Introduction to Data Economics Chapter 2:

The Fundamental Concepts

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

Editor:
Ben Bagamery

Table Of Contents

1. Introduction to Chapter 2: The Fundamental Concepts **3**

2. What is Data Economics and What Does it Enable? **4**

3. Injecting Utility Into Data: Introducing Data Economic Frames of Reference (or "Data Economies") and Data Assets **6**

4. Bringing Data Economies to the Real World—Introducing Data Economic Operating Systems (DEOS), Data Asset Markets, and Data Economic Networks (DENETs) **10**

5. Conclusion - Chapter 2: The Fundamental Concepts **13**

Appendix - What to Read Next **14**

1. Introduction to Chapter 2: *The Fundamental Concepts*

Introduction to Data Economics Chapter 2: The Fundamental Concepts is the second chapter 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.

The first chapter, "On Value, Outcomes, and Data" can be considered a preface to the Introduction to Data Economics series, and is recommended reading before (or after) this paper as it sets up the motivations behind and need for the science of Data Economics.

Several types of Data Economic Operating Systems - digital and otherwise - already exist or could potentially exist, and each is governed by a Data Economic Methodology. This series will also explore the ideal properties of Data Economic Operating Systems (DEOS) in general and describe how they enable the flexible design of Data Economies, offering powerful features to their participants and describing a specific methodology—the Lydion Data Economic Methodology implemented in the Lydion DEOS—that incorporates these ideal properties and features.

This chapter develops a conceptual understanding of Data Economic fundamentals such as **Utility of Digital Data, Data Economic Frames of Reference** (or "Data Economies"), **Data Assets, Data Asset Markets** (DAMs), **Data Economic Operating Systems** (DEOS), and **Data Economic Networks** (DENETs.) It is aimed at a general audience, and, while it contains some technical terms, the paper is meant to be accessible to audiences of all technical backgrounds.

Chapters 3 and 4 of Introduction to Data Economics pick up where this chapter leaves off to explore different topics. Chapter 3 focuses on building an intuitive understanding of Data Economic concepts through examples of different types of Data Economies, while Chapter 4 explores the concepts introduced in this chapter in more depth.

2. What is Data Economics and What Does it Enable?

Data Economics is a discipline focused on **the use of digital data as units of utility and value that enable economic activity.**

Expanding this definition further, Data Economics studies the use of data—specifically digitized data—as the unit and medium of expression, storage, transfer, and exchange of economic value (whether in place of, or in addition to, traditional financial instruments such as currency.)

The previous chapter, **"On Value, Outcomes, and Data"** discusses the emergent need for expanding the language and vocabulary of economics and value beyond "amounts of currency" and other traditional financial instruments. That chapter also explores categories of value that appear to be underrepresented (or are not represented at all) in current economic frameworks, and how an expanded language using digitized data could be used to express and transact value.

> *Economics gives us ways to interact with the material world and understand how to create, exchange, and sustain value. We now have the capability to treat digital data as an interface to such economic activities. Digital data can provide context and richness to the world of economics that mere money has never been able to provide. While currencies are highly scalable, they provide relatively little context. In contrast, highly contextual exchanges within communities are imbued with rich levels of information and communication, but lack the ability to scale. Digital data—as both a language for more contextual and detailed descriptions of value and potentially even as the marker of value itself—can essentially do both.*

Data Economics, therefore, concerns itself with the use of digitized data as a fundamental unit of measuring value (and hence utility) within an economy or, more specifically, within a Data Economic Frame of Reference. This chapter explores fundamental Data Economic concepts that are further expanded upon in later chapters.

As a key distinction in definitions, Data Economics is not the same as the financial economics of data in the following ways:

- The financial (or traditional) economics of data entails **creating markets and business models** for buying, selling, or licensing digital datasets. These markets treat data as a **flat commodity** to be valued using traditional currency (and related financial instruments) and to be bought, sold, or licensed in bulk.

- A **Data Economic Frame of Reference**, on the other hand, uses **digital data generated by** (or otherwise accessed by) **various participants in the economy as the unit** for measuring, storing, and transacting value. In other words, in a Data Economy, packages of digital data—created from the data being generated by the economic activity of its participants—are used for measuring value and for "paying for things" within that economy.

Data Economics therefore explores how digital data can serve as both 1) a means to express value, and 2) a medium of economic exchange.

By extension, Data Economics studies how *digital data being generated by people and organizations can be used to pay for "things and work"* (essentially, for goods and services).

For a participant[1] in a Data Economy, the following types of transactions can be enabled: (representing "you" as the participant to distinguish between "you" and "other participants.")

1. **Others can pay you money in exchange for specific units (or pieces) of your data.**
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.**
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.**

3. Injecting Utility Into Data: *Introducing Data Economic Frames of Reference (or "Data Economies") and Data Assets*

A primary hurdle of being able to "pay for things with data" is that the *meaning* and therefore *value* of digital data is subjective. It depends on both the *context* (from a technical perspective, a set of rules that impose *meaning* on the data—the set of 1s and 0s—in question) that the entity valuing the data imposes, and further, the valuing entity's opinion of the data's *utility* (or use), and therefore its *value*. As a result, the *value of data* depends on the entity evaluating the data, the data's meaning (or context), and any variable that affects those evaluations.

Within a *Data Economic Frame of Reference* (or, simply, a "Data Economy"), the participants first generate agreement on the *context* (meaning) and the *value* of the digital data generated by (or otherwise sourced into) the economy by its participants.

The economic definition of a thing's "value" is a "*measure of utility*" of that thing (*things* here being used as an all-encompassing word including anything we may consider "goods and services"). Therefore, the value of a *package of digital data* would be proportional to its perceived "utility" by an agent. Another way to conceptualize utility and value in this scenario is that the *value of the package of data* is determined at least in part *by the new outcomes that can be generated*

[1] Participants can include individuals or entities

using that package of data. How useful is the data, as perceived by an agent, in helping generate, produce, or measure meaningful or valuable outcomes?

How does a package of data become imbued with utility in the first place? Or, how can a package of data generate new outcomes that are valuable and desired by participants in an economy?

The answer to this question is only limited by human imagination and need. However, the specific approach taken by the Lydion Data Economic Methodology is based on the following hypothesis from "On Value, Outcomes, and Data", page 5**:**

> *If digital data is presented as the unit of defining, measuring, and transacting value based on outcomes, it becomes not only a form of language, but also a "raw material" for the outcomes it measures and describes.*

Also:

> *Data Economics seeks not only to define a framework for packaging digital data to measure and transact the value of outcomes, but also to define a framework for defining the value of digital data itself based on the outcomes it measures and utilities it enables…*

The *Lydion Data Economic Methodology* is based on this approach and is implemented via the *Lydion Data Economic Operating System.*

This methodology **packages up datasets and data streams in "logical blocks" (or data quanta) that represent proof (measurement) of results (or "Outcomes") created by some kind of work performed; a set of "Completed Tasks" requiring expenditure of energy.**

This methodology provides such "data quanta" packaged in a common format—with each instance called a *Data Asset*—with the ability to:

- (A) be uniquely identified from other data quanta representing similar or other types of Outcomes and Completed Tasks.
- (B) be valued using existing measures (such as currency, goods/services, or other types of data).
- (C) be used for measuring the value of other things/work/money.
- (D) be used (or utilized) "to pay for things."
- (E) remember what it has been utilized for in the past.

The above abilities transform a data quantum (representing some set of Outcomes of Completed Tasks) into a Data Asset—a uniquely identifiable piece, or quantum, of data that can be used (or utilized) to enable new outcomes of value for economic participants.

Such *Data Assets* exist within a *Data Economic Frame of Reference*, as described in "On Value", page 6:

> *In an economy based on the value represented by digital data, or what we'll term a Data Economy, we have the opportunity to have the participants of such an economy define the shared outcomes they deem to be meaningful and valuable if manifested in the material world within a Data Economic Frame of Reference. The participants can further define the parameters, values, and tasks (essentially, the intermediate goods and processes and their utility), as well as the specific inputs of participants that will be evaluated as contributing to the desired outcomes within this Frame of Reference. Further, the participants can define the rules and parameters governing the interaction between their Data Economic Frame of Reference and other Data Economies generating outcomes considered valuable by these participants, potentially creating new, shared Data Economies (or shared Data Economic Frames of Reference).*

(Coming Soon) Diagram 3.1: "A DE Frame of Reference Comprising Several DA Types (in their DAM) being created from different types of data"

A ***Data Economic Frame of Reference***, or a "***Data Economy***" in short, is:

1. A set of Participants, and;
2. A set of Data Assets minted from datasets and data streams sourced by these Participants, packaged to communicate outcomes and incentives that are meaningful to the Participants in a shared language.

The ability of Data Assets to store value and to be used as units of transactional value (used to "pay" for things) is due to their ability to tell three "Stories" to every participant within their Data Economic Frame of Reference:

1. **Story of Generation (Context and Scarcity):** Scarcity is framed as the results, or outcomes, of some kind of work/completed task also allows the "data quantum," packaged as a Data Asset, to tell a "Story of Scarcity." In other words, this Story describes the Context of the Data Asset's existence - why is the specific "piece of data" unique, and what work (or expenditure of energy) was used to generate it? The same Story as a result describes the reason or ***Context*** for the Asset's existence - for its

generation - as well as how ***rare (or scarce)*** an instance of the Data Asset is, since scarcity is proportional to the amount of energy required to generate the Asset.

1. Specifically, generating the original (or canonical) quantum of data representing the outcomes of completed tasks (as long as duplicates are accounted for) takes at least as much energy as completing the tasks themselves. The data within the quantum/package that represents outcomes therefore serves as a "proof-of-work" of work performed—or tasks completed (in the real world)—to generate those outcomes.
2. The original (or canonical) instance of a specific "quantum of data" has at least the same characteristics of scarcity (is at least as hard to generate) as the results of the completed tasks themselves.
3. As long as the canonical copy of the data quantum can be recognized as distinct from its duplicates, it can be used as a "proxy" for the actual outcomes (and associated work) that it represents, and can represent the utility and value of these outcomes in various transactions.

Note that this Story can be referred to as the Story of Generation, Story of Scarcity or simply as the Data Asset's "Context Function."

2. **Story of Utility**: Utility is framed as the *results, or outcomes, of some kind of work/completed task* allows the "data quantum" to provide the reason why it can be used, or utilized, to generate some new outcomes. This reason is based on, or is a function of, the reason for the Data Asset's existence - that is - the ***Story of Utility is a function of its Story of Generation (and Scarcity)***.
    1. Intuitively, think of an invoice that you receive from a plumber who installed a new sink in your bathroom: the invoice is a piece of data, or "data quantum," that represents the list of work done—or completed task(s)—to source and install the sink.
    2. Because of this context provided by the completed task(s) listed on it, the "data quantum" that is the invoice can now tell a "Story of Utility." That is, it can make the claim that it can be utilized (or used) by the plumber to gain access to a certain amount of currency from you.
    3. Similarly, if a "data quantum" is created (or "minted") as the set of the "Outcomes" of a set of "Completed Tasks," then that "data quantum" is able to tell a "Story of Utility"—"I mean X, so I can be utilized for Y," or, in other words, "Because I mean X, I can be used to 'pay for' the creation of the set of new outcomes Y."

3. **Story of Value:** As discussed earlier in Section 2 and explored in more detail in Part 3 of Introduction to Data Economics, the economic definition of "value" is "a measure of utility." Telling a "Story of Utility," or more specifically "Story of Potential Utility," is the same as telling a "Story of Value."
    1. In short, a Data Asset carries not just a Story of Utility, but also a Story of Value and the Story of Value is a function of the Story of Utility.
    2. Since the Story of Utility is itself a function of the Story of Generation (and Scarcity), the Story of Value is also a function of the Story of Generation.

The concepts of injecting utility into existing digital data sets and data streams by packaging them up as valuable results or outcomes of work done, and the process of "owning," "buying," "selling," and "licensing" such data packages (or Data Assets), are explored in more detail in Chapters 3 and 4 of *Introduction to Data Economics*.

4. Bringing Data Economies to the Real World—*Introducing Data Economic Operating Systems (DEOS), Data Asset Markets, and Data Economic Networks (DENETs)*

Based on our discussion above, we can now expand the definition and description of ***Data Economics*** and related key concepts (***highlighted*** throughout this section):

1. Data Economics as a discipline studies the use of data, specifically digitized data, as the unit and medium of expression, storage, transfer, and exchange of value.
2. Data Economics is the science of defining, valuing, and utilizing meaningful outcomes that can be identified by results measured by digital data.
3. Data Economics allows digital data from varied owners/generators to be "quantized" into ***Data Assets***—organized into individually identifiable quanta and packaged with rich context representing meaningful outcomes—and then allows that data to interact with digital data from other owners/generators in a way that can create combined meaningful and valuable new outcomes.

Data Economics in this way gives us the scientific and technical frameworks to design and implement ***Data Economic Frames of Reference,*** or ***Data Economies*** for short, that use:

- these discrete pieces (or quanta) of digital data, packaged up in a common format called ***Data Assets*** using a common underlying language and ruleset to represent ***Outcomes***, as the fundamental units of the economy.
- Data Assets, as opposed to using currencies (or similar external sources of value), as the fundamental unit of expression to facilitate an economic exchange.

A ***Data Economic Operating System (or DEOS)*** enables the design and practical, real-world implementations of Data Economic Frames of Reference (Data Economies) across participants (people and organizations) and their diverse datasets to enable solutions for the participants' economic opportunities and challenges.

From "On Value", page 6:

> *Communication among these economies has a shared language with two foundational elements. First, the defined outcomes and tasks are based on tangible and measurable events in the real world, represented as digital data.*
> *Second, a set of rules (or digital "machines") serve as translators to help these economies interpret the value of tasks and outcomes achieved by other economies, regardless of whether the economies share the same values or interact in the real world, facilitating trade or exchange. These machines can also help solve asymmetric information problems by helping one economy understand the activity of a second economy through the lens of what the first economy defines as meaningful or important.*

A DEOS is therefore responsible for:

1. **The Process of "Data Assetization" via Data Asset Markets**
2. **Formation of Data Economic Networks among Participants of Data Asset Markets**
3. **Communication among Data Economies via *Shared* Data Economic Networks**

1. **The Process of Data Assetization via Data Asset Markets**: A DEOS enables *quantization* of ordinary digital data—ideally from any organization's or individual's dataset through a process called "data assetization"—into uniquely identifiable and usable Data Assets.

These Data Assets (quantized sets of data) are utilized and circulated within a ***Data Economic Network***, representing an economy backed by digital data that is generated by that economy's participants, resulting in what we call a Data Economy (or Data Economic Frame of Reference).

The DEOS oversees the formation of different types (or classes) of Data Assets using underlying datasets (from the same or different sources) as "raw materials" and corresponding ***Data Asset Markets*** that contain and enforce the rules (as modular digital programs) for generating and utilizing each type of Data Asset.

Data Asset Markets can assetize, manage, and trade Data Assets on behalf of a person or an organization over digital networks called *Data Economic Networks* (DENETs), as well as with other Data Asset Markets.

(Coming Soon) Diagram 4.1: "Show DEOS assetizing data from underlying datasets into different types of Data Assets via DAMs"

2. **Formation of Data Economic Networks Among Participants of Data Asset Markets:** Each type of Data Asset is controlled by a Data Asset Market, and the participants of a Data Asset Market are connected over a (closed) digital network called a Data Economic Network (DENET). Groups of interconnected Data Asset Markets combine to form Data Economies represented in the real world by Data Economic Networks (running within Local Area Networks or over the Internet).

Each ***DENET*** implements a ***Data Economy (or a Data Economic Frame of Reference)*** containing a set of interconnected Data Asset Markets, each minting and managing a single type of Data Asset representing a class of Outcomes of Completed Tasks, which in turn can be utilized to create new Outcomes.

Further, properties of Data Economic Networks allow authorized participants in the Data Economy to independently identify, track, and verify the history, usage, and shared definitions of value and utility for all Data Assets controlled by Data Markets in that Economy.

(Coming Soon) Diagram 4.2: "Show DEOS generated DE-APPs creating a DENET among Companies connected via Data Markets"

3. **Communication among Data Economies via Shared Data Economic Networks:** A DEOS also enables different Data Economic Frames of Reference—potentially dealing with very different types of datasets from differing industries representing very different types of Tasks and their Outcomes—to communicate with each other and create new, shared Data Economies.

The DEOS enables this via:

1. facilitating communication across DENETs through a program called the ***Data Economy Controller*** that allows Data Asset Markets within different Data Economies to interact with each other and to utilize and trade each others' Data Assets.
2. the creation of ***Shared DENETs*** (and consequently shared Data Economies) between existing DENETs and new, shared Data Asset Markets—markets that are created (or derived) from existing Asset Markets to enable the generation of new types of Data Assets that Participants in both existing Data Economies are interested in generating and / or utilizing.

(Coming Soon) Diagram 4.3: "Show DEOS-generated DENETs connecting with each other"

Thus, the DEOS enables the understanding and trade of:

- very different types of Data Assets representing very different types of value,
- created from very different types of underlying datasets and data streams, potentially from different industries.

Data Economic Operating Systems (DEOS) of varying types and functionality already exist, from formal digital data economies such as those enabled by the Bitcoin or Ethereum networks, to the physical or behavioral data-based economies enabled by loyalty cards at a coffee shop or credit card miles (see Section 4.1 in Chapter 3 of *Introduction to Data Economics* for more on these "everyday" data economies). These "Data Economic Operating Systems," whether implemented as digital networks (such as the Bitcoin network) or less formally as a loyalty points program, implement some subset of the above key features of a DEOS, and, more importantly, use digital data that is usually generated and sourced from designated external sources not owned or controlled by the economic participants.

(Coming Soon) Diagram 4.4: "DEOS comparisons - other DEOS using other types of data, Lydion DEOS using people/companies' own data"

The ***Lydion Data Economic Operating System (Lydion DEOS)*** has been developed:

1. to specifically enable the three key features of a DEOS as described above in designing and managing Data Asset Markets and the Data Economic Networks that they operate within using any combination of datasets and streams owned by any combination of participants (people and organizations).
2. to enable the design and production of Data Assets, Data Asset Markets, and DENETs using datasets that are being generated and sourced by the various participants in these Markets as a result of valuable economic activity.

The Lydion DEOS is used to develop products called ***Data Economic Solutions*** (comprising one or more ***Data Economic Applications***—*DE-APPs* running over *DENETs)* to address challenges and opportunities in a number of verticals for enterprises, communities, and individuals.

These Solutions have various features based on the needs of its participants. They also need a common language so that the Data Asset Markets and Data Economies can organize and communicate. The Lydion DEOS provides this common language while also providing flexibility and customization to suit the needs of different industries and entities.

5. Conclusion: Chapter 2: The Fundamental Concepts

The discipline of Data Economics, to a great extent, involves:

1. Hypothesizing, testing, and optimizing pure Data Economic Frames of Reference that enable valuable economic activity powered simply by the digital data being produced or otherwise sourced by the participants of the economy, and

2. Finding and optimizing Data Economic loops that connect Data Asset Markets to existing markets that enable:
    a. The exchange of Data Assets for money or other form of capital, and
    b. The exchange of Data Assets to pay for things and work (goods and services), which is only possible by connecting Pure Data Economies with Mixed or "Bridge" Data Economies that connect into traditional economies.

The rest of the *Introduction to Data Economics series* will explore several such Data Economic Frames of Reference (or simply Data Economies) and the digital Data Economic Networks that connect the Data Asset Markets involved and enable these Data Economies. The goal of these chapters is to enable readers to to gradually build an intuitive understanding of the power and scope of such Data Economic Networks, and the approaches to hypothesizing, designing, and implementing stable, sustainable, scalable, and most important value-generating Data Economies (and the Data Asset Markets that they involve).

Appendix - What to Read Next

After Chapter 2 of *Introduction to Data Economics* (this chapter), Chapters 3 and 4 can be read in any order.

Chapter 3: *Types and Examples of Data Economies* is aimed at a general audience, and builds an intuitive understanding of different types of practical, real-world Data Economies (both existing and upcoming) through examples, while the important concepts of Mixed and Pure Data Economies.

Updated versions of Chapter 2 (this Chapter) and Chapter 3 with rich, detailed diagrams are coming soon.

Chapter 4 of *Introduction to Data Economics: Deeper Dive into Fundamental Concepts*, aimed at a slightly technical audience, is also coming soon. Chapter 4 picks up at the end of Chapter 2 and goes deep into exploration of concepts such as DAMs, DEOS, DENETs. Chapter 4 also goes

deeper into the Lydion DEOS and its methodology for the development of Data Economic Networks, including an examination of the benefits of assetizing data.