Introduction to Data Economics Chapter 3:

Types and Examples of Data Economies

Authors:
Arka Ray, BS
Jennifer Hinkel, MSc
Sirtaj Singh Brar, BS

Editor:
Ben Bagamery

Table Of Contents

1. Introduction - Chapter 3: *Types and Examples of Data Economies*

This chapter is the third in a series designed to introduce and then detail key concepts driving the science of Data Economics and Data Economic Operating Systems (DEOS) that form the means of bringing practical implementations of Data Economies - or Data Economic Frames - in the real-world.

If you skipped the more theoretical and introductory first chapter "On Value, Outcomes, and Data" to delve into the more technical framework of Chapter 2, consider that Chapter 1 is recommended reading alongside the more technical chapters as it sets up the motivations behind and need for the science of Data Economics.

Chapter 2 of Introduction to Data Economics - *The Fundamental Concepts* offers a brief introduction and summary of the key concepts driving the science of Data Economics and the Lydion Data Economic Operating System, while Chapter 4 - *Deeper Dive into the Fundamental Concepts* (coming soon) explores these concepts in depth.

Forming an intuitive understanding of Data Asset Markets and Data Economies as they can be applied to real-world problems and opportunities is however, not trivial, despite learning about the key concepts.

This paper, Chapter 3 of Introduction to Data Economics, will help the reader develop this intuition one step at a time, starting with a description of the different types of Data Economies (or Data Economic Frames of Reference), which fall into two main categories - ***Mixed*** and ***Pure***, which can be further categorized as:

1. ***Finance*** - ***Mixed* Data Economies** - deal with Data Assets and traditional financial instruments.
2. ***Goods & Services*** - ***Mixed* Data Economies** - deal with Data Assets and real-world goods and services.
3. ***Fully Mixed* Data Economies** - deal with Data Assets, traditional financial instruments, and goods and services.
4. ***Pure* Data Economies** - deal with Data Assets only.

The paper will also give examples of each type of Data Economic Frame - either ones that already exist in the real-world, and in many cases Data Economies that can be or are being built through the science of Data Economics and the Lydion Data Economic Operating System (DEOS).

Chapter 4 and later chapters of Introduction to Data Economics and related materials that explore the concepts introduced in Chapter 3 in more detail, and in many cases formalize and build upon intuitive notions and concepts that are introduced here at only a high level.

2. Introduction to *Mixed* and *Pure* Data Economies — *"How to Pay With Your Data"*

Data Economic frames can be broadly categorized as **Pure** - that deal with only Data Assets and **Mixed** - that deal with financial instruments and goods and services in addition to Data Assets.

In Chapter 2 of Introduction to Data Economics, the three basic scenarios enabled by Data Economics are described. Each of these scenarios can be mapped to a Type of Data Economy

1. **"Others can pay you money in exchange for specific units (or pieces) of your data"** - *Finance-Mixed* Data Economies
2. **"Others can provide things (goods, services, resources, labor) in exchange for specific units of your data—effectively allowing you to *pay with your data*"** - *Goods & Services-Mixed* Data Economies
3. **Others can give you access to (and the ability to use) specific units of their data in exchange for specific units of your data or in exchange for other financial instruments** - *Pure* Data Economies

The remainder of this section gives an overview of each Data Economic type, based on the above scenarios, while the following sections of this paper examines each of these Data Economic types through examples.

(Coming Soon) Diagram 2.1: "The 3 Types of DEs - Mixed and Pure DEs"

1) Finance-Mixed Data Economy: "*Get others to pay you money in exchange for specific units (or pieces) of your data*"

Section 3 deals with a "Mixed Data Economy," specifically a "Finance-Mixed Data Economic Frame of Reference" whose Data Asset Markets recognize some combination of Data Assets and traditional financial instruments such as currency.

- In this section, we introduce the concept of "utility of data" and "utility ownership of data." This concept involves the designing and creating of "products" called "Data Assets" using datasets and data streams as raw materials, and as a result how these can be used, or utilized, to generate traditional revenue streams without losing control or ownership of underlying datasets and data streams.
    - This section will introduce the concept of "utility" of digital data at a very high level, and will open the door for deeper exploration of the concepts of *utility, value*, and the concept of *forming multiple types of products* with specific utility and value from the same underlying data.

- The follow-up to this paper, Chapter 4 of *Introduction to Data Economics* (**Coming Soon**), explores the concept of "data utility" and "data utility ownership" in more detail before embarking upon a discussion of the Lydion Data Economic Operating System and the methodology that the Lydion DEOS uses for the design and implementation of Data Economies—Data Economic Frames of Reference and their real-world implementations through Data Economic Networks (DENETs).

2) **Goods and Services-Mixed Data Economy:** "***Others are able to exchange goods and services for specific units of your data - effectively, you are able to pay for things with your data***"

Section 4 addresses another "Mixed Data Economy," in this case a "Goods and Services-Mixed Data Economy" whose Data Asset Markets recognize a combination of Data Assets and traditional financial instruments (such as currency).

- In this section, we start forming an intuition for how digital data can be used to "pay" for goods or services/labor.

- We start off by examining examples of real-world Data Economies that we may already participate in, and by recognizing the digital data that we may already be using to pay for things; that is, the Data Assets that we may already be using in our daily lives.

- We then recognize that none of these Data Assets are created using digital data that we own or control. The data being used to pay for things in these existing Data Economies does not belong to us, even in cases where we participate in its generation with our actions.

- Next we look at the types of data that could be used as "currency," or more appropriately as an "asset," to pay for things and work (good and services), and we build up to our first example of a real-world "Data Economy" in the form of a Data Economic Network between telecom networks and their users. Such a DENET enables individuals and companies to build up a "Personal Data Asset Portfolio" (PDAP) that can serve as an alternate form of value and wealth for the entity. The PDAP also serves as a gatekeeper function positioned between the entity (such as a personal user) and the world, enabling the user to control exactly who gets to use their data (if at all) and for what purposes, and for tracking the value and credit that various utilizations of their data brings back to the user.

- Finally, Section 4 will also link you to other materials that explore the concept of a "Personal Data Asset Portfolio" in more detail. The paper then continues onto Section 5, which examines the concept of "Pure Data Economies."

3) **Pure Data Economy:** "***Others give you access to and the ability to use specific units of their data in exchange for specific units of your data***"

In Section 5 we will introduce the concept of "Pure Data Economic Frames of Reference," whose Data Asset Markets deal only with Data Assets.

- Since these Data Economic Frames of Reference go beyond the types of economic transactions we are used to and deal purely with Data Assets, they are the most difficult to form an intuitive understanding of (why, after all, would people want to create and exchange data with each other, with no money or thing involved?)

- We therefore give two examples of "Pure Data Economic Frame of Reference" to help us start building an intuition of the kind of solutions that this type of Data Economy can enable:
    - One that involves extending the concept of the Personal Data Asset Portfolio from **Section 5** to "Civic Impact Data Assets" that can be used to track and reward individuals and communities for positive civic behavior, such as helping stop the spread of a pandemic.
    - A second example that entails implementing a complex, distributed contract that helps set the price of a high-value oncology drug based on its long-term outcomes for patients, and involves sourcing data from disparate data sources, many of which have strict privacy and other constraints (and in many cases cannot leave the location where they are generated).

3. Finance-Mixed Data Economies: "*Others pay you money in exchange for specific units (or pieces) of your data*"

(Coming Soon) Diagram 3.1: "Simple Data-Money Loop"

The exchange of data for money is a relatively well-understood concept in the modern world. Several large scale business models and profitable companies are based on the "buying and selling" of digital data for traditional forms of money and related financial instruments.

Data Economics, however, examines transactions involving digital data in a broader framework that goes beyond "buying and selling" of datasets when they are treated as a flat commodity. If we compared the datasets and data streams that a company or an individual owns (and is generating) to land ownership, then the current model of "buying and selling data" is similar to buying and selling ownership of a piece of land and all the resources and related utility embedded within it.

A landowner could derive value from land not only by selling it, but also by leasing it, cultivating it for agriculture, hosting a festival such as Woodstock on it and charging for tickets, or perhaps selling minerals or other resources found within its boundaries. Data Economics similarly enables more transactions with data than the sale of datasets. In this analogy, instead of making a binary choice to sell or not sell your "land" to derive value, Data Economics gives you tools to "mine" precious resources from your "land," turn them into products, establish market value for these resources and products derived from them, and transact them over established and new markets. Data Economics therefore gives you frameworks to create different types of products (called Data Assets) from your underlying data, and these additional Data Assets can then be utilized (used) to derive different benefits and types of value, including models for buying, selling, and licensing Data Assets for currency.

Once again looking at the landowner analogy, Data Economic tools enable a data owner to rent out the resources you mine, as well as rent out parts of your "land" (data) without losing ownership of the land itself. Data Economies allow others to pay you for utilizing your data, and the products that are created using your data, without loss of ownership or control of the underlying data itself.

(Coming Soon) Diagram 3.2: "Diagram showing land being used to mine different resources + make products and COMPARE to Products being "minted" from Data"

Data Economics does this by expanding the notion of "data ownership" to the notion of "ownership of data utility." Instead of buying and selling sets of 1s and 0s, Data Economics enables organizations and individuals to define potential uses of the data, and then *buy, sell, or license these specific data utilities (or uses) packaged up as products called Data Assets.*

Data Economics provides organizations and individuals with frameworks and tools to design and manufacture products called Data Assets using their (and potentially others') data as raw material. Each type of Data Asset is manufactured using a specific set (or quantum) of data that represents proof of a set of outcomes that are the result of some amount of work done (or energy spent). Based on what those outcomes represent and their value, the Data Asset is able to define exactly how it can be used, or utilized, and the new (presumably valuable) outcomes that Asset can create for its owner (and potentially other participants in an economy).

(Coming Soon) Diagram 3.3: "Simple Data-Outcomes-Utility -> Many Utilities from same Data Diagram"

By transforming datasets into different types (or classes) of Data Assets, the owners of the underlying datasets can define and express specific types of uses, or utilities, derived from the underlying data. The owners of these Assets can then either utilize the Data Asset themselves to produce new, valuable outcomes or sell/license the Data Asset(s) and the utility they represent to others in exchange for money or some combination of goods and services.

We next come to the concept of paying for things and work with data packaged as Data Assets, which the following section explores in detail along with examples of Data Asset generation and usage which should help make the key concept of Data Assets more intuitive.

The idea of "ownership and transaction of data utility" and the framework of expressing such utility by transforming digital data into Data Assets are explored in more detail in materials related to this paper, including:

- An introduction to injecting utility into data in **Section 2** of this paper, *Injecting Utility into Data: Introduction to Data Economic Frames of Reference & Data Assets.*
- **Coming Soon: An In-Depth Discussion of Data Economic Utility**

We will leave deeper dives into this very important concept to these complementary materials, and look at the next goal of Data Economics—to pay for things and work with units of your data.

4. Goods and Services-Mixed Data Economy: "*Others are able to exchange goods and services for specific units of your data*"

4.1 The "Everyday" Data Economies Around Us: *We already use data to pay for things!*

"*Getting others to give you goods and services in exchange for your data.*" This concept may sound less familiar than the concept of directly selling your data, especially when compared to popular business models where datasets are sold as a flat commodity. We—people and organizations—have been dealing with and producing digital data at a rapidly accelerating pace for at least a quarter-century. While we know that we may *get paid* for our data, *paying* for things with the data we generate, while tantalizing in a futuristic sense, may seem impractical at best, and impossible at worst.

Yet, however alien the concept of paying for things with data might sound at first blush, if we examine the idea more closely, we will find that we pay for things with data all the time.

1. **Coffee Shop Loyalty Card**: Let's say that your local coffee shop gives you a free coffee with every 10 purchases of any type of coffee on their menu. When you first visit the shop, they give you a blank loyalty card. Each time you buy a coffee, the barista stamps your loyalty card, recording the purchase. When you have a loyalty card with 10 stamps on it, you can exchange that card for a coffee.

In this case, you just paid for your 11th coffee with a piece of information, or data. To be more specific, you (with the help of the coffee shop) *created a product using data*. The product in this case is the loyalty card with 10 stamps, where each stamp is data representing a transaction between you and the coffee shop. Once filled with stamps, the card can be utilized (or used) to get you an 11th coffee. The utility of a 10-stamp loyalty card, therefore, is its ability to be exchanged for one cup of coffee when put through a "process of utilization" that involves handing the card over to the barista at the coffee shop.

Of course, the loyalty card for the coffee shop can be maintained digitally instead of using a physical piece of paper, and in many cases loyalty cards and similar programs use digital tracking systems rather than physical proxies. While you may carry a Starbucks card in your wallet, your Starbucks points are represented digitally and can just as easily be used through your phone as through a plastic loyalty card. Our casual acceptance of this ubiquitous practice is an example of how we are in fact fairly comfortable paying for things with digital data.

(Coming Soon) Diagram 4.1: "Simple Coffee Shop Loyalty Card diagram"

2. **Credit Card "Miles":** Similarly, let's say that you have a credit card that lets you earn "miles" as a reward for making purchases using that credit card. These programs are not very different from coffee shop loyalty cards in concept. You earn a certain number of miles for each transaction using the card (just like you earned a stamp for a coffee purchase on your loyalty card), and after accumulating a certain amount of "miles," you can exchange them for airline tickets (and other things of value that the credit card company might offer), much like you exchanging your loyalty card for a coffee.

   In almost all cases, your credit card miles will be canonically represented and transacted as digital data.

   (Coming Soon) Diagram 4.2: "Simple Credit Card Miles diagram"

3. **Money:** Even money, whether hard currency, fiat currency, or cryptocurrency, can be conceptualized as units of data. Each unit of money represents a piece of information, usually about how and why it was minted, and has an understood utility in an economy regarding what it can be used for, and how. A gold coin represents a quantity of a difficult-to-produce metal, minted into a coin specifically to allow it to pay for other things. A US dollar represents a unit of credit that the US government owes the bearer (or owner) of the dollar. A Bitcoin (as discussed below) is quite literally a uniquely identifiable piece of digital data that can be used within the Bitcoin network to pay for things and work (we explore the idea of money and other physical and virtual objects as data in ***The Basic Framework of Data Economics*** (Coming soon).)

4. **Cryptocurrency (and Utility Tokens)**: In fact, the idea of paying for things and working with pure digital data instead of money seems even more possible now than it did even a decade ago due to the advent of digital cryptocurrencies and utility tokens circulating within networks typically powered by blockchain databases. We can now not only imagine how data could represent value exchange, but can also pay for things with Bitcoin and Ether, and we can even build digital applications that power and are powered by the value of corresponding markets represented by cryptocurrency exchanges.

   However, while digital cryptocurrencies or utility tokens use data, they are not expressly *generated* using your (or anyone else's) data. Instead, Bitcoin, Ether, etc. are generated by participants within a blockchain-backed network (a blockchain being a type of database that is easy to maintain and sync across thousands of people connected by a digital network) using specific rules—or *consensus algorithms*—that allow these participants to "mine" new units of the cryptocurrency and allow all other participants in the network to verify that it was mined following the rules that everyone in the network has agreed to (e.g., the consensus algorithms).

(Coming Soon) Diagram 4.3: "Simple Cryptocurrency mining diagram"

In fact, a large part of the value of a unit of cryptocurrency such as Bitcoin or Ether comes from the fact that they are units, or pieces, of digital data that:

1. Can be uniquely identified and verified by any participant in the network.
2. Can only be created using specific rules for the specific purpose of being used (or utilized) as a type of currency.
3. Not just anyone with a computer or a phone can create; it takes a very specific set of actions, usually involving the provable expenditure of energy (typically called "proof of work") to create (or mine) new cryptocurrency.

So, we see that we in fact do use data to pay for things all the time: data represented digitally as in your electronic bank account, miles or points on a credit card company's servers, coins in your cryptocurrency wallet, or physical representations of data via currency notes or loyalty cards. We also see, as a result, that data—and in many cases digital data—is already acting as a unit of utility and value for enabling economic activity.

4.2 The Digital Data Assets Used in "Everyday" Data Economies: *Made with data owned by others, not by you*

In almost all of the "everyday" data economy scenarios previously described, **digital data is being used as raw material to create a product that can be termed an Asset.** In any study of Economics, the term "asset" refers to something understood to have value and usable to express this value by, for example, settling a debt. Breaking that definition down more granularly, we will describe an Asset in this case as something that can be used (or more formally "utilized") through a known process (of "utilization") to produce outcomes that are considered valuable by a set of economic participants. Thus, an Asset is something that has measurable value (in terms of its utility or new outcomes it can help produce).

(Coming Soon) Diagram 4.4: "Master Diagram of different types of digital data generating Assets - with the data and assets being controlled by others"

In each of the above examples, an Asset of known value is being created using digital data, which in turn can be utilized to pay for things you want (outcomes of value):

1. **The Coffee Shop Loyalty Card with 10 stamps on it, is therefore an Asset** that belongs to you, produced using data. It's an asset because you can utilize it—that is, use it to gain access to new outcomes that you value. In this case, that valuable new outcome is the possession of an 11th cup of coffee. The data used to produce this asset can be physical, as in 10 stamps on the loyalty card, or digital, as in digital representations of 10 coffee purchase transactions.

2. **Your credit card miles are also an Asset** because you can utilize them to gain access to outcomes you value—airline tickets, hotel rooms, and more. Further, they are assets produced by generating data (almost exclusively digital data in the modern day) that represents all the credit card transactions that you carried out to earn those miles.

3. **Cryptocurrencies**, as mentioned above, are unique pieces of digital data generated and circulated within a digital network in which participants have to perform certain energy-intensive tasks (usually solving an equation requiring a large number of computations) or "work" and provide the "proof of work" in order generate new units of such currency. And this makes sense since cryptocurrencies are attempting to model the features of hard (and to some extent fiat) currencies, and a key feature of any currency—from salt to puka shells to gold coins to the US dollar—is that it is a scarce resource that is generated and introduced into the economy as a unit of utility and value by an external agent. In the case of modern fiat currencies, that external agent is typically a government, while for a cryptocurrency the agent is the blockchain-backed digital network it circulates within.

However, none of these Assets are being produced using data that you—as an individual or an organization—own:

1. Some of these digital-data-backed assets are produced using data about you or your organization, such as when the credit card company uses your transactions to award you a certain number of "miles," or when the coffee shop awards you "loyalty stamps/points" based on your coffee purchases. While the data used to create these assets *may be data about you*, it is data that is *owned and controlled by another organization*—the credit card company or the coffee shop. These digital-data-backed assets are thus products developed by others that are made available to you for utilization in exchange for some kind of value you provided them.

2. Others are Assets such as currencies, cryptocurrencies/utility tokens, and digital, data-backed financial instruments that are produced using digital data that has nothing to do with you or data that you generate.

As a result, not only are these described assets being produced with data that you or others (people and organizations) do not own, but they also are not being designed, manufactured, or sold by you or your organization in the vast majority of cases.

Data Economics, on the other hand, is interested in providing the frameworks and tools to take any digital data—created and owned by any person or organization—and facilitate the manufacture of digital products called Data Assets that can be used (or utilized) to gain access to (or pay for) goods and services that the person or organization wants.

4.3 How Can Digital Data That We Own and/or Produce Be Used to "Pay for Things"?

The next question we ask is: *What kind of digital data that we own, have access to, and/or are producing could be used to create products (or Assets) that in turn could be used to "pay for things?"*

We have already discussed such data with the loyalty card and Credit Card Miles examples above. In both these cases, the data that the asset uses (coffee purchases or miles gained through dollars spent) represents proof of completed actions (or work) that hold value for the organization generating the loyalty card or miles program. In other words, the program owner gives you access to the asset (exchangeable for that 11th coffee or airline ticket) in exchange for the data that represents your loyalty to their business.

Business loyalty, however, is only one type of behavior that has value to others. Many other kinds of behavior—and the actions, work, and outcomes those behaviors result in—can be valuable to other individuals or organizations. Such behaviors could include direct actions or labor that result in giving someone goods or services they desire (such as performing a task for a company and delivering data to prove that the task was completed), and also could include actions that, if captured as digital data, could provide residual (or indirect) value to another agent, and thus could be used to "pay" that agent for goods and services they in turn provide.

As another example, data flows through our cellular devices on a daily basis. One of the most valuable types of data that our phones and tablets continuously generate and transmit is location data—GPS and related data around where the device is at any given time, and also most likely where the owner of the device is. Cellular networks have access to (and to a great extent "own") the data that they are helping transmit through their networks, yet it is you the user who is doing the work to create those data assets.

(Coming Soon) Diagram 4.5: "Anonymized Location Data Being Generated and Licensed by Telecom company for Revenue"

Licensing (or selling) anonymized location data—data with users' Personally Identifiable Information (PII) stripped out—to large data buyers (including tech giants) is one of the largest and most profitable revenue sources for cellular companies. The estimated value that a cell network can generate from a single user's anonymized location data—and nothing else—runs into the hundreds of dollars per year.

Think about that for a moment. The value of just the data about where your devices have been, even if it cannot be directly associated with your identity, is valued at hundreds of US dollars per year, and there exist robust markets where such data is traded.

If a system existed that allowed you to control exactly who gets to use your anonymized location data, and to also receive credit for this data being licensed or sold, then the relationship between you and your cell phone company would look very different than it does today. In such a world, the cell phone companies would be competing with each other *to give you value in exchange for you giving them access to and permission to utilize your anonymized location data*—value which could include anything from cell phone services to handset upgrades to other incentives potentially unlocked by your data. You might effectively be paying for your cell phone service, handsets, and more with your data.

(Coming Soon) Diagram 4.6: "Show Node between Telecom Company and User - Anonymized Location Data Being Generated by Node -> Telecom company licenses for Revenue -> Credit flows back to user in form of cell phone service"

In fact, we already pay for digital services with our data—all you have to do is turn on your cell phone and access nearly any app that you regularly use:

- The "free" maps services that you use to navigate from point A to point B aren't actually free, you are paying the provider of the maps service with your location (and related data), that is being used by them to glean insights and improve their services. The same goes for your "free" email service, news service, search service, meeting service, texting service, and so on.
- The price of using pretty much any "free" social media application is usually the data that you are giving the social media company that they more or less have carte blanche to

use as they see fit—from selling it to the highest bidder to show you targeted advertising, to performing research that might result in the next great socio-economic breakthrough, or to the undermining of a country's democratic apparatus.

The fundamental point is as follows: **Digital data that captures our actions—particularly actions that result in specific *outcomes*—and that provides sufficient *proof that such outcomes occurred* is valuable to many different people and organizations.**

(Coming Soon) Diagram 4.7: "Show Simple Diagram of Data creating Data Assets (based on Outcomes) and packaging up with utility and connecting to Data Asset Market"

4.4 Introduction to a "Personal Data Asset Portfolio" and Data Economic Nodes

We have described thus far how the discipline of Data Economics can support frameworks and tools enabling people and organizations in many sectors and spheres of activity:

1. ***Manufacture*** Data Assets using their own digital data stores and sources.
2. ***Define*** the utility (utilities) of each class (or type) of Data Asset they generate. (In other words, define exactly what the Data Asset can be used for and by whom based on the proof of Outcomes that the Data Asset carries.)
3. ***Create*** or ***discover*** and ***join*** Markets (called Data Asset Markets) that are willing to trade these Data Assets to provide you and your organization with reciprocal value based on each Market's valuation of your Data Assets.

As an example how Data Economics can be applied, let's use the aforementioned example using the data flowing through your cellular devices.

- Such data either gets generated by your device, received by your device, or transmitted by your device into the cellular network.
- The cellular network connects to the Internet and forms a bridge for data generated by you and your device to flow through the cell network, and out to the Internet, reaching whatever destination it was destined for (the server running a website, an app, or a service that you are using), and then back to you.
- Typically, once the data flows through your device, you have very little visibility and control to what happens to it, who sees it or uses it, for what purpose, and who ends up getting credit for it (or "monetizing" it).

(Coming Soon) Diagram 4.8: "Show Data Economic Node between User and Cell Network/Telecom + Initial Set of Data Asset types forming - Anonymized Location, Starbucks etc."

We now describe how a similar data exchange would work within a Data Economic system, and how the structure differs. Within a Data Economic system, a Data Economic Node (a computer) acts as a gatekeeper between your devices and the cellular network, as well as with the wider Internet. Notable features of such a system include the following:

1. This Data Economic Node is completely within your control, and you are able to specify exactly what type of data gets stored in the Node, how the stored data gets represented (in the form of various types or classes of Data Assets), and exactly what each instance of each class of Data Asset can be used for.

2. As an example, a class of Data Asset could represent location data with all of your identifiable information stripped out. Another class of Data Asset could be tracking the length and type of exercise you get each day.

3. Furthermore, you get to decide exactly what, if anything, any of these Data Assets get used for. If you don't want your Anonymized Location Data Assets to be used for anything at all, then they don't leave your Node, and the cell network has to follow that rule.

4. On the other hand, if you want the cell network to make your Anonymized Location Data Assets available to Tech Giant X, you can allow these assets to be utilized by the Cell Network and Tech Giant X in exchange for some amount of value received by you. You can set this value at whatever you and the Cell Network (and through them the Tech Giant X) can agree upon (e.g., perhaps every 100 Location Data Assets gets you cell phone service for a month?).

5. Going a step further, let's hypothesize that in addition to Tech Giant X, the Telecom company operating the Cell Network also makes a deal with Coffee Giant Y, who are interested in knowing when one of their customers walks into a retail location of the Coffee Giant. This may give you an opportunity to create another type of Data Asset, one that also captures your anonymized location data, but only when you visit a location of Coffee Giant. Based on the agreement between the Telecom company, the Coffee Giant, and yourself, each "Anonymized Coffee Giant Location Asset" may get minted in your Data Economic Node every three times you visit one of their locations, and each such Asset may get used by you to earn coffee and other loyalty rewards from the Coffee Giant—all through the data you are generating.

6. In each of these cases, the Telecom company would maintain their own Data Economic Nodes that talk to your Data Economic Node, and enable the translation and communication of your Data Assets for these various purposes. In this case, the Coffee Giant Y and Tech Giant X are communicating and trading with you via the Telecom company's Data Economic Node, *but* nothing prevents them from setting up their own Data Economic Nodes to participate directly in your Data Asset Market instead of dealing with you through the Telecom company.

7. What this means is that you can set up Markets that govern the manufacturing, distribution, and utilization of each type of Data Asset that you choose to create within your Data Economic Node, with each Data Asset Market governing one type or class of Data Asset. The rules of each of these Markets has to be agreed upon (via some kind of consensus mechanism) by you and each of the other participants in the Data Asset Market (Tech Giant X, Coffee Giant Y, The Telecom Company, etc.).

8. Data Economic Nodes can represent each of these Participants and do the heavy lifting of translating data into Data Assets and communicating them among these Participants, forming a Data Economic Network representing the set of Data Asset Markets and the specific classes/types of Data Assets they generate and manage.

(Coming Soon) Diagram 4.9: "Personal Data Asset Portfolio: - being generated from the same data streams (flowing through personal devices) and each "Data Asset Market" acting as a "DAM" for the specific type of Data Asset + Utility - Data Asset being manufactured + added to Portfolio + utilized"

A Data Economic Node therefore acts as a gatekeeper and a dam for your data. It creates a reservoir out of the data that flows from and through your devices, and controls exactly who gets to see or use your data and for what. It effectively lets you build a Portfolio of Data Asset types, each connected to and regulated by a Data Asset Market. Your Data Asset Portfolio becomes a new asset class—an alternative form of wealth that you can use (or utilize) to gain access to different types of goods and services that you value; put simply, to pay for things and work with your data.

See the Introduction to Personal Data Asset Portfolio/Telecom Data Economies (coming soon) for a deeper exploration of the above concepts and a "Personal Data Asset" Portfolio that is backed up by a Telecom Network.

We have studied one example of the application of Data Economics, and have reviewed concepts such as Data Assets and the Data Economic Node, from the perspective of personal data belonging to individuals. While this is highly interesting, the applications of Data Economics are equally, if not more, relevant to enterprises across all industry verticals considering the amount of data generated by enterprise and how data is already used to address business challenges and opportunities. Being able to assetize and control the distribution and utilization of specific pieces of digital data has enormous implications for addressing existing challenges and opportunities in many industry sectors, as we will see in the next section.

5. Pure Data Economies: "*Others give you access to and the ability to use specific units of their data in exchange for specific units of your data*"

5.1 Introduction to Shared and Derived Data Asset Markets

In **Section 3** , we examined the idea of getting paid (in money) in exchange for specific utilities of our digital data, without having to give up control of the underlying datasets.

In **Section 4**, we also examined the concepts of **Data Assets**, **Data Asset Markets,** and **Data Economic Nodes**, and the concept of creating a Portfolio of digital Data Assets that let us "pay for things," or gain access to specific goods and services.

The next conceptual step in understanding how Data Economies work is to examine whether Markets could exist to allow trading of our Data Assets for other types of Data Assets generated by others.

Let's imagine an existing Data Asset Market (X) (A Data Asset Market that manages Data Asset type X) that we participate in. We can imagine that Data Asset Market (X):

- Is able to connect with another Data Asset Market (Y) (A Data Asset Market that manages Asset type Y),
- And that the participants of these two separate Markets have decided to create a shared Data Asset Market (X-Y) that is able to allow trade between Market X and Market Y for Data Asset types X and Y.

(Coming Soon) Diagram 5.1: "Shared Data Asset Market X-Y forming from Market X and Market Y"

Any number of Data Asset Markets can combine forces in this way to form Shared Markets. If we had other Data Asset Markets Z, A, B, and C, each managing their respective Data Asset types, any combination of these Markets could decide to form shared Data Asset Markets (X-Y-Z, A-B-C-Y, Z-X-B, etc.) that would therefore enable:

- Various types of Data Assets to be traded for each other.
- Various types of Data Assets to be combined with each other to form new types of Data Assets (also known as *Derived* Data Assets).

This gives us another interesting notion around Data Assets and Data Asset Markets: Existing types of Data Assets, created by different Data Asset Markets potentially with different sets of Participants, can be combined to form new types of Data Assets.

- These new Data Assets are called **Derived (or Inherited) Data Assets**;
- The corresponding Markets for Derived Data Assets are called **Derived Data Asset Markets**;
- And the Data Asset types that these Derived Data Assets derive/inherit from are called the Derived Data Assets' **Parent Asset Types**.

(Coming Soon) Diagram 5.1: "Derived Data Asset from Parent Data Assets - Show some combinations of Markets deriving from each other"

5.2 Introduction to Pure Data Economies and Their Potential

Recalling some earlier concepts, we know that each Data Asset type represents one or more specific types of utilities that can be derived from the underlying set of data.

(Coming Soon) Diagram 5.2: "Traditional Utility vs Data Economic Utility"

As a result, the ability for any type of Data Asset to be traded for other types of Data Assets is only limited by the ability of each of the Data Assets' Data Markets to demonstrate their respective Data Assets' *utility*, and by extension *value to the other Market*.

- The more utilities you can find for your data that are valued by you or by someone else values, the more types of Data Assets you can mint and sell/license, and the more types of Data Assets you can potentially receive in exchange.
- Furthermore, being able to combine different types of Data Assets to derive new types of Data Assets opens up even more possibilities for individuals and companies in terms of deriving new types of utilities from their data by combining it with data coming from other participants in the economy.

(Coming Soon) Diagram 5.3: "Show the same data creating different Data Assets - going into Markets - also show separate Data Asset Markets combining to create Derived Data Asset Markets that let data combine to form new utilities for the same underlying data."

Given the infinite types of Data Assets that can potentially be manufactured from the constantly accelerating quantities of data people and companies generate, the possibilities of such exchanges are limitless. In many cases, the value being expressed and exchanged in a purely Data Economic transaction, where all parties are generating, trading, and utilizing only Data Assets (and not external markers of value such as currency) is either difficult, inefficient, or in many cases impossible to express through a traditional financial transaction. Such Data Economic loops that only involve Data Assets and no other external sources of value (such as currency, goods, or services) are called "Pure Data Economies" (or a Pure Data Economic Frame of Reference).

We can therefore categorize Data Economies as "Pure" or "Mixed," as discussed previously:

1. "**Pure**" **Data Economy:** In a Pure Data Economic Frame of Reference, all Participants and Data Asset Markets trade and transact among each other solely based on Data Assets, without any external tokens of value involved, including currency or other financial instruments. Note that a Data Asset type within a Pure Data Economy might be representative of some type of thing or work (goods or services), but all that is generated and traded within the Data Economy are Data Assets.

2. "**Mixed**" **Data Economy**: Also called an "Edge Data Economic Frame of Reference," a "Mixed" Data Economy involves Data Asset Markets (and their Participants) that trade in some combination of Data Assets, traditional financial instruments such as currencies, goods and services, and/or other external sources of value. "Mixed" Data Economies can be further categorized into:
    a. **Finance-Mixed Data Economies**—Where Data Asset Markets recognize transactions involving combinations of currencies (or other financial instruments) and Data Assets.
    b. **Goods/Services-Mixed Data Economies**—Where Data Asset Markets recognize transactions involving combinations of real-world goods and services and Data Assets.
    c. **Fully Mixed Data Economies**—Where Data Asset Markets recognize transactions involving combinations of financial instruments (currency, etc.), goods and services, and Data Assets.

Mixed Data Economies are also called "Edge/Bridge Data Economies" because they connect the Data Asset Markets generating and transacting Data Assets with traditional economic markets generating and transacting financial instruments and goods and services. They also form a "bridge" between Pure Data Economies trading only in Data Assets with traditional markets, since Pure Data Economies often have to reach traditional economic markets (circulating currency, goods, services) by first connecting with a Mixed/Bridge Data Economy.

(Coming Soon) Diagram 5.4: "Pure DE and Mixed DE"
(Coming Soon) Diagram 5.5: "Pure DE connected to Mixed DE connected to financial/goods + services markets"

We have discussed examples of Mixed Data Economies in the above two Sections [4 and 5]. In this Section, we turn our focus to Pure Data Economies. Much of the potential of Data Economics lies in being able to express, transact, and utilize value that is otherwise difficult or impossible to express, let alone transact or utilize, via traditional languages of economic value (such as financial instruments).

Pure Data Economies are pivotal in allowing the expression of such value because they enable the expression, comparison, measurement, and transaction of value without relying on traditional financial instruments. Instead, Pure Data Economies open up an entirely new vocabulary for expressing and transacting utility and value, using digital data packaged up as Data Assets. As a result, Pure Data Economies also open up an entirely new class of transaction where all participants are communicating with and exchanging only digital data packaged up as assets (some of which, of course, may represent things and work done in the real world).

It is not an easy task, however, to form an intuitive understanding of how such Pure Data Economic loops can be formed in a stable, sustainable, and scalable manner, and what specific purposes such Data Economic loops might be serving. While we can still intuitively understand that value can be derived from our data and packaged up and sold in a way that gets us access to money, things, and work, it is harder to grasp why we would want access to other types of Data Assets in exchange for the Data Assets that we generate. This is simply because, as mentioned above, the classes of transactions enabled by Pure Data Economies have no precedent in human history, thus we have no experience, documented knowledge, or intuition to draw from.

To help us develop an initial intuitive understanding of "Pure Data Economies"—where all participants are trading and transacting using only Data Assets—and the types of transactions that just Data Economic loops can enable, let us examine two such Pure Data Economies:

1. **Section 5.3—A "Pure" Data Economy to Encourage "Staying at home" during a Pandemic:** The first example of a Pure Data Economic loop is a hypothetical one—a Data Economy that is powered by data coming from individual citizens as well as official government sources that rewards people for taking measures to control the spread of the COVID-19 pandemic. Though such a Data Economy does not exist today, the framework outlined can not only serve as an example of the types of incentives that Data Economics can offer for positive civic behavior during a future pandemic, but for positive civic behavior in general.

2. **Section 5.4—A Pure Data Economy to Enable "A Shared Answer to a Shared Question": Focusing on an Oncology Drug-Pricing Outcomes-Based Contract:** The second example of a Pure Data Economy is one that has practical applications across industries, wherever collaboration across disparate datasets belonging to different entities to enable common incentives may be needed. Data Economic Solutions using the framework described are already being designed and implemented in multiple industries, including for implementing distributed outcomes-based contracts for pricing high-value drugs (in this case, oncology drug regimens).

5.3 Example 1: A "Pure" Data Economy to Encourage "Stay At Home" During a Pandemic

As a result of the COVID-19 pandemic, almost all major nations of the world have had to launch and sustain efforts to encourage citizens to stay at home and reduce contact with others as much as possible, particularly when shelter-in-place or similar measures have been issued by civic authorities, in addition to practicing social distancing and using masks when in public.

Despite overwhelming evidence that these relatively simple public health measures are critical for the protection and safety of the individual as well as the community, enforcement of these behavioral changes has proved a steep challenge to countries across the world, from "Shelter in Place" protests in the US to the police having to monitor and enforce curfew on the streets of India.

The challenges behind enforcing these simple measures demonstrate how ineffective systems of penalty are in encouraging positive civic behavior, particularly when incentives to *not* partake in such positive behavior exist or when positive civic behavior conflicts with economic interests of citizens and organizations. Treating the COVID-19 pandemic as a wake-up call, public health agencies, governments, and related organizations have an imperative to move nations toward the implementations of frameworks that can offer stronger incentives to individuals and communities who encourage positive civic behavior while being economically viable.

Designing, implementing, tracking and verifying such incentives at scale presents a myriad of challenges, with the major issues including:

1. How to design and balance positive civic incentives (or rewards), and how to enable the complementary civic and health policy frameworks to implement and enforce these incentives.
2. The availability and trustability of technology solutions to enable the design, implementation, tracking and management (and verification and audit) of such incentives at scale.

Looking at this problem from a Data Economic perspective, we can immediately see the opportunity to:

1. Mint types of Data Assets based on the proof of positive civic behavior from a specific person, community, or organization.
2. Use these Data Assets as a basis to reward individuals or groups for the positive behavior demonstrated.

Let's take "staying at home during a pandemic" as the positive civic behavior that a Data Economy is trying to encourage and is willing to reward. Imagine that the infrastructure existed to form a Data Economic Network among the citizens of a city (or state, or country) and the government agencies with the responsibility (and presumably at least modest resources) to encourage these citizens to stay at home as much as possible. The government agencies and citizens can then decide to set up Data Asset Markets to track and reward the positive civic behavior.

- The first goal of the Data Economic Network would be to enable the citizens to track and measure the impact of their positive civic behavior, down to the individual (or organization) level, in this case staying at home. An example:
    - *"Person P Stayed at Home Between 2 pm and 4 pm on Date Y and Provided Sufficient Proof."*

(Coming Soon) Diagram 5.6: "Simple Diagram connecting people staying home with Impact such as Lives Protected, Resources Protected etc."

- To complement this information, the government agencies, using the data sources available to them, can help calculate the impact of such behavior. From the above example—*"The potential net impact of the 2 Hours at Home was:*
    - *Z citizens protected from COVID,*

- *X hospital beds made available,*
- *B other resources freed up."*

- Thus, Data Asset Markets can be set up among citizens and the government agencies to mint Data Assets that give the citizens credit for each of these positive outcomes of their behavior—that is, staying at home and providing "sufficient" proof.

- So, a simple Data Asset Market, minting Assets to give a citizen credit for staying at home, could be as follows:
  - ***"1 Stay at Home Data Asset"** -> **"Generated if Person X Stayed at Home During Hour Y"***. If Person P can provide "sufficient proof" to back up this statement. In this case, "sufficient proof" can be something as simple as anonymized GPS coordinates, combined with a digitally-time stamped photograph of the neighborhood, or whatever standard the government agencies and citizens agree upon. Such "proof" can also be designed in a way to protect individuals' privacy while still allowing verification.

  - The entire Data Economic Network (DENET)—each citizen, organization, and agency that is part of this Data Economic Network—can independently verify that the proof provided meets the standard demanded by the Data Asset Market. The DENET in this case will even have the ability to completely anonymize the proof, so that a participant in the network can verify the proof without having any way to associate it back to the individual who generated the action.

  - Further, each participant in the DENET can also track the creation and usage of every single "Stay at Home" Data Asset generated by the Market for them and ensure that any discrepancies can be adjudicated not just by the government agencies, but by all participants in the Data Economy.

(Coming Soon) Diagram 5.7: "'Stay at Home' Data Asset generation"

- Going a step further, the government agencies can then setup Data Asset Markets to give citizens credit for each "Stay at Home" Data Asset they have earned by giving them access to other Data Assets that represent the positive impact of their staying at home:
  - Based on data sources available to agencies, they can make best effort to areas near the individual (or organization) Person P (who stayed at home during hour Y) to estimate the impact that each person staying home had on reducing the spread

of the pandemic, freeing up health resources, and even extended impact such as reduction in traffic and pollution levels.

  - Thus, each Stay at Home Data Asset could be used, or utilized, by the citizen who earned it to access these "Impact" Data Assets:
    - "1 Stay At Home Data Asset" = "X Lives Protected—Impact Data Assets"
    - "1 Stay At Home Data Asset" = "Y Health Resources Freed—Impact Data Assets"
    - "1 Stay At Home Data Asset" = "Z Pollution Reduction—Impact Data Assets"

- How can these "Impact Data Assets" be used to incentivize the positive behavior of "staying at home"? Our Data Economic hypothesis has three parts:
  - First, that simply having direct visibility into the impact that their behavior is having on stopping the spread of the pandemic, freeing up resources for those who need them the most (just because there is a pandemic does not make other ailments go away), and other outcomes that they may not even be consciously aware of,such as the impact on congestion or pollution levels, will provide a baseline incentive for citizens to keep displaying such behavior. This is further augmented if a citizen is able to display their portfolio of "Stay at Home Data Assets," "Lives Protected Data Assets," and more as validated markers of their contribution to helping control the pandemic.

  - Second, the portfolio of "Impact" Data Assets ("Lives Protected Data Assets" and others) can be used to give citizens access to tax incentives, methods to pay for parking meters or toll credits, payments towards parking and traffic violations, and more, designed based on the needs of the citizens of the area. To go back to a concept discussed throughout this paper, this imbues the "Impact" Data Assets earned and owned by citizens with *utility*—the ability for these citizens to utilize these Assets to gain access to new outcomes they value (such as tax incentives, stimulus resources, and more.)
    - This further adds to the concept of a "Data Asset Portfolio" that acts as an additional source of value, where each type (or class) of Data Asset can be utilized by its owner to gain access to new, valuable outcomes.

  - Third, the portfolio of "Impact" Data Assets ("Lives Protected Data Assets" and others) at the community level could be used to create competitions, "gamification," and other scenarios via scorecards of how a community, county, state, or region is performing. Such friendly competition might be encouraged by prizes from public or private entities based on the societal savings achieved. For example, an airline might want to fund a prize for a community or region leading the way in reducing transmission rates and helping their airline business get "back to normal."

(Coming Soon) Diagram 5.8: "'Stay at Home' Data Assets leading to 'Impact' Data Assets leading to incentives."

- Of course, the existence of such a Data Economy does not mean that people won't try to "game" or "cheat" such a system by finding ways to "hack" (from a technical or social perspective) the Data Economic Network and the infrastructure that runs it. Wherever there are incentives, a certain set of people will try the most efficient way to access those, even if that means bending or breaking the rules in place to access such incentives. However, our complementary Data Economic hypothesis to the one above is:
    - If the incentive is easier to access following rules (less effort/resources needed) than by not following the rules, then people will tend (more often than not) to try and follow the rules rather than break them. This does not mean that there won't be "gamers" of the system, but the incentive to game the system may be less attractive to the average participant in the economy, and might just be of interest to the groups of people who inherently enjoy the process of gaming systems.
    - Data Economic Networks and the infrastructure backing them up are designed from the ground up to be distributed or decentralized, in other words, managed without having to rely on one or more designated sources of authority. Thus, there are inherent mechanisms of audit and verification within a DENET that make it difficult to "cheat" or "game" without clearing a minimum, and fairly significant, bar of effort. Going back to the earlier point, the goal of the DENET is to make it easier (more efficient and less expensive) for its participants to gain incentives by following the rules agreed upon by the participants than by trying to break them.

The relevance of such an incentive framework goes beyond the current need for people to socially distance during the COVID-19 pandemic.

1. Such incentives will continue being relevant in encouraging people to spend more time at home until vaccines are readily available and prevalent, even after bars, restaurants, and other social opportunities open back up.

2. Besides shedding light on the types of scalable incentives that can be tracked and implemented to encourage staying at home, this framework can be generalized to other

important civic and public health-related incentive mechanisms, such as encouraging fire safety and "defensible space" landscaping at the individual homeowner level in areas prone to wildfire (to use another prominent 2020 example), conserving water during a drought, or even encouraging healthy exercise habits.

A Pure Data Economic Frame of Reference that is implemented by one or more Data Economic Networks (DENETs) shared among citizens, government, and related civil society organizations can become a powerful tool to drive socially valuable civic behavior via a system of positive incentives in contrast to often ineffective methods of economic penalties, disincentives, and "punishments".

5.4 Example 2: A Pure Data Economy to Enable "A Shared Answer to a Shared Question"—Focusing on an Oncology Drug-pricing Outcomes-based Contract

Another entire class of problems exist where any potential solutions by necessity involve sourcing partial answers, or partial results, from different participants, and then calculating a shared answer for all Participants. Such a premise is common in brain-teaser puzzles, often set up as an individual giving piecemeal, "secret" information to each of a number of others who must combine forces to figure out the answer (such as which train their friend will be arriving on, or the birthday of another person).

Applying the same concept to digitally stored data, we can envision an entire class of enterprise solutions that could be unlocked if organizations had the ability to compute and to source partial results based on data that only specific participants are able to access, and then to use these partial results to compute a larger, shared result that interests all participants.

In real-world scenarios, one of which we will examine briefly in this section, there are usually one or more significant constraints in being able to compute partial results and create shared answers from these partial results:

1. **Lack of trust in a central authority:** Each participant sharing partial results wants to be able to compute the shared answer independently without having to trust a designated authority or central "source of truth" to compute the shared answer from partial results.
2. **Fear of losing control of data:** Each participant wants to track exactly how their data gets used and where it goes, and wants to ensure that their contributed data does not get redistributed or used for anything other than for computing shared answers.
3. **Data confined to where it gets generated:** In many cases, due to privacy and/or legal or regulatory requirements (including GDPR or HIPAA compliance), the datasets used to

compute partial results may not be able to leave the premises where they are generated or may not be able to be shared with other organizations.

4. **Sharing computed partial results, not the source data:** Due to the above or other business reasons, each participant may only be able to share out computed partial results, and may want or need to do so without having to share the input data.
5. **Credit and incentive systems not strong enough:** Incentives for computing shared answers to common questions of interest are not stronger than the cost or risk of making private datasets available.
6. **Disparate datasets that do not interact:** The format of each of the datasets/data streams that is required from each participant could be different, and not natively set up to interact with each other.

A very interesting example of this specific class of problem/opportunity is outcomes-based contracts for determining long-term pricing of high-cost, high-impact drugs such as those used in oncology. This would be an example of a relatively simple outcomes-based agreement between the drug manufacturer (pharmaceutical company) and payer (insurance company) around pricing a new oncology drug:

1. The average patient is expected to stay on the drug regimen for one year, without their disease progressing (progression-free survival, PFS).

2. If the average patient, over a period of five years, stays on the drug regimen for longer than one year without progression—that is, the drug is more successful than expected in producing the desired outcomes in the patient—then the pharmaceutical company gets a bonus payment from the Payer proportional to the performance.

3. On the other hand, if the average patient stays on the drug regimen for less than one year over a period of five years after the drug's release, then the Payer (insurance company) receives a discount on the base price for the drug, again, proportional to the drug's under-performance.

To complete the terms of the agreement, let us further define the specific sources of data that need to be used to compute the results:

4. The **Manufacturer** (pharmaceutical company) needs to provide partial results based on private data about the drug, such as Average Sales Price (ASP) and private results from trials or pricing models. Let's call these partial results the set **M**, based on the Manufacturer's dataset **Mdata**.

5. The **Payer** (insurance company) needs to provide partial results based on claims data that they receive from the various administrations of the drug to patients. Let's call these partial results the set **P**, based on Payer's dataset **Pdata**.

6. Similarly, perhaps a network of **healthcare providers** (clinics, hospitals) need to provide data around specific instances of administrations of the drug to various patients. Let's assume that these **Providers** are either being compensated for providing a service with their data contribution, or are part of the contract, or are participating on the patient's behalf. Let's call these partial results **H**, from the Providers' dataset **Hdata**.

7. Whatever the overall outcomes the contract cares about—in this case, progression-free survival and related outcomes, and let's call this computed dataset **Contract-Outcome**—can be calculated using the partial result sets **M, P**, and **H**, which in turn are calculated from the disparate datasets **Mdata, Pdata, Hdata**.
    a. Contract-Outcome = Function(M, P, H)

Many of the constraints common to this class of problem are applicable in the implementation of this outcomes-based contract:

1. **None of the parties want to lose control of the data**. The Manufacturer, Payer, and Provider all want to ensure that the data that is shared is only used for computing the results of the contract and for nothing else.
2. **None of the parties want to submit their data to a central authority and depend on a central source of truth to compute the results**. The parties would prefer being able to compute the results independently to the extent possible without violating data (and related privacy) constraints.
3. **The datasets Mdata, Pdata, and especially Hdata that contains clinic/hospital records, cannot leave the premise where such data is generated**. For example, GDPR in Europe mandates similar constraints for many health care providers.
4. In many cases, **the input data—Mdata, Pdata, Hdata used to compute the partial results M, P, H—may themselves not be shareable**. That is, while the computed partial results M, P, H can be shared with the other Participants in the contract, the input data Mdata, Pdata, Hdata cannot be shared.
5. **Further, Mdata, Pdata, and Hdata may comprise multiple disparate datasets of different formats**, resolution, and update cadence.

Of course, we are discussing this class of problem because modeling this as a Data Economic Solution implemented among the participants in such a contract enables us to overcome a number of the above constraints. Previous research shows that implementing a single such contract using traditional methods of audit and adjudication will cost the participants about $1.7m per contract, making such contracts economically unfeasible even though they may lead to better outcomes for the patient and the participants. With a Data Economic system, the cost of implementing and maintaining individual contracts (of two or more participants), while maintaining strict constraints such as GDPR HIPAA compliance, is reduced to $200k/contract.

In fact, this was the first commercial Data Economic Solution developed with the Lydion Data Economic Operating System (DEOS) for enabling outcomes-based distributed contracting among pharmaceutical and insurance companies for pricing drugs. With real-world implementations, Lydion's Outcomes-based Contracting Platform has demonstrated that it can implement and manage an outcomes-based contract at a fraction of the cost per contract ($200k per contract instead of $1.7m per contract).

To conclude this paper, we will take a high-level look at the design of a Data Economic Solution (and the associated Data Economic Networks) that can be used to implement such an outcomes-based contract.

To get an understanding of what a Data Economic Network (or a set of DENETs together implementing a Data Economic Frame of Reference) is trying to accomplish when modeling the Outcomes-based contract described above, let us turn our attention to the shared answers that all participants (Manufacturer, Payer, Provider) want—the outcome of the contract, based on the outcomes produced by the drug. As discussed above, this is the result dataset Contract-Outcome, that is a function of the partial results represented by M, P, and H, which in turn are created using the private datasets Mdata, Pdata, and Hdata.

We can thus model the Data Economy as trying to manufacture this shared answer as a Contract-Outcome Data Asset, which needs to be manufactured using the following "raw materials" or "input resources":

1. Partial Result M—Generated by the Manufacturer as "M Data Asset." The M Data Asset, in turn, is manufactured using the Manufacturer's dataset Mdata as raw material.
2. Partial Result P—Generated by the Payer as "P Data Asset." The P Data Asset, in turn, is manufactured using the Payer's dataset Pdata as raw material.
3. Partial Result H—Generated by the Payer as "H Data Asset." The H Data Asset, in turn, is manufactured using the Payer's dataset Hdata as raw material.

The Contract-Outcome Data Asset is therefore a Derived Asset, which is manufactured using (or derived from) the Data Asset Markets producing the M, P, and H Partial Result Data Assets.

This is a consistent framework that can be used to model systems that have the features and constraints discussed earlier in Section 7.4—it basically boils down to "manufacturing" a Data Asset using inputs that are themselves Data Assets built from different input datasets/data streams. Thus, the shared answer/result is modeled as a "target" Data Asset that is a product manufactured using other Data Assets (via their respective Data Asset Markets) sourced from the "raw material" of different datasets/data streams, much like a complex physical product (such as a car) is manufactured using component assets which are themselves built using raw materials sourced from different entities and associated markets.

Given what we have learned about Data Economic Nodes and their capability to implement and manage distributed Data Asset Markets, we can design a simple three-sided Data Economic Network among the Manufacturer, Payer, and Provider(s) to implement the outcomes-based contract described above.

(Coming Soon) Diagram 5.9: "3-sided DENET forming to adjudicate VBA Contract-Outcome from Mdata, Pdata, Hdata and intermediary "partial result" Assets"

This three-sided DENET is formed by three Data Economic Nodes—one controlled by the Manufacturer, one by the Payer, and one by the Provider(s).

1. The Manufacturer's Node (Node-M) sits behind their "data firewall" and has access to their dataset Mdata.

2. Similarly, the Payer's Node (Node-P) and the Providers' Node Node-H sit behind their respective "data firewalls" with access to Pdata and Hdata, respectively.

3. As part of the process for designing the specific Data Economy (DE Frame of Reference), the rules of the outcomes-based contract are translated to the rules (expressed as Data Asset Markets) governing the generation and usage of a set of Data Asset Markets, specifically:
    a. The partial result Data Asset Markets M, P, and H, which use restricted datasets Mdata, Pdata, and Hdata as their input "raw materials."
    b. The final result is the Data Asset Market Contract-Outcome, derived from the Parent Data Asset Markets M, P, and H.

4. The Manufacturer's Node-M creates the Data Asset Market for Partial Result M Asset, and connects to Node-P and Node-H representing the Payer and Provider.

5. Similarly, the Payer originates the P Data Asset Market, and the Provider originates the H Data Asset Market, and their Nodes (P-Node and H-Node) connect with each other, as well as with the Manufacturer's Node M.

6. Each Node also ensures that every other Data Economic Node is enforcing and playing by the same rules (those defined by the outcomes-based contract), even if each Node cannot examine the private data that other Nodes are using to compute the partial result Data Assets M, P and H.

7. Thus, the Manufacturer computes partial result M as M Data Assets and sends them over to the Payer's Node-P and the Providers' Node-H. Similarly, the Payer sends partial result P Data Asset to Node-M and Node-H, and the Providers send partial result H Data Asset to Node-P and Node-M.

8. Therefore, each Node now has access to the partial results they need to compute the result of the overall contract (Contract-Outcome)—specifically, the partial results encoded as M, P, and H Data Assets.

9. Thus, each Node can generate a "Contract-Outcome Data Asset" independently, using the partial result Data Assets M, P, and H. Specifically, the Contract-Outcome Data Asset Market is a Shared Data Asset Market that is derived from the Data Markets M, P, and H, powered by the private data from the Manufacturer, Payer, and Provider, respectively.

10. Further, each Node can track exactly what their Partial Result Data Assets M, P, and H get used for (to compute the Contract-Outcome Data Asset), and ensure that due credit is flowing back to each Participant.

Thus the three-sides DENET manufactures the "target" Data Asset Contract-Outcome, which encodes the results of the outcomes based contract (at a given moment in time), using the diverse "raw materials" coming from datasets Mdata, Pdata, and Hdata.

For those who want to explore this and similar Data Economics Solutions in more detail:

- Much more on the Lydion Data Economic Operating System used to implement Data Economic Solutions is available on Lydion Insider, as is
- more on the Lydion Healthcare Outcomes-based Contracting Platform

6. Conclusion - Chapter 3: *Types and Examples of Data Economies*

Most of the Data Economic Frames given as examples above are being designed and implemented as Data Economic Solutions using the Lydion Data Economic Operating System (DEOS). SIgnificantly more supplementary materials are available on each of the above Data Economic Solutions on Lydion Insider.

Over the rest of the Introduction to Data Economics series and associated materials around Data Economics and the Lydion technology, we will explore more examples of Data Economic Frames in the context of understanding the concepts introduced in Chapters 2 and 3 (this chapter).
There are a few different pieces of material you can look at from here.

First, if you have not read Chapter 1, then that is a great place to begin. This paper provides several ideas that are explored in more depth in this paper and the papers (and related materials) that follow.

From "On Value, Outcomes, and Data", page 5:

> *What follows is that we can abstract away from our discussions around the value of datasets and instead start to talk about "the value of the varied outcomes represented by an underlying set of digital data" to business, society, or ourselves as individuals. Given the technology landscape of the early 21st century, we now have the means to trace and measure results via digital data in a way that enables improved valuation of outcomes, not only more easy-to-measure inputs.*

The concept of "value and utility of outcomes represented by data" is explored in more detail in ***Chapter 4 of Introduction to Data Economics*** (**coming soon**): "Utility of Digital Data-based Outcomes" is a key concept underlying Data Economics, so we encourage exploring these topics for audiences of all interests.

Also from "On Value", page 5:

> *From a business perspective, this could be transformational. From the individual perspective, we can better understand how our actions and activities contribute to the whole, and we can take some level of control and "ownership" over the digital data that is generated by our individual activities.*

The most impactful features imbued into digital data by the process of assetization that an enterprise or individual owning the data would be interested in are also explored in Chapter 4, along with features of the Lydion Data Economic Operating System (DEOS) and the framework used by the DEOS to create and maintain Data Asset Markets and the Data Economic Frames of Reference that they operate within. Further reading on the functional technical aspects of the Lydion DEOS can be found on Lydion Insider.