. Leverage the network effects fairly and equitably using the combinatorial power of multiple datasets and diverse technologies by working with other data ecosystem stakeholders</li> </ol>
<b>Innovators</b> 	<ol style="list-style-type: none"> <li>1. Innovators include the start-up community and the small and medium-sized enterprises (SMEs) segment exploring opportunities to solve real-life challenges using data and conventional/emerging technologies</li> <li>2. Discover new ways of leveraging data for scalable solutions</li> <li>3. Participate actively in the sandbox(es) created by various authorities to experiment with new ideas by accessing data in a controlled environment</li> </ol>
<b>Researchers</b> 	<ol style="list-style-type: none"> <li>1. Develop standards and protocols to enable DExs, particularly irreversible methods of anonymization, federated databases, owner-centric data management, lightweight consent management frameworks, privacy-preserving technologies and intellectual property rights (IPR) preserving technologies</li> <li>2. Develop data-governance frameworks adapted to a DEx</li> <li>3. Conduct applied research on innovative use of datasets</li> </ol>
<b>Civil society</b> 	<ol style="list-style-type: none"> <li>1. Explore vulnerabilities in a DEx ecosystem, specifically in domains of data security and privacy</li> <li>2. Observe the operations of a DEx and identify any restrictive practices</li> <li>3. Advocate policy with the objective of enhancing protection of stakeholder interests equitably and inclusively</li> </ol>

Building on the work undertaken by the Centre for the Fourth Industrial Revolution India and presented in this paper, the Data for Common Purpose Initiative (DCPI) will facilitate further collaboration between public- and private-sector partners to

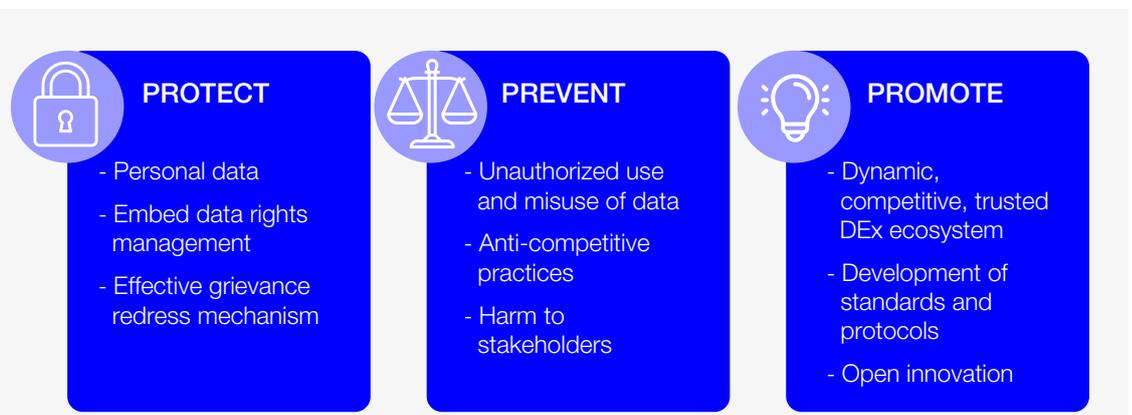
explore the roles and responsibilities of DEx service providers. Deliverables aim to provide jurisdiction- and industry-agnostic tools, while ensuring adaptability as per local context and requirement<sup>29</sup>.

### 3.3 3P approach to a governance framework for a data-exchange ecosystem

Data has unique characteristics, the most noteworthy being its volume, velocity, variety and veracity, in addition to its non-rivalrous nature and above all the immense scope for innovation that access to data provides. The combination of the above characteristics makes it difficult to design a governance framework, whether government-led or self-regulatory. Taking into consideration the

existing (and proposed) governance frameworks in India (Table 3.1) and the various stakeholders (Table 3.2), any framework should aim to balance enabling innovation with governance requirements to accelerate the evolution of data economy in India. The following principles are proposed to guide the formulation of such a framework in a 3P approach, namely, Protect-Prevent-Promote (Figure 3.2)

FIGURE 3.1 3P framework



#### Protect

1. *Personal and non-personal data*
  - Personally Identifiable Information (PII) of natural persons should be protected across the data value chain by all stakeholders involved in the ecosystem. The principle of privacy-by-design should be observed in the design and implementation of all digital and data ecosystems, specifically those dealing with personal data. These include but are not limited to notice, choice, consent, purpose limitation, collection limitation, disclosure limitation, right of the data owner to access and correction, security, accountability and transparency.
2. *Embed data rights management*
  - Differential authorization of data use may be adopted to allow the data owners/providers to specify for which purpose(s) their data can be used, for what duration and whether the data should be monetized. To realize this requirement, a data-rights management framework may be developed, akin to digital rights management in the media and entertainment sector.

#### 3. *Effective grievance redress mechanism*

- The interests of all stakeholders of data should be protected through appropriate grievance-redress mechanisms.

#### Prevent

1. *Unauthorized use and misuse of data*
  - The purpose of data sharing may be identified and agreed upon to prevent possible misuse of data. Broad categories of data processing purposes may be defined through appropriate standards and guidelines applicable in general for all DExs or specifically to each domain or sector of the economy. One such example is the set of standards developed by the International Organization for Standardization (ISO), 14265-11<sup>30</sup>, on “classification of purposes” of using health data. The framework should be designed so as not to discourage innovation and preferably in the form of self-regulation in respect of processing of non-personal data.

2. *Anti-competitive practices*
  - The framework should be designed considering the particular characteristics of data that make it more amenable to anti-competitive practices in subtle and indirect methods. Reporting norms may be provided with respect to listed practices that have pronounced predilection for creating monopolies and a propensity to prevent new entrants through barriers of scale, exclusive and proprietary technologies and requirements of high computing/ storage capacities.
3. *Harm to stakeholders*
  - A certification mechanism may be established to ensure that the applications that require the use of various datasets are *bona fide* and can be trusted by the users.

#### Promote

1. *A dynamic, competitive and trusted DEx ecosystem*
  - Lightweight process for registration / de-registration / exit of data ecosystem stakeholders and participants may be developed, depending on the sector and purpose for which the data is used.
  - Commensurate with the sensitivity and inherent value of the data, appropriate reporting and compliance mechanisms may be developed
  - Data portability among data business entities and various service providers in the DEx ecosystem may be encouraged, subject to reasonable restrictions

2. *Development of standards and protocols*

Governance agencies should be encouraged to:

  - Develop and enable adoption of standards and protocols, *inter alia*, to enable interoperability, smart contracts and discovery of datasets
  - Develop open-source tools and technologies to enable DEx ecosystems to scale easily
3. *Open innovation*
  - Promote ease of access to data for innovation and research
  - Ensure equitable access to data, especially for start-ups and SMEs
  - Ensure fair, reasonable and non-discriminatory (FRAND) terms for accessing, using and valuing data
  - Promote partnerships that can scale across participants, sectors and industries

Agile frameworks supported with mechanisms to promote, support and empower a DEx ecosystem will set the stage for and facilitate collaboration, interoperability and innovation among stakeholders. Such an approach would enable data ecosystem participants to realize value and equitable access, while adapting to continuous change in the ecosystem, governance and industry trends.

## BOX 3.2

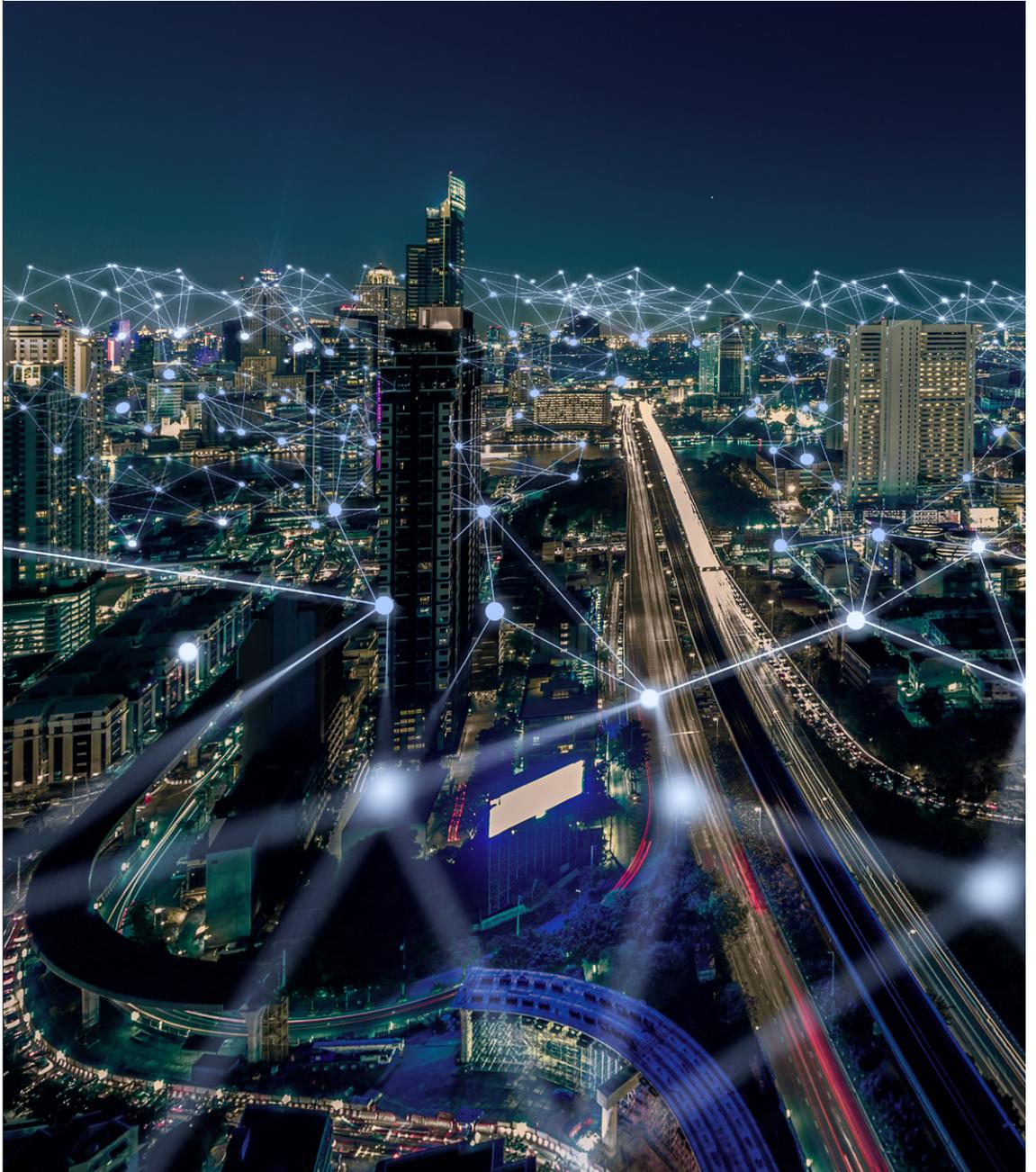
### Cross-border data flows

Cross-border data flows are technologically possible but may be regulated and restricted due to local regulatory frameworks. To harness the benefits of emerging technologies, flow of data in a trusted environment is essential.<sup>31</sup> Global cooperation and coordination between governments to adopt robust cross-border data-sharing policies is of critical importance to

ensure that all the economies benefit from the Fourth Industrial Revolution. A fine balance is needed between supporting and enabling global movement of data to facilitate commerce while simultaneously inspiring trust among individuals, industry and governments, and enhancing their ability to control access to their data, even as economic value is generated for all stakeholders.

4

# Incentivizing Data Sharing



Governance frameworks and compliant technological solutions are essential to a flourishing data economy. What remains to be determined is how to assess the value of data and incentivize stakeholders to share data and develop a self-

sustainable DEx model in a voluntary manner. To do this, it is necessary to understand the various factors that confer value on data and how various stakeholders can be incentivized to share data in a trusted environment.

## 4.1 Determining the value of data

Data has inherent value, which is a combination of its apparent value and latent value. Both types of value can be enhanced if conscious efforts are made to enhance the positive attributes and reduce negative attributes. The value-enhancing attributes of data are its architecture and design, storage and operational practices, quality, timeliness, security, interoperability, propensity to be discovered and above all, a transparent and trusted data governance system. Some of the value-diminishing attributes of data are sensitivity,

exclusivity and restrictions on use. Objective value determination of data remains difficult.

The Data for Common Purpose Initiative (DCPI) investigates this subject in greater detail as part of the global multistakeholder work underway for data exchange. The initiative looks to develop best practices, insights and tools to support initiative participants in implement well-designed, equitable and sustainable data valuation frameworks as they pilot and launch exchange platforms<sup>32</sup>.

FIGURE 4.1 Factors influencing the determination of data value



Source: Putting a value on data, PwC, 2019<sup>33</sup>

## 4.2 Incentivizing the sharing of data

Data may be shared for different purposes via various means. Some governments have been promoting the sharing of data, using public funds, for the benefit of their society. Businesses have been adopting both open data and data monetization models, depending on the nature of data and the purpose and use of data. Public-private data-sharing models are at a nascent stage due to various issues, some of which relate to regulatory risks, confidentiality of data, concerns relating to data being used by competing entities, insufficient mechanisms to distribute risks and rewards equitably in the data value chain and increased accountability. These risks and concerns can, to a certain extent, be addressed through techno-legal solutions. However, the right kind of incentives, ones that enable and empower public and private data holders to share their data for common purposes, is a *pre-requisite*.

A unique attribute of data is that it is non-rivalrous, that is, its value does not diminish once used, unlike other commodities. Instead, the same dataset can be used, re-used, re-purposed, combined or aggregated with different datasets to create value, in myriad ways. Some examples of incentives that have been used/proposed to encourage data sharing in a DEx are:

### 1. Policy and Regulatory Frameworks

Depending on the importance of datasets and their use within a specific sector, there are instances where governments have facilitated data sharing from both public and private sector. As an illustration, the Act on Transport Services in Finland, which came into force in 2018, provides for opening of certain essential data in the transport sector, in a bid to examine the transport sector in a holistic manner<sup>34</sup>.

### 2. Monetary incentives

Data is often seen as a commodity. As such there are private data marketplaces/exchanges that allow buying and selling of datasets. In such a scenario, datasets may be used to generate direct revenue.

Aside from direct monetization of datasets, which will involve establishing objective valuation methods and the creation of demand for high-quality trusted datasets, there are several indirect benefits which can be realized through data sharing, discussed below.

### 3. Non-monetary incentives

*Reciprocity:* Data providers can be incentivized to share data in exchange for access to data from other providers, especially in a scenario where they would benefit from having better visibility. For example, providers of cold storage of vaccines and transportation companies would mutually benefit by sharing data through a DEx for tracking and tracing vaccines.

*Opportunity to innovate:* Certain businesses tend to make datasets available to provide an opportunity for innovation by way of hackathons/challenges, etc. They benefit from receiving insights into their existing datasets or solving a specific problem.

*Data credits:* Data sharing for common purpose could be considered as part of corporate social responsibility initiatives, as it can provide significant benefit to society. For sharing data, companies could be provided data credits, akin to carbon credits.<sup>35</sup> Not only will this incentivize using data for common purpose, it may also be included as a metric for environmental, social and governance (ESG) compliance.

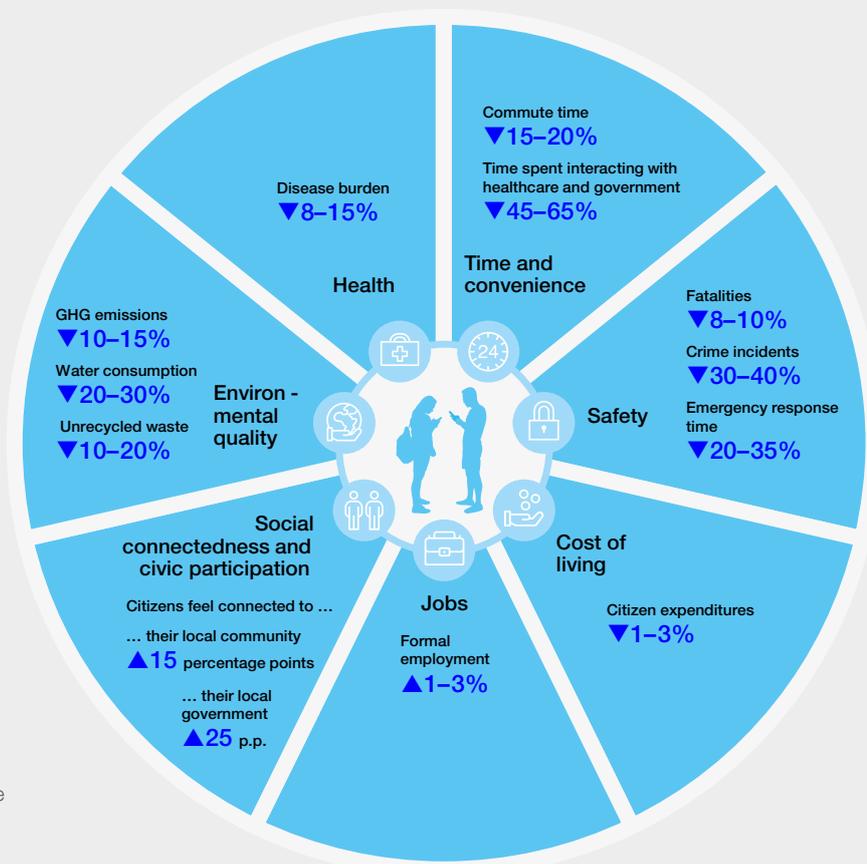
Depending on the ownership of DEx, the domain in which it operates and the relevant stakeholders, these incentives by themselves or in combination may be used to develop a self-sustainable DEx ecosystem.

## BOX 2 Shaping the future of smart cities: An urban data exchange

Smart cities around the world have invested heavily in the deployment of cameras and a multitude of sensors to capture live city data. Moreover, various citizen services platforms have been aggregating vast volumes of data over time. Data sources include citizen engagement portals, e-payment services, public transport systems, energy and

utilities metering systems, geographic information system (GIS) and property management systems, Wi-Fi and cellular infrastructure, waste management and other social platforms. These data sources have laid a strong foundation for cities of the future.

FIGURE 4.2 Improvement (in percentage) in key quality of life indicators by smart city applications



Source: Smart Cities: Digital solutions for a more livable future, McKinsey Global Institute (2018)<sup>36</sup>

As per a recent (unpublished) World Economic Forum study along with Smart City Mission and the Ministry of Housing and Urban Affairs, Government of India, the potential of about 50 urban datasets was identified across various urban domains:

- *Security and safety* (closed-circuit television (CCTV) cameras, crime and safety data, dynamic location of response teams, social media and grievances data)
- *Disease outbreak* (anonymous healthcare data from hospitals, clinics and pharmacies, health applications and internet of things (IoT) wearables, mobility data, wastewater, geolocation and availability of resources, social and grievances calls)
- *Mobility* (public transport, parking, traffic signals, camera feeds, crowd events, road construction and repairs, grievances and social data)
- *Waste management* (IoT sensor data of bins, location tracking of garbage collection vehicles, grievances and social data, availability of sanitation resources)
- *Water supply and storm water drainage* (smart meters, IoT sensors of distribution and pumping systems, social and grievances data, weather forecasting, flood monitoring sensors, repair and maintenance schedules, geographic information system (GIS) data)
- *Energy supply* (smart meters, smart grid, social and grievances, GIS, maintenance and breakdown, power management systems)
- *Environmental data* (air quality index sensors, camera feeds, crowd events, waste management systems, grievances and social data)

Affordable and easy availability of quality and usable datasets – both historic and near-real-time – is one of the most important requirements for the start-up ecosystem and industries providing innovative solutions for smart cities. Smart City Mission announced the launch of **IUDX (India Urban Data Exchange)**, which creates conducive technological, regulatory and commercial environment in an integrated manner for making available the requisite data.

Some of the examples of use cases leveraging an urban data exchange:

1. **Smart water management:** AI-powered smart water management systems, such as digital flow meters that track, measure and optimize water consumption in real time.
2. **Smart energy management:** Potential use cases in the energy sector include energy system modelling and forecasting to reduce unpredictability and increase efficiency in power balancing and usage, as well as for predictive maintenance of grid infrastructure.
3. **Predictive storm water management:** Forecast flooding due to overflowing of storm water network based on historical patterns of GIS and other data points, alert citizens and help keep people safe and informed, create simulation of water flow in different scenarios across storm water network, use predictive analytics based on complaints and cleanliness schedule, dashboard for citizen grievances related to storm water cleaning, dashboard on the storm water network clean-up work.

## BOX 3 Shaping the future of logistics: A logistics data exchange (LDEX)

According to a NASSCOM report<sup>37</sup>, Data and AI could add \$450 to \$500 billion to India's GDP by 2025, out of which \$55 billion would be added to logistics sector alone. This value will be added by solving various systemic problems in India's logistics sector:

1. **Supply chain cost efficiency:** India's logistics costs are currently extremely high, at 14% of the GDP. To increase efficiency, it is essential to enable data-driven optimization of asset utilization (warehouses, multimodal transport units, ports, cold chain, etc.) across supply chains.
2. **Track and Trace:** Enable the vision of paperless processes for multimodal logistics in India by facilitating "one nation-one permit" and enhance ease of doing business.
3. **Improved last-mile delivery:** AI helps optimize location of delivery terminals, fleet size, optimum consignment size and delivery frequency. This becomes essential to enable businesses of emergency supplies and perishable goods, especially in remote and relatively inaccessible areas.

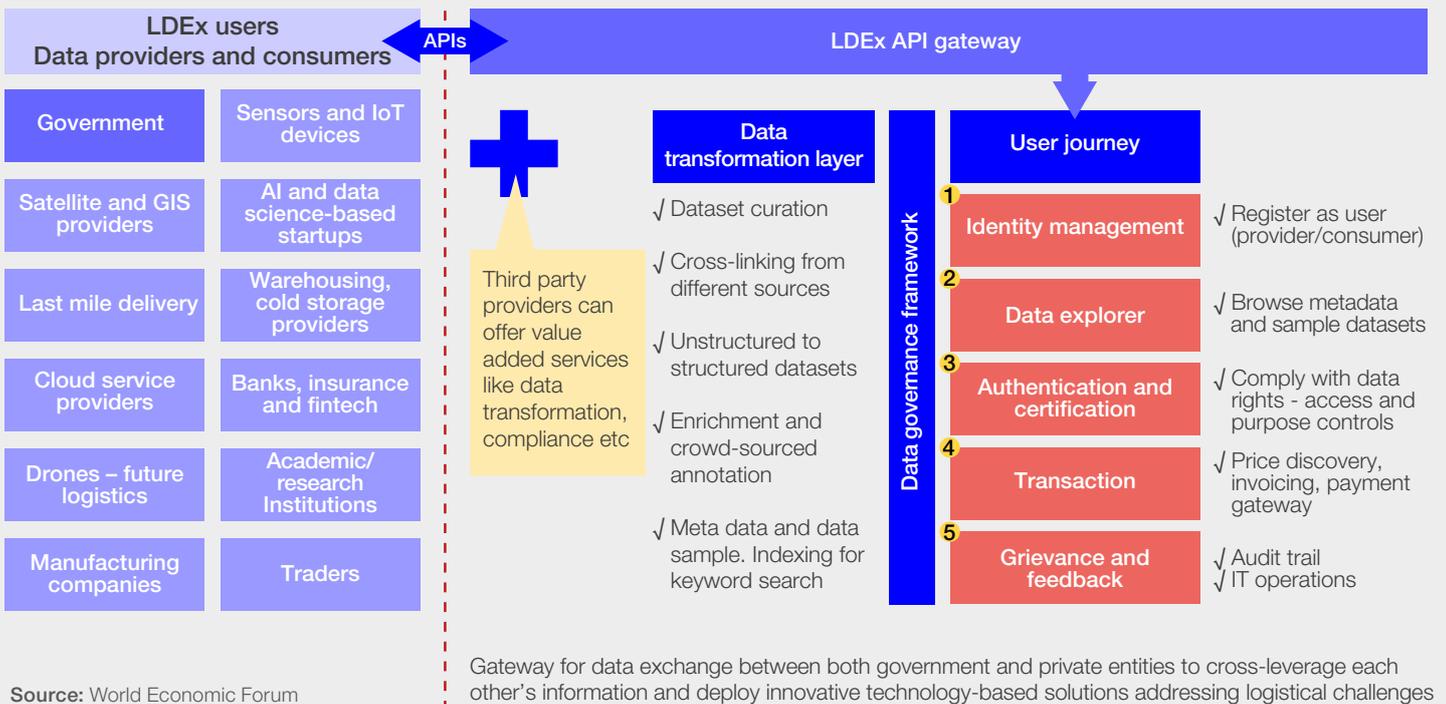
The case for a logistics data exchange is its potential to create social and economic value for the various stakeholders of an ecosystem including government (taxation, infrastructure planning, track

and trace, etc.), transportation and last-mile delivery companies, warehousing, cold storage providers, manufacturing companies, banking and insurance companies.

Realizing the potential to unlock data in the logistics sector, the Government of India has initiated a flagship project, the Unified Logistics Interface Platform (ULIP), which would act as a gateway for data exchange between government and private entities to cross-leverage each other's information and deploy innovative technology-based solutions addressing logistical challenges.

Phase 1 is slated to be completed in 2021, integrating the information available with various existing government applications handled by various departments/agencies across the supply chain, such as railways, shipping, civil aviation, goods and services tax, road transport, customs, foreign trade, etc. This interdepartmental government initiative will catalyse the private sector to unlock the potential of data, serving as an example for other sectors to follow. Data integration is a critical first step. As part of the next phase, a fully functional data exchange with APIs and information exchange protocols for seamless interaction between private- and public-sector entities is envisaged. An illustrative model of a Logistics Data Exchange (LDEX) is provided here:

FIGURE 4.3



Source: World Economic Forum

Such an exchange has the potential to increase efficiencies in the logistics sector, give rise to new businesses which are not viable in the current state of data ecosystems, thus creating furthermore high-paying jobs and attracting investments.

Given the potential of data unlock in the logistics sector, the Centre for the Fourth Industrial Revolution India and NITI Aayog will be collaborating on an application-oriented white paper illustrating a logistics data exchange to make the vision of ULIP a tangible reality.

5

# Enablers for a Data-Exchange Ecosystem



Data exchange as a data-sharing mechanism for deriving value from data is at an incipient stage. Various DEx models – both public, private and public-private partnership-based in different domains – are being tested nationally and globally. If these models are to be adopted and become self-sustainable, it is necessary to promote and enable DExs. The following are considered key enablers for the growth of DExs:

1. Availability of data
2. Usability of data to meet specific or generic requirements of data users

3. Environment of trust between DEx stakeholders
4. Collaborative and multistakeholder approach to promote adoption and growth of DExs
5. Effective governance systems to protect the interests of the stakeholders, society and to promote growth of DExs

The first four enablers are discussed in the following sections. The fifth enabler was presented in Section 3.

## 5.1 Availability of data

Availability of data is a pre-requisite for contemplating data exchange. As alluded to in Section 1, a major challenge in operationalizing DExs is unavailability of required, complete and trusted datasets. As such, if critical mass datasets can be identified and made available at the outset, it will give an initial momentum for the evolution of data ecosystems and exchanges. The best data ecosystems are built around an analytics platform that helps enterprises integrate

multiple data sources, deploy machine-learning tools to automate the process of conducting analysis and track performance metrics. For example, for developing an agriculture DEx, some of the essential datasets would be pertaining to financial data (credit history, digital transaction history), agriculture data (crop yields, soil health, inventory of agricultural commodities), land registry records, real-time data on vehicle movement and meteorological data, among others.<sup>38</sup>

## 5.2 Usability of data

The usability of data depends on the following non-exhaustive attributes:

1. Discoverability
2. Usefulness
3. Standards-based
4. Privacy-protected
5. Consent-based
6. Authorized access

FIGURE 5.1 Usability of data



Source: World Economic Forum

1. **Discoverability:** Discoverability enables data consumers to know of the existence of the data in the first instance. It is established and / or enhanced by the following activities usually undertaken prior to offering the data to a DEx:
  - **Metadata:** Defining metadata and hosting it on a DEx enables the dataset to be discovered by the search engine of a DEx. In addition, defining keywords would enhance the results of the search.
  - **Data characterization:** Summarizes the general characteristics or features of the dataset. The datasets corresponding to the consumer-specified criteria are typically discovered by a query.
  - **Data discrimination:** Is a comparison of the general features of the different datasets which broadly meet the search criteria of the consumer. This enables the consumer to select the dataset best suited to its requirements.
  - **Data classification:** Strategy brings efficiency into the system, enabling more informed navigation and exploration of data by the users and optimization of technology infrastructure required to maintain and preserve such data.
2. **Usefulness:** Once discovered, the data should be useful to the consumer. This depends not only on the relevance of the data to the purpose that the consumer has in mind, but also on three essential attributes that the dataset should have:
  - **Usability** comprises factors that are considered prerequisites to enable using the data for the intended purpose. To be considered usable, the data should be:
    - a. Relevant to the context of any analysis or outcome expected
    - b. Interpretable, to enable the users to process the same and generate economically valuable insights
    - c. Economical to justify cost-benefit over a sustained period to meet the objectives of the consumer
  - **Quality** assesses data on additional conditions beyond basic usability, like completeness, reliability, accuracy and verifiability that help generate a differentiated output, which is enriched and meaningful. To be qualitative, the data should be:
    - a. *Accurate:* The data should be correct and free of errors of commission and omission to be potentially of any economic value.
    - b. *Verifiable:* The users should be able to trace back the information to its source to build trust in the data and use the same for informing decisions or other outcomes.
    - c. *Efficient:* The data should be comprehensive enough to create value for the user and yet not be overloaded with additional or redundant data that has limited or no utility.
    - d. *Reliable:* The data should not contradict another piece of information in any other established system or source.
3. **Delivery** comprises attributes of data that together enable seamless consumption, assimilation and dissemination of data through the platforms and channels constituting a DEx. The data should be:
  - a. *Timely:* The most-updated available version of data should be delivered to be of value to the user.
  - b. *Accessible:* The data should be available through a channel that adheres to the user's technology as well regulatory requirements in effect.
  - c. *Secure:* The data should be available in a form and shape that protects the privacy of data providers/owners and minimizes exposure of any participant in the ecosystem to cyber threats.
4. **Standards-based:** Data should conform to the applicable semantic and syntactic interoperability standards. These attributes not only render it discoverable, but also enhance the facility of its use by the consumer due to ready availability of tools for processing such standardized data. Sector-specific DExs should promote the interoperability sources and / or development of such standards if they do not exist. Standards should also be designed for metadata and for the formats of the outputs of data characterization and data discrimination functions.
5. **Privacy-protected:** As alluded to in Section 3, datasets may contain personal data or purely non-personal data or an intricate mixture of personal and non-personal data. Protection of personal data is one of the foundational and inviolable principles of the digital world. Privacy-by-design is a norm that is required to be observed by all stakeholders, including but not limited to data providers/intermediaries/consumers at various levels and stages of a DEx. Personal data can be collected and processed only with the consent of the data provider for pre-specified purposes. Regulators and/or governments should develop appropriate frameworks of data architecture that guide designers to establish and adopt the principle of separation of personal and non-personal data at the schema level to ensure compliance with data protection regulations.
6. **Consent-based:** Consent management is an essential requirement in dealing with any dataset that contains personal information or in

some geographies, even anonymized data that has its origins in personal data. A transparent privacy policy adopted by relevant DEx participants would facilitate the flow of the data across various layers of a DEx, in compliance with the applicable regulations. As part of the Forum-led Data for Common Purpose Initiative (DCPI) multistakeholder collaboration, a workstream is focused on elevating the importance of consent in expanding citizen participation in the data-driven economy.<sup>39</sup>

7. **Authorized access:** To unlock economic value from any data it is essential that such data is available to all the requisite DEx stakeholders in an accessible and interpretable

form. In this context, this section provides a set of key considerations that together ensure access to data for all authorized participants:

- **No aggregation of data:** Depending on the domain and the purpose for which a DEx operates, data may be maintained in a federated manner, as it provides no single point where all data is aggregated. All the actions may be performed in a distributed manner by the ecosystem stakeholders.
- **Data ownership shall remain with the owner:** Ownership of all the datasets in a DEx and the associated intellectual property rights (IPR) may continue to remain with the data provider/owner throughout the data lifecycle.

## 5.3 Building trust

Trust is an essential pre-requisite for the establishment and sustained growth of DExs. The challenge is to provide stakeholders with clarity, control and comfort to empower them to be confident in active participation and data sharing. With trust as an essential requirement for exchanges, the Forum's Data for Common Purpose Initiative (DCPI), in collaboration with a multistakeholder community and the Centre for the Fourth Industrial Revolution India, launched a workstream to co-design frameworks for gaining and maintaining trust in DExs through consent<sup>40</sup>.

Within the scope of this paper, trust means:

1. Trust **in** the stakeholders operating in a DEx
2. Trust **between** the stakeholders operating in a DEx
3. Trust in the **systems** deployed in a DEx and
4. Trust in the integrity and genuineness of the **transactions** taking place on a DEx

The requirements of trust are outlined in Figure 5.2.

FIGURE 5.2 Trust-enhancing processes



### Trust in stakeholders

- Establishing a transparent, multistakeholder governance and structure for redress on a DEx
- Requiring publication of the privacy policies of stakeholders on their respective websites and on a DEx website(s)
- Formulating anti-trust regulations for a DEx
- Formulating a code of conduct for stakeholders



### Trust between stakeholders

- Providing standards-compliant systems for identification, authentication and authorization of the stakeholders and individuals representing them
- Ensuring effective enforcement of the contracts between the parties (for example, through smart contracts)



### Trust in systems

- Requiring all stakeholders to follow the principles of security-by-design and privacy-by-design, and publication of their privacy-by-design principles on the website of a DEx
- Requiring mandatory security audit and privacy audit of all stakeholders and publication of audit certificates



### Trust in transaction authentication

- Requiring periodic declarations on the trustworthy use of the data for the purpose(s) for which it has been provided and procured
- Providing a testing environment on a DEx platform for prospective data consumers to test the data quality and utility
- Ensuring non-repudiation of the transaction by adopting appropriate technological means like use of distributed ledger technology (DLT)

## 5.4 | Multistakeholder approach

The data economy is large, complex and interwoven. The “network effect”, which needs to be leveraged to realize the immense potential of data, implies that there would be intricate relationships between various data ecosystems and datasets. Such relationships need to be defined and developed in a careful and responsible manner, to ensure that data is used for the benefit of the community, individuals or businesses as per agreed norms and, equally importantly, not misused by any stakeholder to cause harm or to enable undue enrichment. A collaborative effort by all stakeholders would enable such a balance.

Community building is an essential step in a multistakeholder approach. This involves adoption of certain core principles: (1) recognition of the rights of the data providers/owners and repatriation of a rightful portion of the economic benefits arising out of the use of their data (2) a transparent set

of rules for engaging with a DEx (3) adoption of a risk management strategy and (4) inclusivity. Identification and clear articulation of the value proposition of a DEx is an essential first step in building the community.

While a champion may be necessary for creating the initial visibility and momentum for the concept of a DEx, it may not always be sufficient for growth and sustainability. A formal or semi-formal organizational structure may be required. A consortium can possibly play the critical initial role of defining the governance framework for a DEx, establishing a DEx itself, creating a strong initial use case to demonstrate the new value and for developing an open-standards-based platform. A consortium may be government-led, business-led or standards-led, depending on the context in which DEx is proposed to be established.

6

# Looking Ahead



A flourishing data economy benefits the government, citizens, industry, business, innovators and researchers in multiple ways ranging from enhanced efficiency and transparency to creation of new economic value through innovation. India is well poised to realize the benefits of a digital economy-- with its well-established information technology and communication infrastructure and multiple digital ecosystems like digital identity and digital payment systems. Many are of the opinion, that the immense potential of the data economy can be realized, *inter alia*, by promoting the establishment of DExs through open, federated and scalable architectures, by appropriate governance mechanisms to ensure equity and transparency and by protecting the rights and interests of all

stakeholders. Any such DExs must be rooted in ethical frameworks that respects the rights of the individual parties involved, including businesses.

In this context, the issues raised, such as privacy, security, promoting innovation, preventing anti-competitive practices, techno-legal regulatory frameworks and incentive mechanisms, are neither static nor straightforward. This paper aims to develop a data ecosystem that supports data sharing through DExs. As such, it serves as a starting point to discuss and develop a collective understanding of the various challenges in developing such an ecosystem and to enable DExs thereby to unlock the potential of data-driven economies for common purpose.

# Contributors

This white paper is based on the consolidated views of the Centre for the Fourth Industrial Revolution India, the Data for Common Purpose Initiative (DCPI) community and shared ideas. It is a combined effort of all involved based on numerous discussions, workshops, feedback groups and

research. The opinions expressed herein do not necessarily reflect each individual or organization involved in the project or process. Sincere thanks are extended to those who contributed their insights, including those not captured below.

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