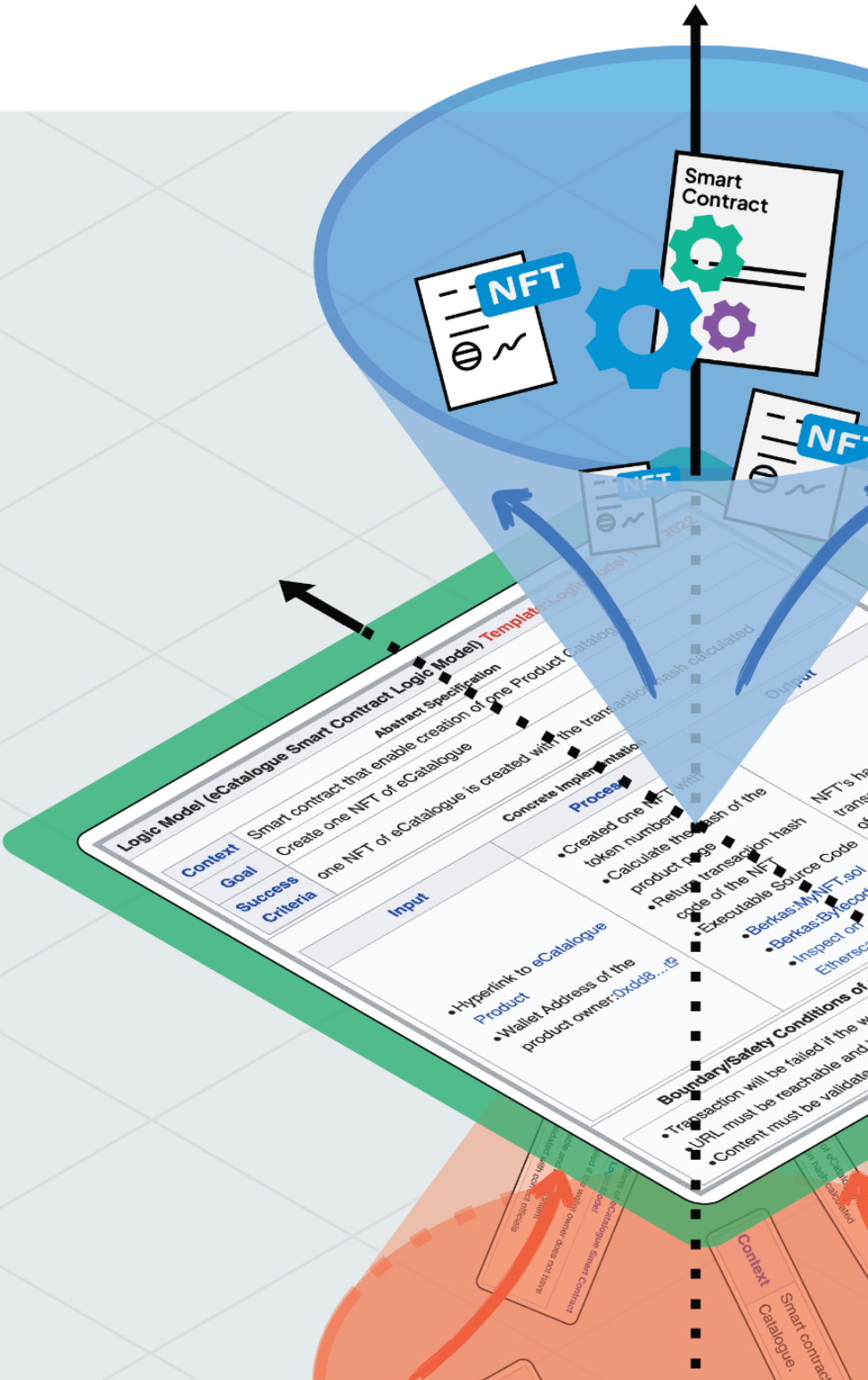
Science of Governance

Through self-administered data



From Sanskrit विविधतायां एकता ...

Bhinneka Tunggal Ika
Tan Hana Dharma Mangrwa

In Differences there is only one,
and there is only ***one unifying*** *version of the truth.*

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11 November 2022

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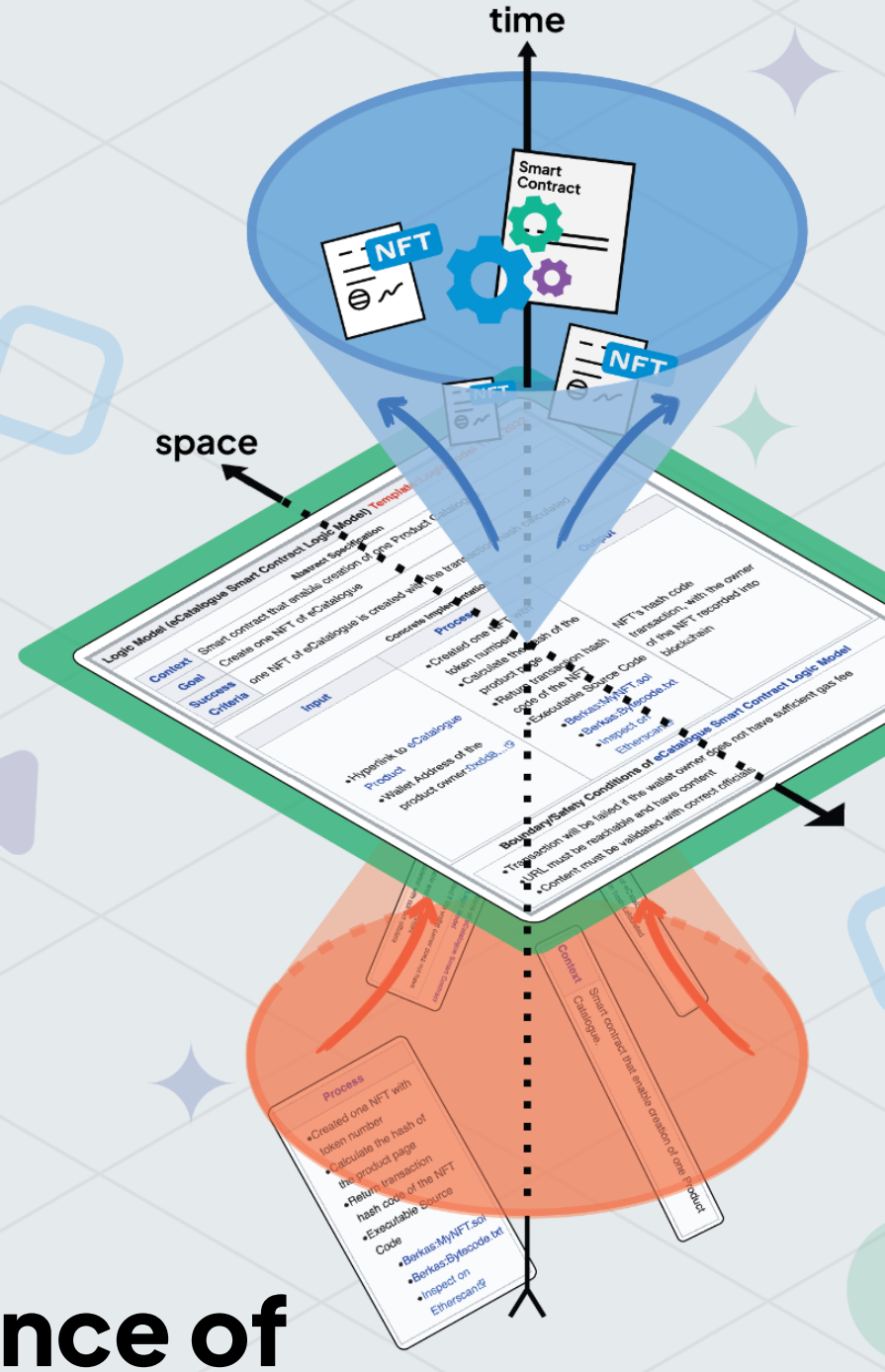
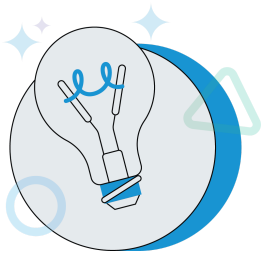


Theory

The Science of Governance (SoG)



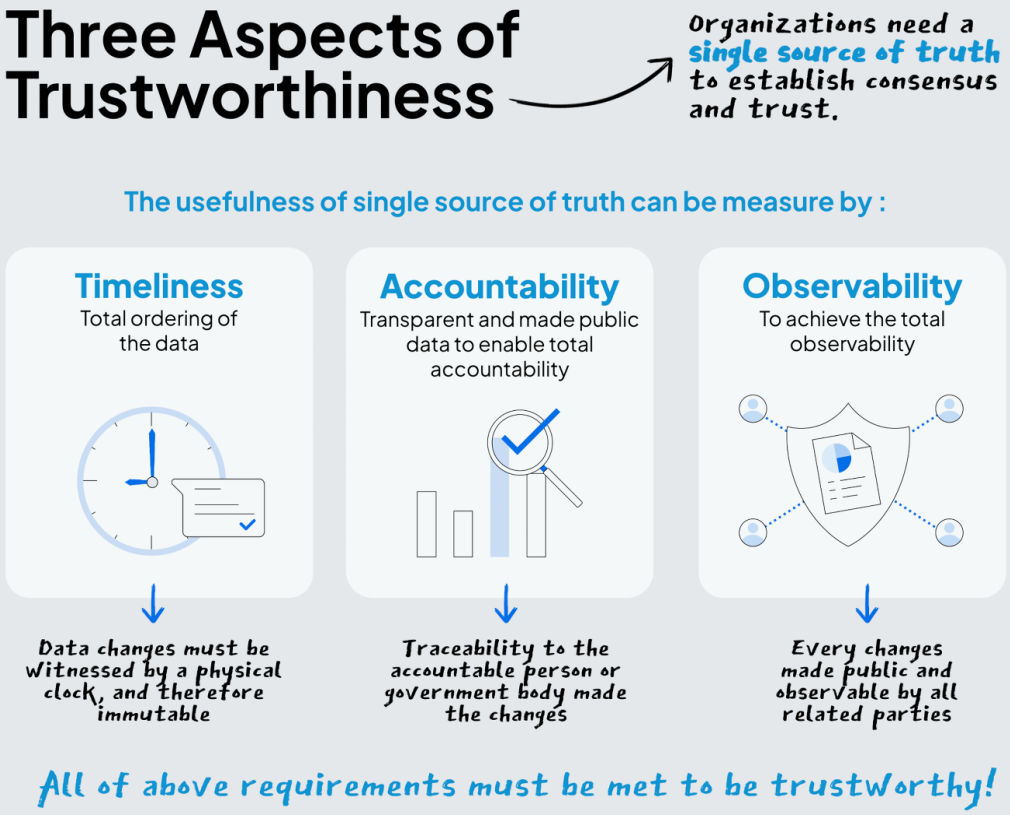
I. Context

Digital Transformation challenges Social Stability

Everyday, people around the world are persuaded by others who simply have more information. This is known as ***information asymmetry***, where one entity has better access to knowledge while the other entity does not. Examples of this phenomenon range from car salespeople selling bad cars to unwary buyers,[1] to developing countries getting overly high interest rates from lenders, crippling their economy. Information asymmetry can be used with good intentions, and could also lead to exploitation.

Currently, data processing technologies are increasing information asymmetry in ways that are becoming a major problem in public administration. Malicious and systematic data technology exploitation can be conducted by individuals or public institutions that have more access to data or data processing technologies. To ensure sustainable justice in modern societies, the notion of governance must be grounded to the power of persuasion's root, which comes from information asymmetry. We call this scientific endeavor the Science of Governance (*SoG*). *SoG* focuses on the fundamental properties of information asymmetry: the timely access, accountability, and observability of public data.

[1] See "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism." by George A. Akerlof.



Power structures always needed tools and methods in guiding timely actions, creating accountability for policy outcomes, and monitoring progress. Models of thought were utilized to create and execute policies shaped by power structures. These include: "Objective and key results (OKR);" used to define measurable goals and measure outcomes,[2] "Management by objectives (MBO);" defining specific objectives and sequentially how to achieve each objective,[3] and "logic models," describing the chain of causes and effects leading to an outcome.[4] Without advanced computers and software, political structures still functioned using thought models, creating their own codes, and storing information.

[2] See *Measure what Matters: OKRs - the Simple Idea that Drives 10x Growth* by John E. Doerr.
[3] See *The Practice of Management* by Peter Drucker.
[4] See "Logic Models" by Joy A. Fretchling in Works Cited.

A typical logic model is shown below:

Logic Model (eCatalogue Smart Contract Logic Model) Template:LogicModel 11 2, 2022

Abstract Specification

Context	Smart contract that enable creation of one Product Catalogue.
Goal	Create one NFT of eCatalogue
Success Criteria	one NFT of eCatalogue is created with the transaction hash calculated

Concrete Implementation

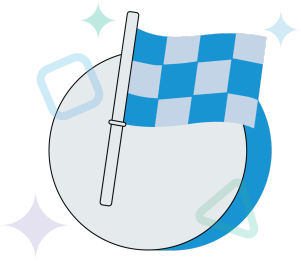
Input	Process	Output

• Hyperlink to eCatalogue Product
• Wallet Address of the product owner:0xdd8...
	• Created one NFT with token number
	• Calculate the hash of the product page
	• Return transaction hash code of the NFT
	• Executable Source Code
	  • Berkas:MyNFT.sol
	  • Berkas:Bytecode.txt
	  • Inspect on Etherscan
		NFT's hash code transaction, with the owner of the NFT recorded into blockchain

Boundary/Safety Conditions of eCatalogue Smart Contract Logic Model

- Transaction will be failed if the wallet owner does not have sufficient gas fee
- URL must be reachable and have content
- Content must be validated with correct officials

Large-scale digital technology uses these logic models; even complex technology like smartphones and blockchains were built on a foundation of prior inventions and systems. The current priority is having government structures utilize today's technology with the logic models in place to its fullest extent. We name this new field, *SoG*.



II. Goal

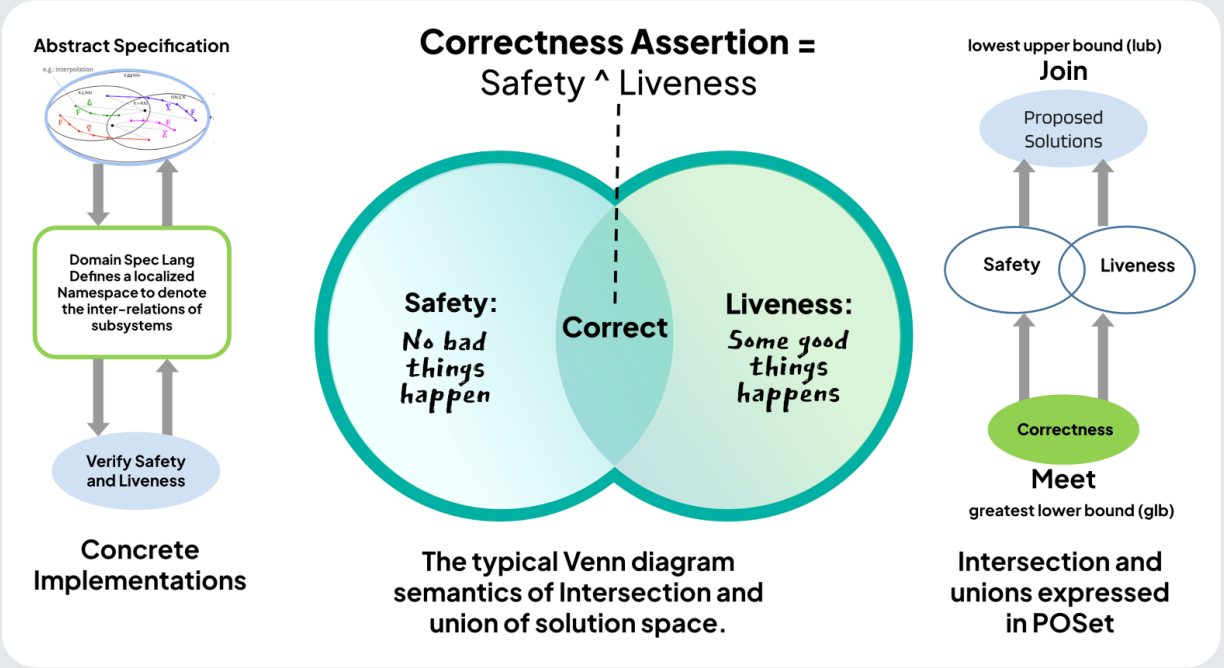
Ensure Governance Correctness by Data Technologies and Sciences

SoG works on establishing a fair and just political process in a world overwhelmed by the asymmetric distribution of data governance technologies. It should provide a trustworthy foundation to help governing bodies allocate resources to execute policies efficiently, utilizing different aspects of established governance theories and creating new governance theories, while employing readily available technologies to deploy solutions in the real world. In other words, an End-to-End solution for governance practice must have a scientific basis that can be scaled up in applications through technology and have a unifying policy decision frame that can be applied to all domains of applications. This requires the Science of Governance to be abstract, so that it doesn't associate itself with a specific application context. It also needs to be concrete, so that all policy decisions made are observable and accountable. The only medium to deal with this dualism is nothing but ***data***.

The Logic of Correctness

It turns out that there is a logical way to express correctness that is scale-free and domain independent. The Venn Diagram representation of correctness can be found in the diagram below. It shows that correctness is the logical intersection of safety and liveness conditions. A system or policy is considered to be safe, if it is harmless or nothing bad happens from executing the policy. A policy is considered to be alive, or satisfy the liveness condition, if something good happens during the policy execution. This generic, domain-independent statement of correctness allows policy designers to separately list the conditions of what are considered to be bad, and then list the conditions that are considered to be good. This logical decomposition of correctness is a powerful intellectual construct that enabled system engineers and computer scientists to build systems as complex as the entire Internet. Whether a governing body can consistently apply this construct in policy framing decides how well an organization may be governed by explicit rules.

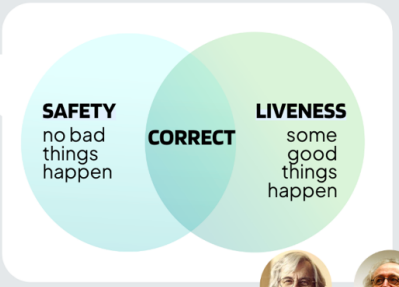
Visual Representation of System Correctness



Correct by Design according to Hoare

Hoare logic (also known as **Floyd–Hoare logic** or **Hoare rules**) is a formal system with a set of logical rules for reasoning rigorously about the correctness of computer programs.

Image and source: Wikipedia on Hoare Logic



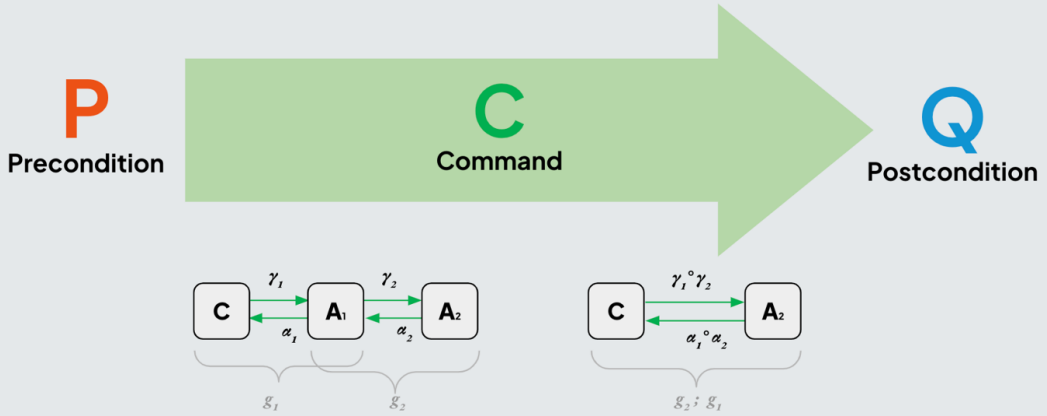

Leslie Lamport


Patrick Cousot

CORRECT functions (C) must satisfy both {P} and {Q}:

$$\{P\}\ C\ \{Q\}$$

Hoare Triples can be composed to create other composite "functions" with computationally verifiable correctness specifications.



The idea of writing down satisfactory conditions in written contracts is not new. The new challenge is that we have so many possible conditions in this already highly interconnected world. The notion of ***Correct by Design***, as spelled out by Sir Tony Hoare, shows another way of decomposing a policy or an executable "program": a program executed by computers or humans can always be expressed in terms of the ***{P} C {Q}*** styled Hoare Triples. One may roughly match ***{P}***, the precondition of a policy, as the expression for safety requirements, and the post condition ***{Q}*** to be a logical expression of liveness requirements. The interesting twist of a Hoare Triple, is that one can easily imagine these Hoare Triples to be linked/composed to express more complex policies or programs. It is the complexity of these

composable arrows[5]/Hoare Triples that make it a domain-independent way to organize the correctness condition in a formalized data structure. Due to its composability, Hoare Triples may serve as the universal data primitive to encode arbitrary large-scale social and industrial governance challenges. Due to its simplicity, Hoare Triples are suitable to decompose application scenarios that must deal with the complex interactions of many knowledge domains. The Hoare Triple is such a Universal Construct: it is everywhere and has been already adopted by many popular governance tools, such as the Logic Model (for more detail, please see ***Appendix*** on ***Logic Model as Multi-Level Hoare Triples***).

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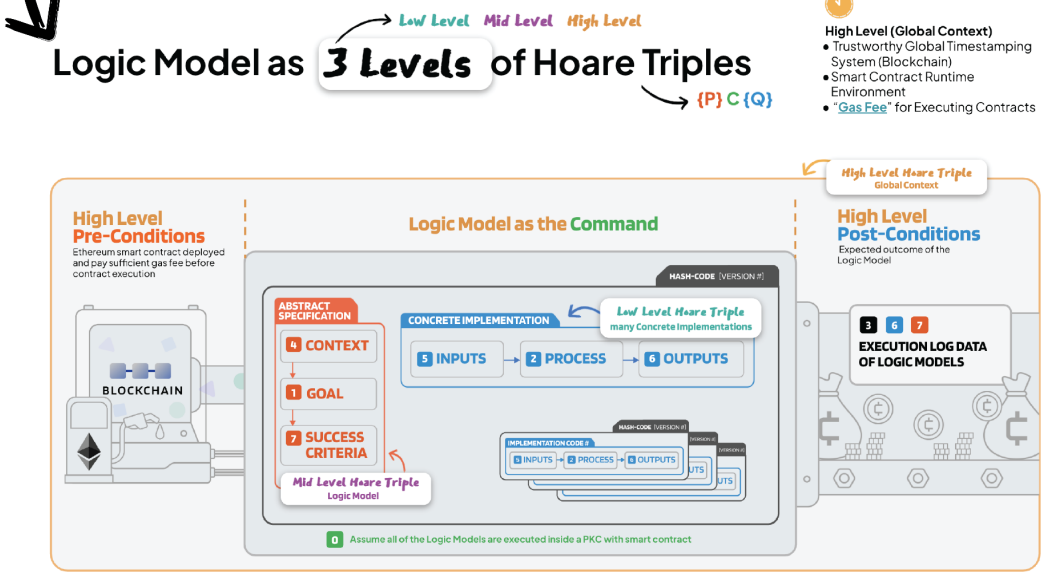
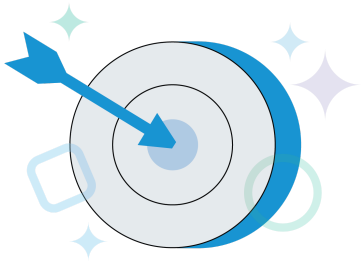


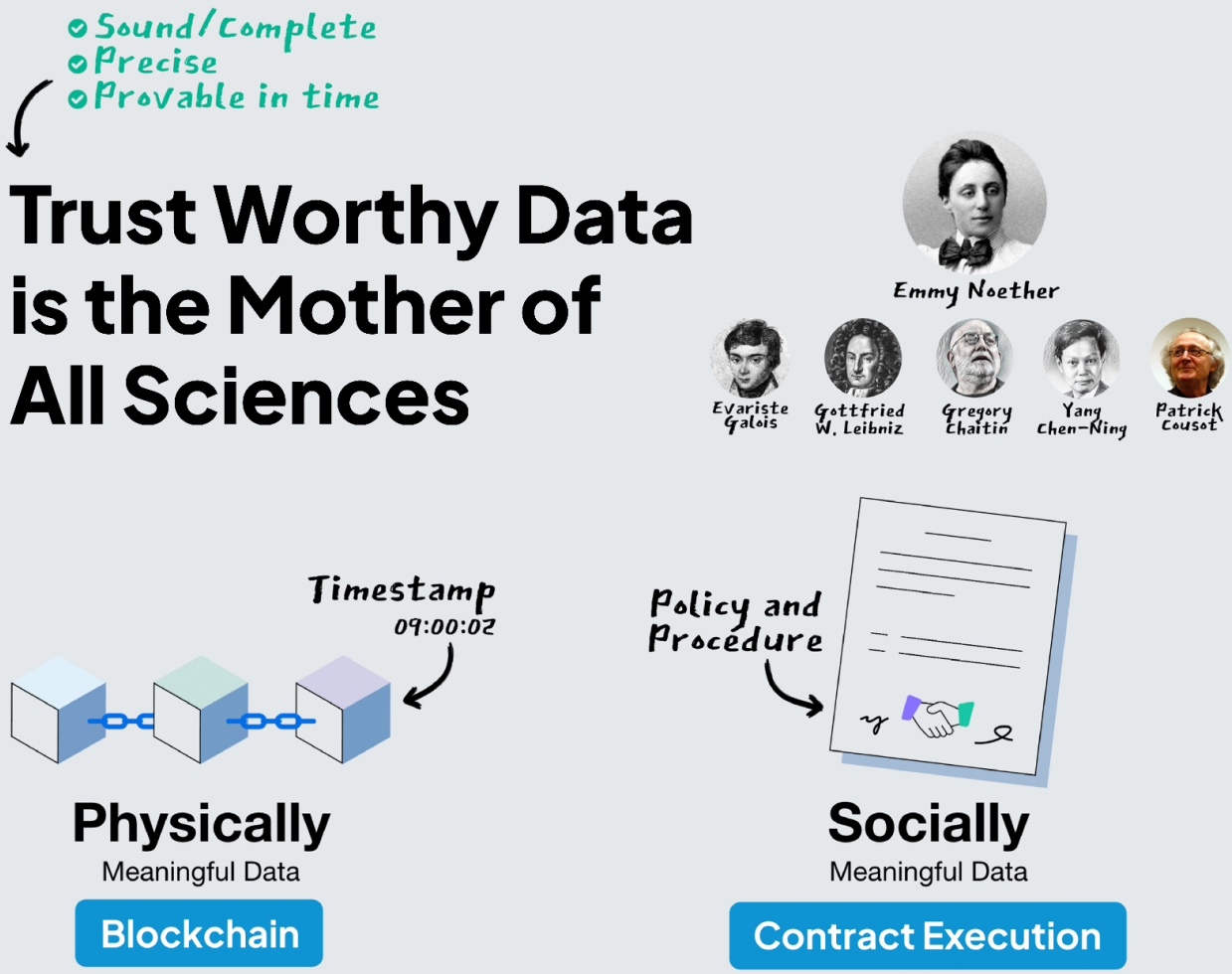
[5] See Seven Sketches of Compositionality by Spivak and Fong, in Works Cited.



III. Success Criteria

Assess governmental practice via time-stamped Data

Only after recognizing that a unifying logical primitive may be the grounding representation of scientific judgment can one consider policy framing and governance practice as not just an art form, but also a form of scientific endeavor. It also marks a new era of Digital Transformation by actively applying *Correct by Design* methodology to not just engineer inanimate objects, but also use the same principle to reason about ***ethical integrity*** logically. In a highly connected world, we should be allowed to adopt technologically sophisticated cognitive/thinking tools to tackle the complexity created by technologically sophisticated interconnected systems.

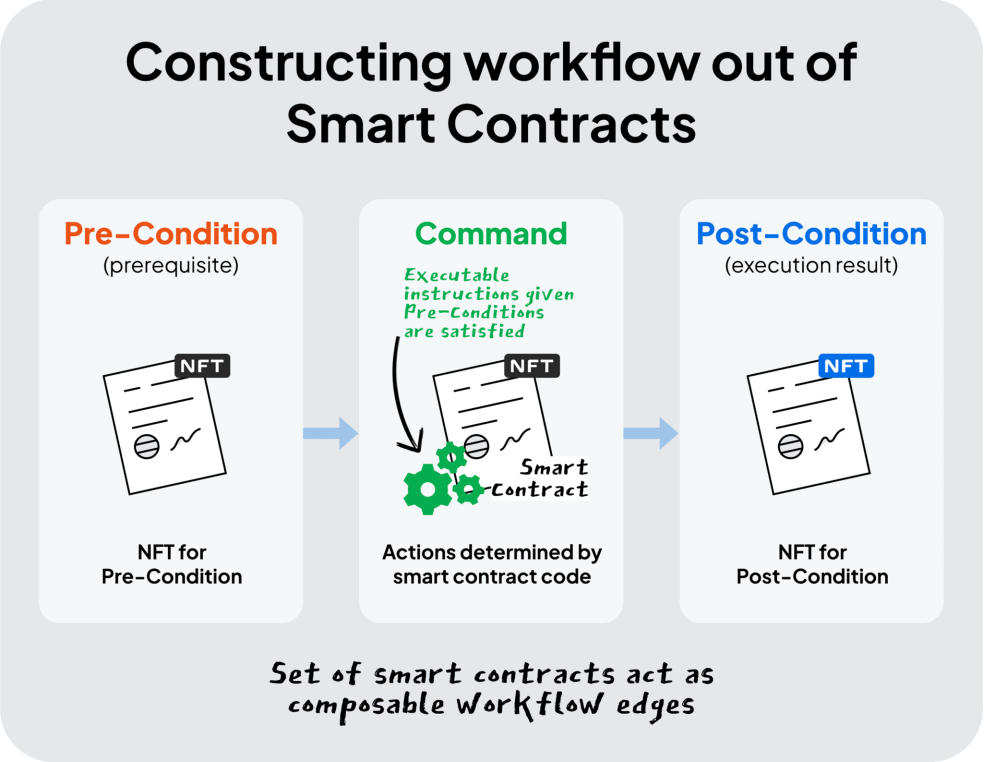


To establish itself as a legitimate field of scientific discipline,[6] *SoG* needs to be grounded and validated in the physical world and must be socially meaningful to people willing to use this theory. Data may be associated with physically observable parameters, such as timestamps[7] and spatial markings. To associate social meaning to data, one must engage with many socially relevant participants to agree on certain pieces of data. These are often called signed contracts. A signed contract often is dated, and that date value is a timestamp.

[6] See Bruno Latour's Science in Action in Works Cited
[7] Associating time value with a piece of data is called time stamping.

Combining Hoare Triple with Blockchain

Time penetrates everywhere. Once a reliable time source is approved by many participants, complex workflow amongst these parties carries them across vast space. Since all blockchains must regularly package a "block" of mutual agreements in a fixed time interval, the process of packaging agreements makes blockchain both socially meaningful (many social agreements) and physically meaningful (each block denotes an increment of time). Using Blockchain as a common ledger to share actionable code, often called a Smart Contract, both pre- and postconditions can be bound to socially agreeable physical time. In other words, a trusted timestamp system defines the temporal ordering of events. It allows "commands" or "contractualized action " to be executed in a sequence that fulfills the functions of an arbitrary and complex workflow that must be met for agreements grounded in time, denoted by Blockchain.



For example, in the physical world, the sequential order to contract execution can be easily encoded in logical assertions bound in Pre-Conditions of other Commands. The required time to fulfill the command execution, such as payment due dates after product delivery, can be encoded in Post-Conditions. These time-bound logical

statements are the essential programming constructs that make up the composition of modern workflow systems, often called the Enterprise Resource Planning (ERP) system. ERP's most essential function is to ensure all enterprise actions across highly dispersed geographical locations follow programmatically-defined temporal ordering sequences. With Blockchains and Smart Contracts providing a trustworthy global clock and custom-defined action triggering conditions, many expensive ERP software solutions could be replaced by public computing services, sometimes referred to as the Web3 movement.

An Open Format of the Code

Governmental policies are codes, and codes should be represented in domain-independent and scale-free data structures such as ***Hoare Triples***. The ***domain-independent*** and ***scale-free*** nature of the Hoare Triple provides a unifying data primitive to express and examine the process of policy construction and deconstruction without being fixated with a narrow field of domain knowledge or a particular physical scale. The same reasoning applies to business operations and even personal event management. Coupled with a trustworthy timestamping system, a time-bound Hoare Triple can be the Open Format to construct workflow for any application domain and any scales of applications.

Open Format is an important assumption in the global pursuance of Digital Transformation. The integrity of digitized governmental policies must be united in a logically invariant data type, allowing any policy to be computationally examined with computable correctness. ***Correct by Design*** provides a logical framework to connect causal structures and policy statements in a common data type, that is not tied to any specific interest parties. This openness in format enables a unifying semantic realm to reason about policy consequences in one logical universe.

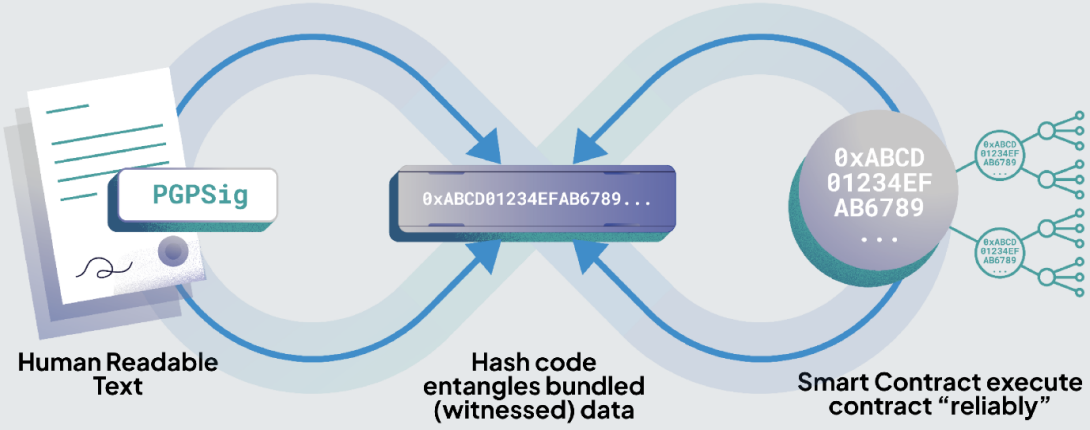
We also encourage governmental agencies to contribute their practice in a scientific community by promoting the movement of creating an ***Open Format Repository*** across many government agencies, so that their governance experience can be shared and reused. This repository will catalog for existing security-aware communication formats, curate these designed artifacts as Ricardian Contracts, and manage the

evolutionary history of the curated content as Non-Fungible Tokens (NFT). This blockchain-validated (timestamped) repository of data content composed of executable source code with textual descriptions would elevate public accessibility to the highest level possible, making ***Open Format*** knowledge reusable across application domains and shareable by various sovereignties and cultures.

Open Format for Everyone

The foundational assumption about Correct by Design is to enable the broadest and deepest possible self-reflection in a common data format that synthesizes abstract rules with concrete evidence in world events administered by digitized government policies. This data format cannot be only accessible to highly trained programmers. The format must be accessible to people who can read and write natural languages. The combination of human readable text with a specific set of executable contracts needs to have some forms of technical certainty. Ricardian Contract was invented by Ian Grigg in 1996, which proposed the generation of one fixed-length number, called hashcode, to represent the unique composition of human readable text and machine executable contract by passing this contractual package with a secure hash code generating algorithm. This proposition is also known as the Bowtie model, because the diagram of the proposed data format looks like a bowtie.

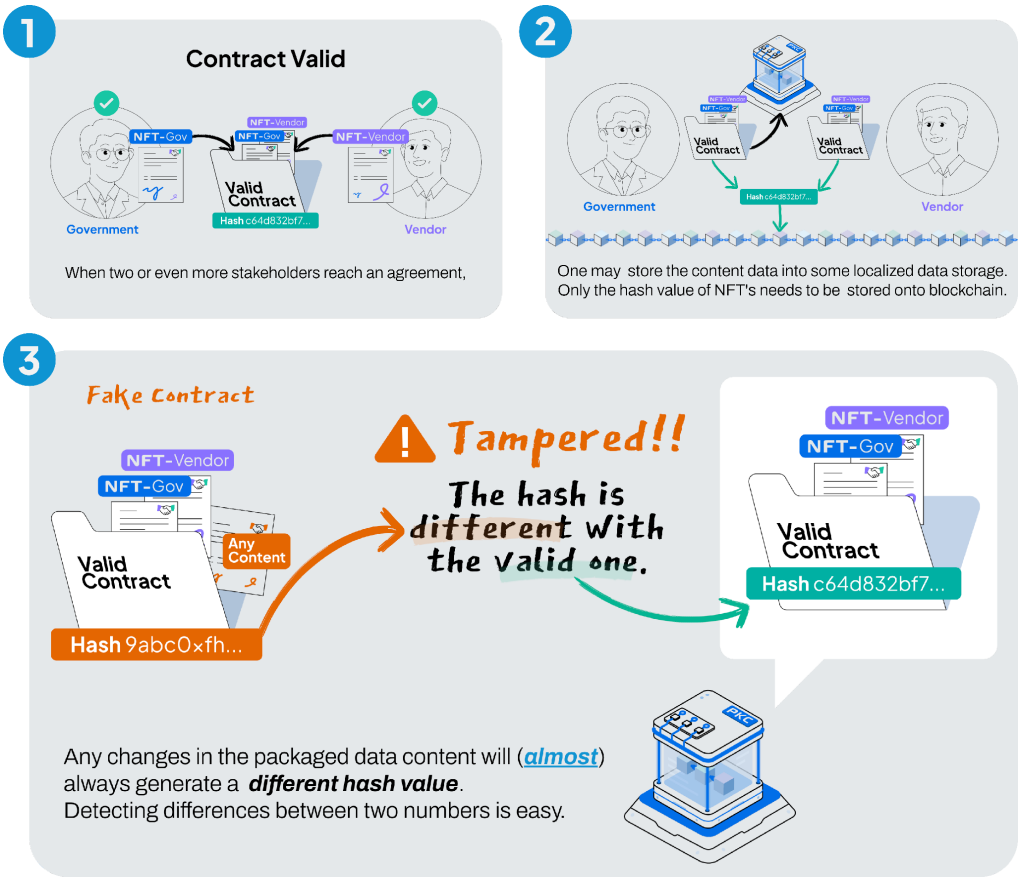
Ricardian Contract combines Text with Smart Contracts:
Human readable text, hash, and automated execution together keep data accountable



Please see https://en.wikipedia.org/wiki/Ricardian_contract

Trustworthy and Economical Data Storage

Blockchain, as an immutable database can be expensive to operate. It is particularly expensive to store a large amount of data on a frequent basis. It can serve as an economically viable notary service if it is coupled with local storage systems. As proposed in the following diagram, blockchain only needs to store the hash code of a Valid Contract, while the detailed data content of the Valid Contract can be stored in local file systems of participating parties. As long as the presented data content generates the same hash code, it can be considered to be valid. In case any modification is made to the contact package, running through the same secure hash generating algorithm again, it will guarantee to generate a different number, and then we may know that the data package has been tampered.

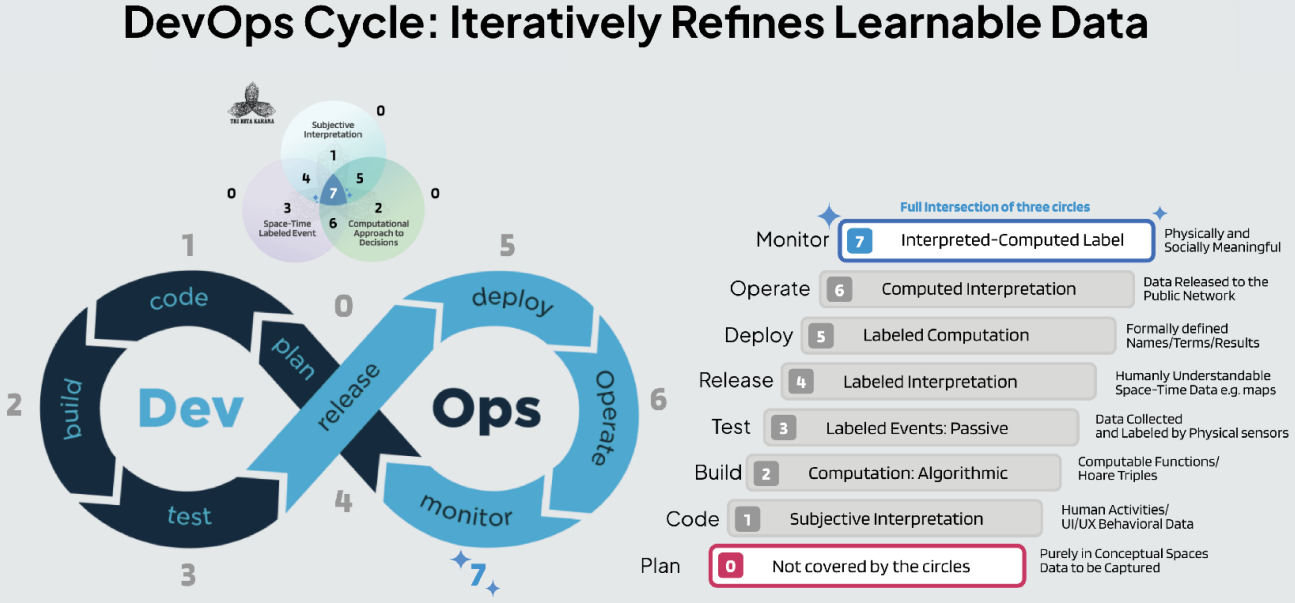


This public infrastructure, coupled with data and computing service packaging tools like microservice and microservice orchestration, provides a new breed of data services that allow citizens to own and operate data centers like large organizations. This creates a form of scale-free data sovereignty that was not possible before. Tools such as

the Personal Knowledge Container created in Indonesia were designed to demonstrate the feasibility of such an egalitarian data instrument.

Summary: An End-to-End Argument on SoG

It is popularly known that large-scale Internet engineering follows a so-called Hourglass model[8]. To govern any organizations in this era dominated by the Internet, it is inevitable to ask what would be an End-to-End argument[9] that would really cover everything? This is reflected in multiple concepts, workflow cycles, and operational models. The causal cone of ***Past***→***Present***→***Future***, and the Ricardian Contract, being visually presented as a so-called Bowtie Model, both are presented in diagrams shaped like hourglasses. Also, the DevOps cycle is often drawn in the shape of a Mobius Strip, which also looks like an Hourglass shape. These recurrences of hourglass shape are not coincidences.



[8] See Becker's On The Hourglass Model, referenced in Works Cited.
[9] See Saltzer's End-to-End Arguments in System Design, also referenced in Works Cited.

There is a reason that all these things must have a common point of control. The action of control may only happen at "the present (time)," and "the present" is often short and locally small, and it must deal with a very large world of possibilities. Therefore, all decisions that have big impacts must condense a significant amount of past experience, and expand out to a wide range of future possibilities. That is why all system design patterns eventually shape like hourglasses, some of them oriented in different directions, the general shape being wide on both ends and skinny in the middle, which is why hourglass has been recognized as a geometrical pattern to describe controllability in various literatures. Interestingly enough, hourglass happens to be a device that is used to measure time.

Time, Data, and Symmetry Breaking

It is ***time***, the cognitive phenomenon that captures the unifying direction of causal relations, which breaks symmetry in our physical world, so that every moment of presence has a common direction pointed to the future, not the past. Governance is about capturing opportunities in time, and it must use the past data records, to inform actions into the future. The influence can only be exerted into the future. It is axiomatically defined in the field of theoretical computing science, all data are represented as ordered pairs of data(basically Hoare Triples). For governmental purposes, one may think of these basic data types being packaged and annotated as Logic Models or Ricardian Contracts. We hope that this article convinced readers that the first step to initiate a scientific endeavor of governance, is that framing correct and sustainable governance practices needs one and only one data type, the "ordered" relations. This singular type of data structure, shown as arrows(or Hoare Triples), is just a way to denote causal relations, which is why we can intuitively perceive time. Moreover, data of any kind must be encoded in some kind of ordered relations, so that it could be the carrier of information content, and therefore provides the basis to assess the consequences of information asymmetry.

Self-Governance and Information Asymmetry

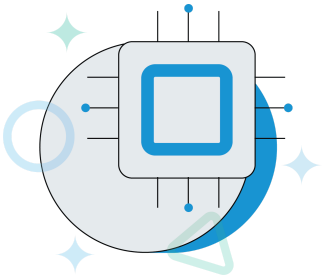
We argue that information asymmetries cannot be avoided, but they can be technologically distributed by allowing more people to utilize computing resources that a significant portion of the world population already owns. The people who can make use of the Science of Governance are not just the ones who have more powerful computers or higher bandwidth network connections. It will have to be the people who know how data and causal structures can be employed to create information asymmetry in their preferred subjects of interest. Moreover, the successful people must have a timely, accountable, and observable system to deliver contextualized/application specific information to adequately govern their own organizations. This is where a free and unbiased technical instrument must be created and adopted to enable correctness in governance. The creation of such a technical instrument is about pragmatic data engineering, not just theoretical science, which will not be discussed here[10].

We hope readers can see that the causal entanglement of data in spacetime is the direct predictor of governed outcomes. With new waves of Internet of Things technologies, and higher bandwidth communication infrastructures, the correct casual entanglement of data in spacetime still has a long way to evolve. Remember, the Science of Governance is scale-free and domain-independent. The abstract structures of Logic Model, Ricardian Contract, and Hoare Triple will continue to enjoy their inevitable existence in future scientific endeavors. Independent of the size of organization one plans to govern, formally arrange and retain ordered pairs of instructions (Logic Model/Hoare Triple) is the necessary knowledge to enable a form of self-governance that should be enjoyed by every free soul in the universe.

[10] SoG can guide its design and implementation, but not specify the detailed engineering decisions.

Tools

Personal Knowledge Container (PKC)



I. Tech for Trust

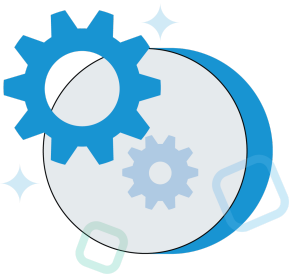
SoG needs a Technical Instrument to Build Trust

Personal Knowledge Container (PKC) is a self-administered knowledge management solution that addresses the problems caused by information asymmetry as diagnosed by the Science of Governance (*SoG*). PKC is created to show that it is technically feasible and economically viable to enable individuals and small organizations to process data in a timely, accountable, and observable manner in ways that are similar or equivalent to systems only affordable by large-scale organizations. It can be trusted, because it is open, transparent, and most importantly operated and owned by persons who generated the data from the source. PKC chooses currently known technologies that allow data providers to contain the right to govern at the origin of data, so that its technical architecture is trustworthy.

PKC is a technical solution that addresses the political problem of data ownership. By making data processing technologies available to the masses through open-sourced and freely distributed PKCs, this technical instrumentation should help reduce technologically or economically induced information asymmetry, and therefore build trust amongst society participants.

As Blockchain and Smart Contract related data infrastructures become increasingly mature, the features of geographically-dispersed collaborative workflow as promised by the so-called “Web3.0” programming model has already been incorporated into PKC.

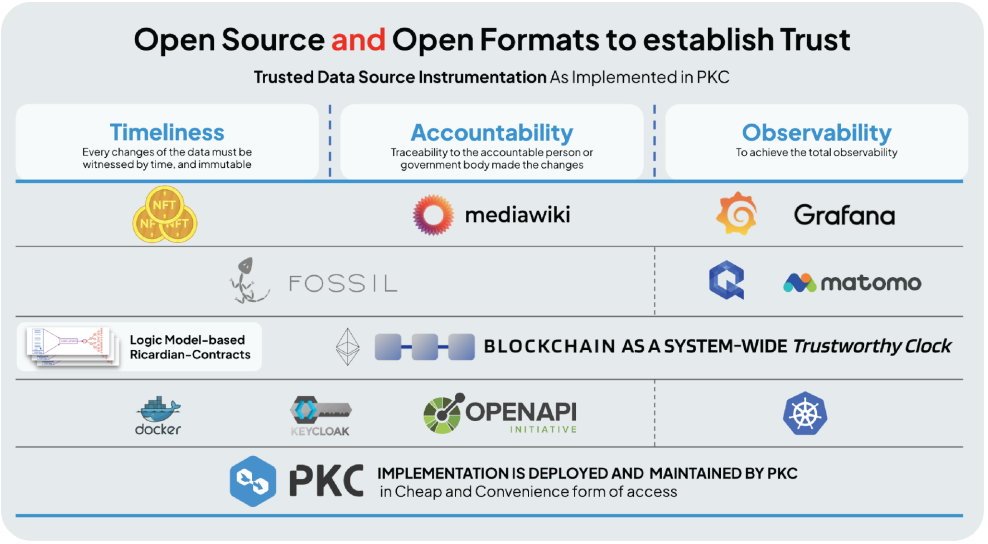
The increasing adoption of digital payment systems and publicly registered Data Assets, commonly known as Non-Fungible Tokens (NFTs), makes the case that Internet-scaled marketplaces could be designed and deployed by grassroot startups. Since the public deployment of Ethereum in 2015 as a “programmable blockchain”, many of the highly publicized online economic events have been conducted by rules encoded in machine executable contracts. This also gave birth to the field of Cryptoeconomics, an area of digitally transformed economic activities that are usually associated with Decentralized Finance (DeFi) applications. The lack of an Internet-scale regulatory framework to govern these economic activities is another kind of information asymmetry that favors communities with better access to data processing technologies. By bundling Blockchain-compatible services and Smart Contract deployment capabilities in PKCs, it reduces the unfair advantage that is biased toward people who have the resources to participate in these newly minted economic activities. PKC as a general-purpose data and computing service container also allows more people to participate in these online marketplaces with a wider range of asset classes. To contextualize the design intent, PKC is not just a specific data manipulation tool designed for Information Technology professionals, it is a stack of governance technologies that addresses the evolving needs of large-scale online interactions.



II. Processes and Resources

Only manipulate data assets in Open and Exchangeable Formats

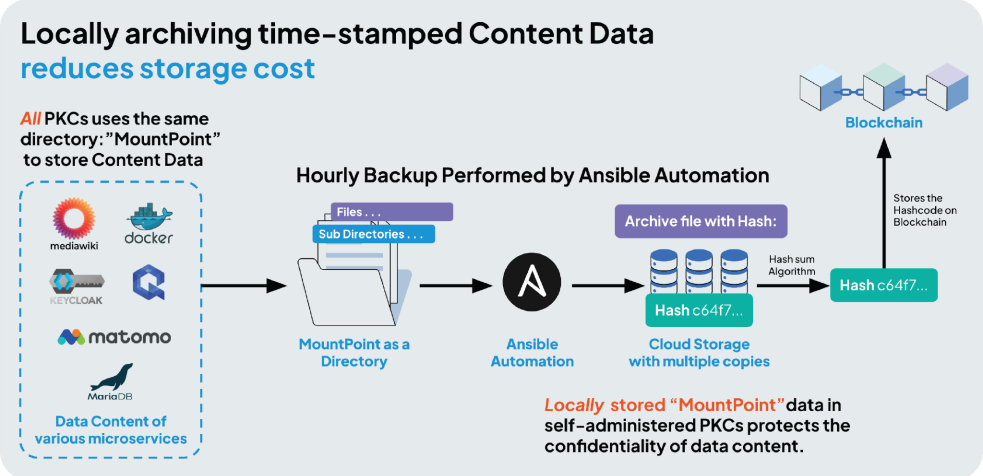
To ensure trustworthiness, the source code of PKC should not only be open-sourced, it is even more important to be compliant to open and exchangeable formats. The following diagram shows the open-source solutions adopted as the key functional elements of PKC.



The more interesting part is the notion of open and exchangeable formats. A format is open if the encoding structure and the metadata regarding the structure is transparent and well-documented. One such technical effort to ensure openness is called Open API, originally the Swagger API project. It forces all computing services to produce results in JSON formats (human readable), and offers a set of web-based graphical user interfaces to expose the metadata and allow data extraction and data submission to be operable through standard network requests. PKC adopts Open API protocol by exposing data content in the MediaWiki database. The other services such as Keycloak and QuantUX already have native implementations of Open API.

PKC connects Web3 to the Cloud Native Industry

The enablers in distributing these technology building blocks is not new. It has been a massive social and economic movement in the making for at least 30+ years. The most relevant technologies include software container technologies such as Docker, container orchestration technologies such as Kubernetes, and OpenShift Framework for standardized Continuous Integration and Continuous Delivery (CI/CD) tool chain. These software integration efforts are not only free, but they have abundant tutorials and community practitioners that can help create fully functional distributed data centers with near-zero software development cost. In terms of hardware infrastructure, PKC is designed to reduce the cost of data ownership by using commodity hardware solutions to enable remote and low-cost communication services, such as Wifi Mesh, and 3~5G access points. By localizing personal data storage, one may choose to only store the hash code of a large data set to Blockchain. This "layered" solution of data storage would retain a mechanism to verify data content that must be tampor-free, while not having to incur massive costs of data storage on public blockchain.



PKC can also locally serve computing services with containerized microservices, therefore reducing large amounts of unnecessary network traffic across the public Internet, and therefore reducing network operations costs.

It is the collection of all these existing open-source technologies and commoditized hardware solutions that enabled the possible mass adoption of PKC. In other words, PKC is a technology stack for

trust-building that empowers individuals and agencies to exercise sovereignty over their own data assets in affordable ways. For example, when one needs to share a file with many potential downloaders, a solution is to store it in the IPFS format and naming scheme, so that it can be addressed across the Internet based on its digital content. PKC can include an IPFS service node as one of its Dockerized services.

NFT: Facilitate the Transfer of Governance Rights

Data formats also need to support exchangeability. A piece of data asset should be exchangeable in the marketplace by having a common set of annotation to denote its ownership and protect its content to be only editable by its owner. This can be accomplished by publishing/minting data assets as Non-Fungible Tokens (NFTs). Without going into the technical details of minting NFTs, the main obstacle of minting NFTs is that public NFT minting services all require upfront crypto currency payments. The good news is that there are public NFT minting and publishing services that require extremely low fees. NFT as a special kind of securely protected data content allows for many kinds of workflow security programming that was not feasible before. For example, one may transfer the ownership of certain rights, which serves as the condition to modify or authorize information in a workflow. So that decision-making accountability can be programmatically controlled using NFT ownership transfer. This is a critical feature in managing the governance practice in many organizations.

PKC allows for content filtering independent of outside influence

An important feature of PKC is the ability to filter data content based on self-operated content filters. The ability to control the data filters is not only useful for preventing children from seeing age-inappropriate content, it can also be used to actively filter and prioritize content beneficial to social, intellectual, and economic activities. Running a privately owned knowledge container such as PKC will enable individuals to search, organize, and store data content in ways that can be isolated from data surveillance technologies. Without a self-administered knowledge container, online content consumption is inevitably influenced by some external parties, which may not be desirable. The ability to independently configure data filtering options with minimal external influence is also an aspect of freedom of modern citizens. PKC serving the data filtering functions based on privately controlled computing services also enables a kind of law enforcement possibility that does not intrude on individual privacy.

Personal Knowledge Container (PKC)

III. Desirable Outcome

Egalitarian access to Data Processing Technologies

PKC implementation can be successful when it satisfies the following conditions:

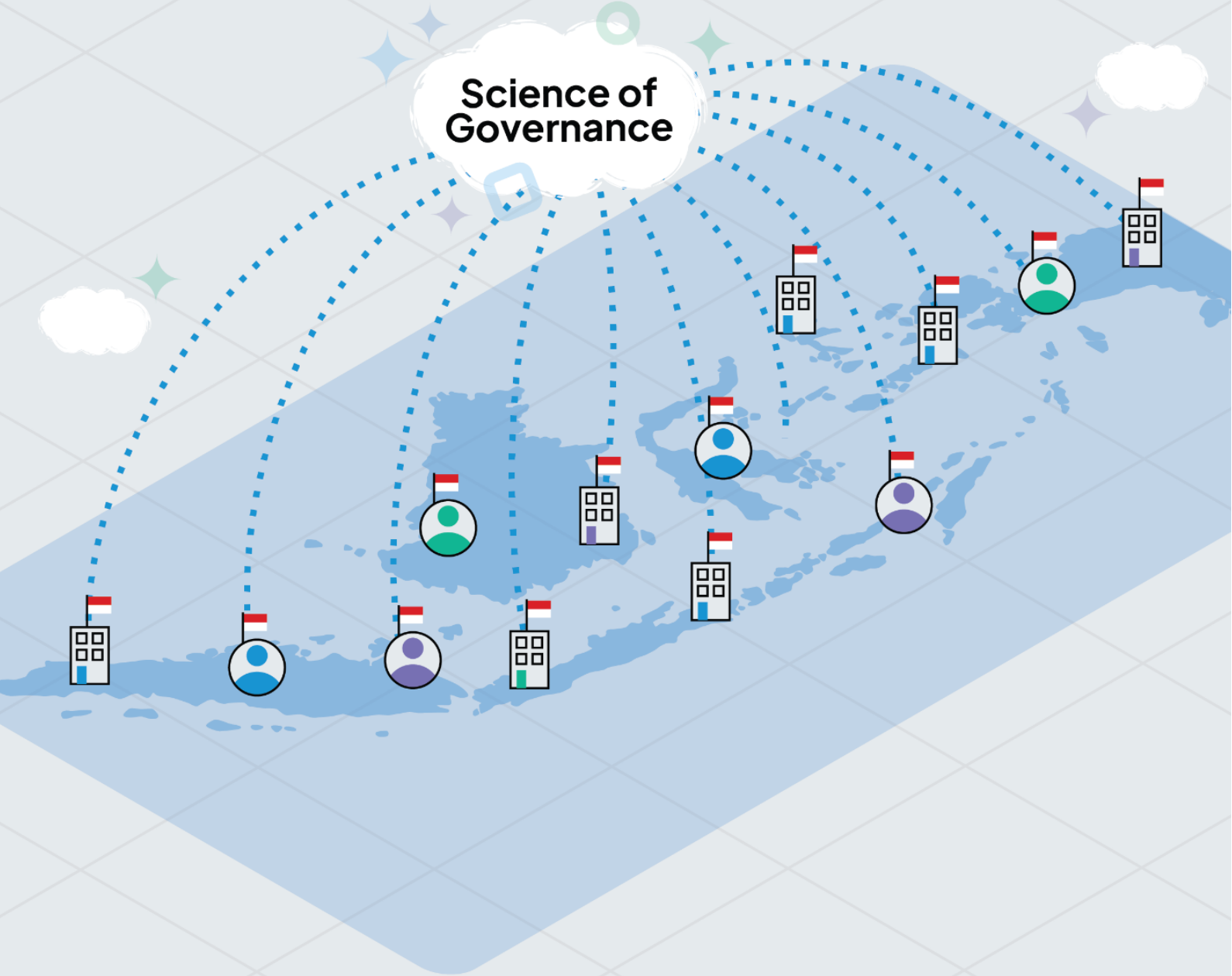
1. It should allow owners of PKC to collect, catalog, navigate, search, and process data assets using computing technologies that have been released to the general public as Open-Source and Open Format solutions. All chosen technical solutions should be affordable to the largest possible audience.

2. It must manage the change history of data assets by registering changes using various levels of technically secured (cryptographically verifiable) procedures, so that data assets can be traced to know at what time and by whom did the collection of data change. Therefore, it becomes technically possible to assign accountability, observe, and change outcomes with timely remedies.

3. It must encode knowledge in a Correct by Design (CbD) format, which should fit in logic models composed of human-readable text and relevant executable code. The operational experience accumulated from the execution of each logic model should also be recorded by PKC to provide feedback for future refinement of the logic model.

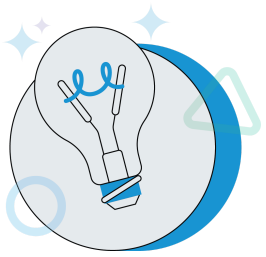
It is only after a wide enough population started to have egalitarian access to data processing technology similar to large tech companies, that the societal issue of information asymmetry could be systematically addressed. PKC is a technical solution to address this concern as prescribed by the Science of Governance.

Personal Knowledge Container (PKC)



Applications

Concrete SoG Examples



I. Applications

Concrete SoG Examples

SoG provides a rigorous framework for policy correctness, so that tedious and complex entanglement of interacting policies[11] and anecdotal events can be verified with the help of automatically executed algorithms[12] and big data. In other words, making policy changes learnable and accountable requires the realization of a PKC-based version control and content comparison/verification framework that analyzes government policies against a significant amount of real world events.

However, keeping event data in ways that both uphold the sovereignty of a government, while protecting privacy concerns of individuals is a technical dilemma. For instance, health data can still be accessed by savvy tech specialists if the raw data is stored in blockchain alone. This dilemma can be incrementally resolved with improved and well-engineered data security solutions, such as creating a unique hash code for the data and assigning them a Smart Contract. Operationally effective and legally accountable data management systems require continuous improvements in the technological infrastructure of the governed geographical regions, as well as the technical literacy of local citizens. To ensure educational equality, data-intensive literacy and technical knowledge, such as skills and awareness of Continuous Integration and Continuous Deployment (CI/CD),

[11] See C.A.R. Hoare's *Communicating sequential processes* in Works Cited.
[12] See Koo et al. "Algebra of Systems as a Meta Language for Model Synthesis and Analysis" in Works Cited.

should be embedded in the educational curriculum for all citizens under the movement of Digital Transformation. Based on this observation, we have the following propositions:

a. SoG-based Curriculum and Dissemination

To practice ***SoG***, the professional user needs both the body of knowledge (the curriculum) and a publicly accessible data infrastructure. This will reduce the entry barriers of public data to all societal members. In parallel, educational institutions must have evolving pedagogic approaches to strengthen operational learning. To propagate the knowledge of ***SoG***, a collection of relevant books, papers, and online articles will be continuously refined, compiled, and annotated under the direction of the G20 Professorship Program.

The data infrastructure allows for scalable distribution of content through network channels using the most widely accessible data formats and data presentation terminals, such as HTML5, Web3D and Smart/Ricardian Contracts[13]. The interactive data content should be displayable on portable computing devices. Student's learning performance should also be recorded, analyzed, and protected[14] for their personal growth purposes. A collection of interactive models and executable specifications should be assembled in order to facilitate the learning of open formats.

Online virtual 3D laboratories connected with remote laboratories and data from physical laboratories can play a big role in federated online research[11]. That way it will be a domain independent research center for anyone who wants to contribute. The data will be secured through the PKI-based blockchain.

Pedagogically, the Gasing method[15] will be applied to experiment, summarize, and integrate ***SoG*** body of knowledge and data infrastructure, so that it can be orchestrated within school environments and create a self-reflexive (CI/CD aware) curriculum

[13] See Code is Law by Lawrence Lessig in Works Cited
[14] This is the idea of the SoulBound Token, as Vitalik Buterin articulated in Works Cited
[15] Gasing method is an educational framework originally created by Prof. Surya that has proven to work at scale and with a wide range of student capacities. See references on Gasing Method in Works Cited, Gasing Method is being practiced with Indonesia's Presidential Scholarship Program and training camp being supported by Yuan Xun's work on the concept of Nucleus of Computing.

based on data-intensive evolving evidence from the real world. The end goal is to practice the use of individually-operable data instruments[16] and self-administered knowledge content to enable everyone to own their personal data assets.[17]

b. Social Governance Applications

Government agencies should systematically identify areas of applications to apply ***SoG*** by enhancing data transparency while protecting natural security and privacy rights of its citizens. Currently, LKPP (National Procurement Agency), and Digital Nomad Visa Programs[18] organized by Immigration office are just two examples.

In a neighboring country, Australian Digital Transformation Agency (DTA[19]) is trying to deliver the strategic outcomes with more human centric, sustainable, and easily accessible digital government services for the people, businesses, and the government addressing the issues of data security, privacy, trust, transparency, and governance. A cross-ministerial platform such as myGov is an excellent example of similar efforts. Indonesia will seek to collaborate with the Australian government to refine the practice of ***SoG***.

c. Educational Governance Applications

SoG needs to be learned by educators and school administrators as a new leadership skill. This means traditional disciplinary-based departmental administration boundaries must be adjusted to accommodate the intellectual revelation since the explosion of connected data[20]. Education administrators and school teachers must refresh their mindsets about what teaching and learning should be in this modern age. A new kind of school and schools that train educational governance practice must be created. We propose to create such a pioneering institution in Bali to train educational institution leaders on the subject of ***SoG***.

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[16] A proof of concept of such a data instrument has been built by Sir Tim Berners-Lee, see Works Cited, and one other implementation is available here.
[17] See reference programs by Mizanul. Chowdhury's Proposals in Works Cited.
[18] See Bali Digital Nomad Visa in Works Cited.
[19] See Digital Government Strategy in Works Cited.
[20] See dev4x.com Website as shown in Works Cited.

d. Next steps before the G20 in 2022

To launch the *SoG* as a governance policy initiative during the 2022 G20 meeting, we must:

1. Engage global opinion leaders in creating an *SoG* **Proclamation**, which will define the goals and direction of the initiative. This document will be minted as an NFT and will allow programmable transfer of governance ownership.

2. Work with the **next G20 host country**, India, to announce an ongoing G20 Professorship office, which will serve as the office to provide the stewardship of the Intellectual and operational efforts.

3. Create a sample **knowledge sharing website** to share data and content knowledge with all interested parties of *SoG*. It should also provide reference material to existing and similar efforts that have been created in related fields.

II. Proposed Actions
after G20 in Indonesia

To operationalize the *SoG*, we need to enable the following actions and associated resources:

1. Creating an institution, initially called the ***G20 Professorship Program***, which will invite world leading experts in various fields to collaborate and formulate the foundational scientific questions and solutions of *SoG*.
2. Working with educational institutions (universities, educational ministries), to develop strategies and programs in **disseminating knowledge of *SoG***. This would include political and scientific literacy for the young. It would also provide a trans-disciplinary body of knowledge for transfer agencies to educate government officers and educational institution administrators.
3. Working with regulatory bodies, global technology standard institutions and data instrument (semiconductor) manufacturers, to organize **standards/formats setting consortiums**, and set up ethically aware and interest-neutral standards.
4. Assembling early technology contributors, to build ***Proof of Concept*** prototypes to demonstrate the feasibility of *SoG* solutions.
5. Mobilizing Indonesian government agencies (e.g. ***LKPP* and *Immigration Office***) to plan for their internal digital transformation activities. Provide training courses and present data-intensive solutions to leaders of these agencies to become aware of possible options in improving their internal operational and governance efficiency.
6. Work with talented people (including digital nomads) and opinion leaders to create ***broadcast quality media*** content (video and websites), endorsed and spoken by leading government officers (ideally, the President and the Coordinating Minister) to articulate the strategic value and long term impact of *SoG* to Indonesia and to the world.

III. Summary

The success criteria must make *SoG* not only be scientifically sound[21], but also be practically operable. To satisfy these two potentially contentious criteria, we need to inclusively consider competing scientific methodologies[22], deploy trustworthy data-intensive platforms for all to collect, and compile operational data to an actionable body of knowledge. Then, we must convert operationally tested wisdom into industrialized protocols/communication formats that safeguards the interactions amongst political entities under governance.

[21] The notion of Soundness, Precision and Terminability is articulated by Patrick Cousot in his work on Abstract Interpretation in Works Cited.
[22] See "Einstein and Chomsky on Scientific Methodology" by Raymond Dougherty in Works Cited

Overall Summary

The Science of Governance (*SoG*) is our answer to the growing problems of information asymmetry and technological complexity caused by the accelerating Digital Transformation. These problems plague social justice and destabilize political structures. Due to its abstract nature, *SoG* is a neutral theoretical foundation to help innovate and improve global governance while employing Tech for Trust (TfT) to solve the world's problems and serving as a concrete global "clock." The success of *SoG* depends on the following aspects: assessing governmental practice via time-stamped data, using an open-format, domain-independent, and scale-free methodology, providing a trustworthy and inclusive data infrastructure, and ensuring and utilizing secure data protection protocols to protect privacy. Key to *SoG* is the wide distribution of the Personal Knowledge Container (PKC).

PKC is a tool that gives agency to every being on Earth to create and store knowledge and values with little entanglement. Through adopting the Correct by Design (CbD) notion using Hoare Logic, PKC can facilitate secure knowledge storing through treating all data as NFTs and through the execution of Smart Contracts, which are transparent by their technical nature. PKC is designed to make high-powered data security instruments free to independent agencies; it can be independently configured to filter data and security breaches, reducing potential safety hazards. It can utilize publicized knowledge through Smart Contracts or NFT exchanges. It will provide feedback and operational experience to improve Smart Contracts, cataloging data assets, implement software, and instill CbD knowledge content through hyperlinked Logic Models.

SoG needs to be applied through creating a ***SoG***-based curriculum and dissemination, applying ***SoG*** through social governance and educational governance, and must be created as a governance policy initiative during the 2022 G20 meeting. To operationalize the ***SoG***, a G20 Professorship Program has been created, and this document is its first public offering. Education bodies should also develop strategies and programs in disseminating knowledge of ***SoG***. Training courses and data-intensive solutions on the subject are given to leaders of government agencies to improve their operational and governance efficiency. ***SoG*** shall also work with regulatory bodies, global technology standard institutions and data instrument (semiconductor) manufacturers to organize ethically aware and interest-neutral standards. ***SoG*** also needs to assemble early technology contributors to build ***Proof of Concept*** prototypes to demonstrate the feasibility of ***SoG*** solutions. Finally, ***SoG*** should be articulated through widespread websites and videos around the world.

It is time for us to share freely available data processing technologies to reduce technology-induced information asymmetry, and ***SoG*** will spur the fight that will lead to a better future for everyone.

Acknowledgements

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Appendix

Logic Models as Multi-Level Hoare Triples

Logic models describe the chains of causes and effects leading to an outcome. While many logic models use a four-step process (Input, Activities, Output, and Outcomes/Impacts), logic models can be turned into concise (one page) document, listing the abstract goal statements in a triple, called: Context -> Actionable Goal -> Success Criteria, and another triple called Input -> Process -> Output. This is structurally identical to a Hoare Triple, which consists of three things:

Pre-Condition → ***Command*** → ***Post-Condition***

A logic model is shown in the following example:

Logic Model (eCatalogue Smart Contract Logic Model) Template:LogicModel 11 2, 2022

Abstract Specification

Context	Smart contract that enable creation of one Product Catalogue.
Goal	Create one NFT of eCatalogue
Success Criteria	one NFT of eCatalogue is created with the transaction hash calculated

Concrete Implementation

Input	Process	Output

• Hyperlink to eCatalogue Product
• Wallet Address of the product owner:0xdd8...
	• Created one NFT with token number
	• Calculate the hash of the product page
	• Return transaction hash code of the NFT
	• Executable Source Code
	  • Berkas:MyNFT.sol
	  • Berkas:Bytecode.txt
	  • Inspect on Etherscan
		NFT's hash code transaction, with the owner of the NFT recorded into blockchain

Boundary/Safety Conditions of eCatalogue Smart Contract Logic Model

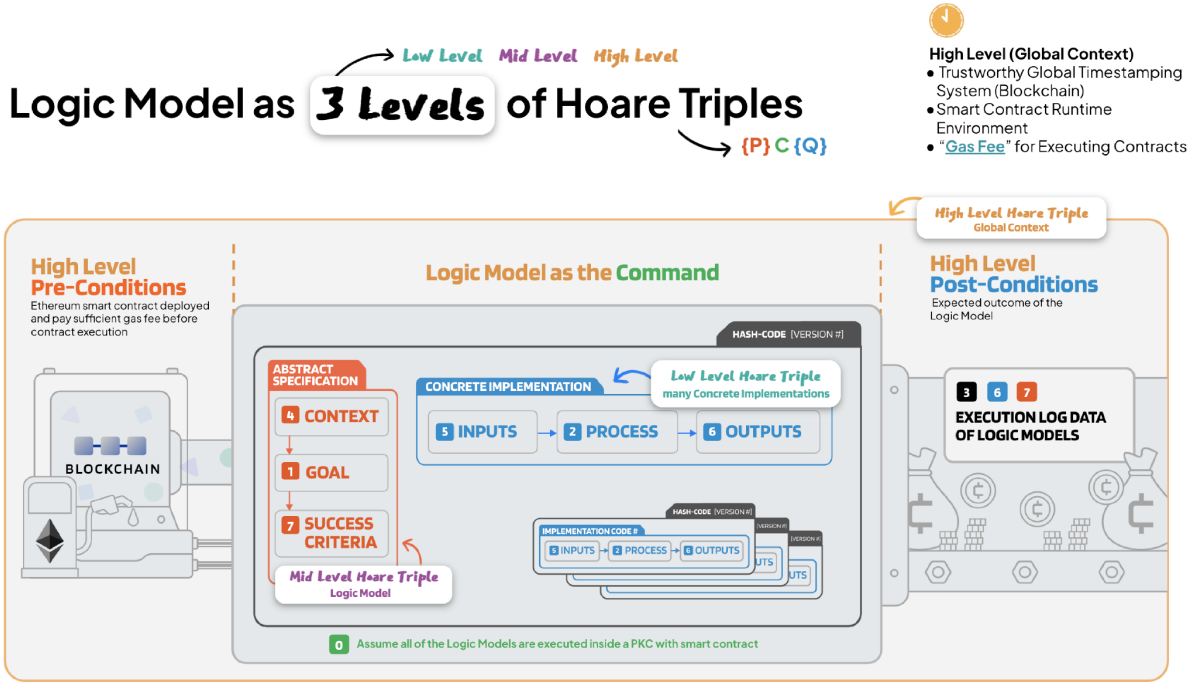
- Transaction will be failed if the wallet owner does not have sufficient gas fee
- URL must be reachable and have content
- Content must be validated with correct officials

A logic model can also be considered as a macro-structure, which can be condensed into a higher order triple:

Abstract Specification → ***Execution Plan*** → ***Boundary Conditions***

From a Correct by Design viewpoint, it is necessary to convert all structures into a Hoare Triple. Therefore, one can use the same data structure to capture all causal relations into these three data elements. The consistent format allows convenient verification and version control of these three types of information containers, and can be executed and validated using humans or machines.

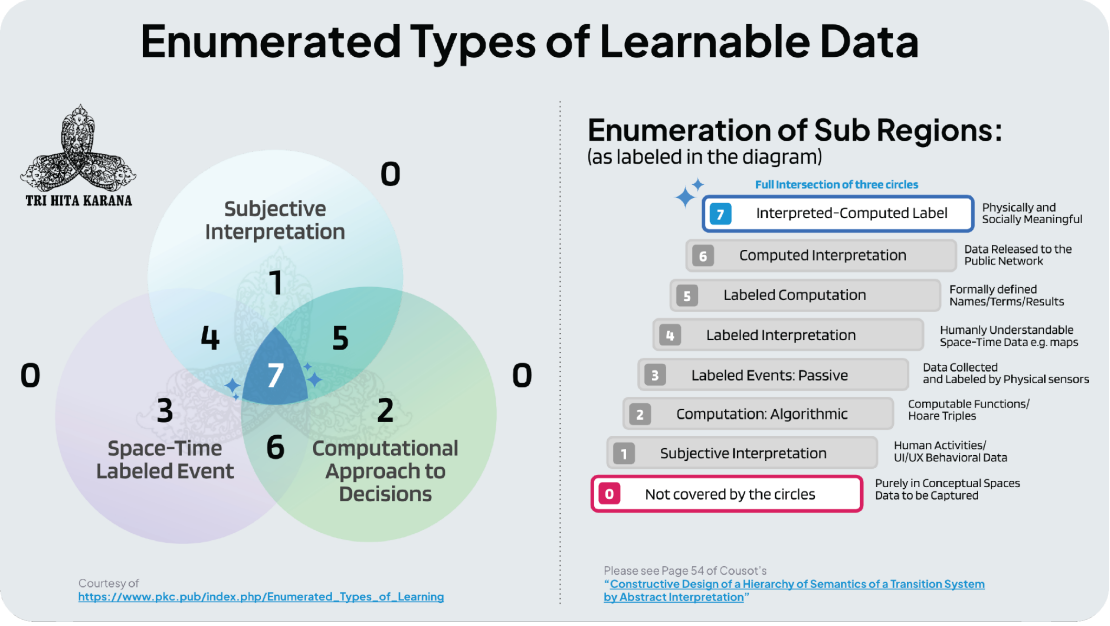
The idea of a logic model being composed of a multi-level Hoare Triple can be illustrated as follows:



The box marked Hash-Code contains two Hoare Triples. The left one is the ***Context→Goal→Success Criteria*** triple. The right one is the ***Inputs→Process→Outputs*** triple. It is the intention in the diagram to show that there could be many implementation approaches to satisfy abstract specification. Therefore, the diagram has many other entries for ***Inputs→Process→Outputs*** Hoare Triples. The overall logic model as a "Ricardian Contract" is shown on the top of the above diagram as a collection of Human Readable Text, Hash-Code entables bundled data, and a piece of Smart Contract code that can be executed by machines "reliably". The operation of such a "Ricardian Contract" would generate execution logs, and its anomaly or conditions that might break in any known or even known causes can be captured as a "Boundary Condition of Logic Model" and stored in a common data structure, similar to the notion of exception capture in modern programming languages. The three kinds of Hoare Triple, including the last one that is the "higher level" Hoare Triple, treating "Boundary Conditions" as a Postcondition, is a nested data structure that allows many different pieces of content knowledge to be composed of different instances of textual descriptions, executable code, and data type descriptions. This provides a mechanism to store and capture all kinds of enforcement mechanisms, which therefore can serve as a generic data container for information.

The numbers that marks these boxes, 4, 1, 7 for ***Context→Goal→Success Criteria***,

and 5, 2, 6 for ***Inputs→Process→Outputs***, can be found in the following Venn diagram:



Each of the numbers represents a "Namespace" that covers a different area of interpretive interest. The goal of this Venn Diagram is to help classify content knowledge in categorized namespaces that each lead to appropriate interpretive actions, so that knowledge content can be managed in a consistent manner, using appropriate computational or human interpretation approaches.

Also important to note is that a logic model/logic frame is a tool that is being used by many government agencies to express the intent and expected outcomes of government-sponsored programs. This short explanatory text and diagrams hope to present a path to organize traditional pen/paper content of the model to a digital storage medium that can be captured directly in tools such as MediaWiki. In fact the first screenshot of the logic model is an implementation of a logic model template in MediaWiki. In other words, the notion of using a logic model in a relational/hypertext oriented data storage is already feasible. With a proper set of tools, such as using Blockchain and Smart Contract to assign trustworthy timestamps and unique hash code to a Smart Contract, one can make information and contract execution

globally transparent in ways that traditional logic models cannot do. It will be a very pragmatic and powerful tool for governmental project management and control, since it will help easily track all kinds of changes in the logic model with access and links to many other kinds of digitized data content. In other words, logic models can serve as a human-machine front end to the full stack of Technology Stack for Building Trust (Tech for Trust).

Appendix

https://pkc.pub