Tokenize human heritage layer by Lay3rs.

Whitepaper v1.1

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Lexicon

ReFi

Regenerative Finance (ReFi) is a concept that relies on blockchain technology to create decentralized financial systems designed for their positive externalities, whether financial or nonfinancial.

It aims to democratize access to financial services, make the financial system more transparent and equitable, and provides opportunities to fund preservation initiatives. It leverages the possibilities offered by blockchain technology to apply them to use cases that have an impact beyond their own model and community.

This mechanism is not simply a business model, but a deep commitment to the interweaving of the digital and physical realms in a symbiotic relationship. In championing this approach, Lay3rs is not only a pioneer in the digital sphere, but also firmly anchors its responsibilities in the original establishments.

Supported Cause

In the digital twin model proposed by LAY3RS, "Supported Cause" refers to an organization or initiative that stands to benefit directly from the revenues generated by digital twins. Each time a digital twin is created and monetized; a predetermined portion of its total revenues is systematically redirected to its corresponding preservation organization(s).

These organizations exist exclusively to preserve, protect and revitalize an original human heritage of which the digital twin is a reflection.

Digital Twin

The digital twins created by Lay3rs consist of raw data and generated data, derived from various types of captures (geolocated point clouds, photogrammetry, videos, acoustic maps, etc.) or archives. These data allow us to aggregate an increasingly large and precise set of data over time about a monument to be preserved. These data are then assembled into an extremely accurate but complex and heavy global 3D model. It is then semantically segmented to isolate all parts of the monument (architectural elements, objects, textures, etc.).

Thanks to blockchain technology, the aggregated data will create the largest and richest library of resources on monuments worldwide, serving as a permanent archive beyond the natural or human risks that threaten cultural heritage every day.

Exports

These subsets of data are optimized and packaged for specific digital creations and business processes. These ready-to-use models are called Exports, and it is these elements that are distributed to creators in the form of exploitation licenses. Over time, they generate value around the digital twin.

There are numerous applications that benefit from the creation of Digital Twin Exports. Firstly, this faithful reproduction serves as an ideal tool for scientists and architects in their preservation and maintenance missions for monuments.

The emergence of virtual or augmented tours, as well as services in AR, VR, or MR, rely on digital twins to immerse users in an environment or enable spatial orientation in the absence of GPS signals, for example.

Two major entertainment industries, film, and video games, utilize many 3D resources derived from reality captures to anchor their creations in a meaningful environment. The different Exports from the digital twin can be used for visual effects in movies or as real-time 3D assets in video games.

NeRF

Neural Radiance Fields, or NeRFs, are a recent deep-learning technique in visual computing that allows 3D scenes to be represented using neural networks.

At the heart of NeRF is the idea of representing a 3D scene not as a set of surfaces or voxel grid, but as a continuous field of light flux emitted, reflected or transmitted (radiance). It's a bit like imagining that the air around us is filled with tiny particles that have color and brightness properties, and these properties change depending on where and in which direction you look.

Dynamic Archive System

This system is a way of implementing and compiling data constantly regarding a digital twin.

In that sense we never stop gathering data to offer a larger and larger range of Exports with more and more precision.

XR

Extended Reality (XR) is a broad term that encompasses Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR).

- Augmented Reality (AR) is a technology that overlays digital information, such as images or data, onto our view of the real world. For example, an AR application could display information about a monument when you look at it through your smartphone screen.
- Virtual Reality (VR) is an immersive experience that places you in a completely digital environment. With a VR headset, you can look around and interact with a virtual world.
- Mixed Reality (MR) is a combination of the previous two. It allows you to interact with virtual objects placed in the real world as if those objects were present.

XR technology aims to combine or reflect the physical world with a digital twin capable of interacting with it. The fields of virtual reality and augmented reality are rapidly growing and are applied in a wide range of industries, including entertainment, marketing, real estate, training, and remote work.

Fungible Token

A Fungible Token is a type of cryptographic token that is interchangeable with other tokens of the same type. This means that each unit of this token type is identical to every other unit. Fungible tokens are often used as currency because their interchangeable nature makes them useful for transactions. Examples of Fungible Tokens are USDT (Tether), UNI (Uniswap) or MANA (Decentraland). Each USDT is, for instance, identical to every other USDT; they all have the same value and can be freely exchanged with one another.

Non-Fungible Token

A Fungible Token (NFT) is a type of cryptographic token that is unique and non-interchangeable with other tokens. Each NFT has information or attributes that make it different from other tokens, which can give it a different value. NFTs are often used to represent ownership of unique digital assets such as digital artwork, digital

collectibles, and even virtual land parcels. An example of an NFT is CryptoKitties, where each cat is an NFT with unique attributes.

DAO

A decentralized autonomous organization (DAO) is a form of organization that is managed by rules coded as smart contracts on the blockchain. A DAO is collectively owned and controlled by its members, rather than by a single entity or a small group of individuals. In a DAO, all decisions are made through consensus or voting, with each member having a proportional vote based on their ownership stake in the organization. The governance rules of the DAO are encoded on the blockchain, which means they are transparent and immutable.

DAOs can be used for a wide range of purposes, from managing digital assets to organizing collaborative workgroups. They are designed to be fully transparent, thereby avoiding issues of corruption and conflicts of interest that may arise in traditional organizations.

IDTO

The initial Digital Twin Offering corresponds to the moment it is published on the platform Build3rs.

It means that the Pool DAO can start gathering Lay to develop the digital twin concerned.

Milestone

A Milestone is a stage in the development of the digital twin. It is structured into several batches of data to be acquired or Exports to be created, enabling the digital twin to be developed in a relevant way. It is from these batches that the Data Hunting missions will be created.

It may be financed directly by the smart contract project or give rise to a new call for external contributions in LAY. In this case, a call for contributions will be made directly via the tools offered on the Lay3rs platforms.

Pooling

is the name given to the mechanism of gathering resources of any kind (money, opportunity, data, etc.).

This system enables anyone to get their fair share regarding its participation in the creation and development of the digital twin.

Data Hunting

Data Hunting represents all the different models allowing a DAO pool to gather external datas and detailing at which conditions. Those datas will be use to grow the digital twin ressources and produce new Exports.

Manifesto

We live in an era of digital transformations that are both rapid and profound, where blockchain, extended reality (XR), and artificial intelligence (AI) technologies are constantly redefining our relationship with distance, time, knowledge, and society.

In parallel to these technological advancements that propel us into the future, current events regularly remind us of the fragility of humanity's heritage, that precious link to our past, even paradoxically when it is centuries old.

In fact, due to:

- Human actions and mistakes
- Natural disaster
- Effect of time
- Inaccessibility for geopolitical purposes

Human heritages such as Notre-Dame Cathedral, the Göbekli Tepe or the Palmir temple, among others, are all at risk of disappearing from future generations. It is essential to preserve what has been, ensuring the continuity of human culture and civilization.

Furthermore, as technologies reshape human societies, concepts and philosophies, the historical and cultural impact of the priors is growing dominant especially in a quantitative way. Preserving a maximum of timeless human heritage that made us unique with the help of innovating technologies would be one of the ways to cohabite with future silicon-based lives.

The Napoleonic expedition to Egypt has provided us with engravings, sketches, and later, photography, laser measurement, photogrammetry, and so on. The creation of archives of the past has followed technological evolution, continuously enriching and refining these traces so that they can be used by others for study. We are now at a turning point in a new technological leap.

In the case of Notre-Dame Cathedral, renovation work was greatly facilitated by the creation of its digital twin, which aggregated various previous captures. Another case is the Palmyra, where artificial intelligence was employed to virtually reconstruct the ruins, simulating the trajectories of each fallen block on the ground.

Given the relevance of such use cases and the observation of the fragility of these elements in an increasingly volatile context, it is urgent to archive the most precious aspects of our world. This will ensure that these cultural building blocks remain accessible to future generations worldwide.

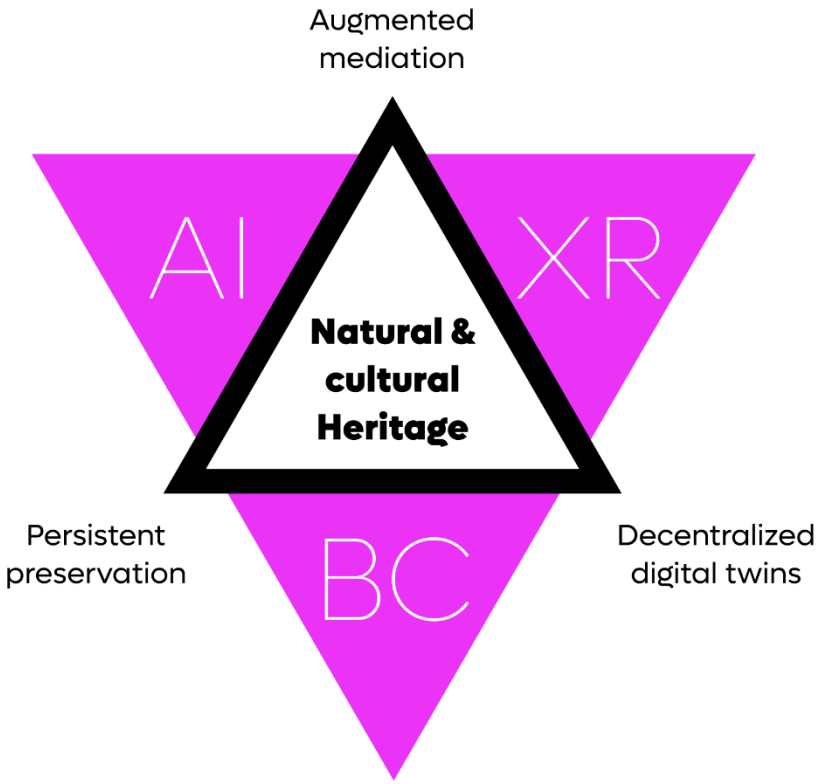
We will leverage technology to overcome challenges and make knowledge accessible to everyone today and in the future. AI will be used to reconstruct digital twins of what

is most valuable to those committed to preservation. We will create accurate digital replicas of existing, destroyed, or lost historical sites and artworks.

Blockchain will provide a transparent and secure infrastructure to ensure the persistence of digital twins' data, crucial for long-term preservation and independent of third-party operated services. Its decentralized nature will enable new forms of public engagement in preservation, establishing digital twins as a common digital good.

Different forms of extended reality (AR, VR, MR) will enable people from all backgrounds to discover and interact with cultural heritage in personalized and immersive ways. Extended reality will serve to broaden access to culture while simultaneously reducing its environmental impact associated with transportation and the preservation of physical objects.

By combining these technologies, we can create powerful tools for the sustainable and environmentally friendly preservation and valorization of human heritage.



Problems that Lay3rs seeks to solve

Fragility of heritage and archives

By nature, both natural and human heritage, as well as the archives created from them, are constantly under threat from time, natural disasters including climate change, and the consequences of human activities, be it economic, urbanistic, or conflict-related such as wars. It is crucial to find effective and sustainable ways to preserve these precious elements for future generations.

Funding heritage preservation

Funding is a major challenge for heritage preservation, regardless of its forms, and the means to secure funds for preservation institutions are often limited. In France, for example, a historical monument can rely only on public assistance, ticket sales, and marginally on sponsorship and events. While this equation may still be relevant for major monuments, what about lesser-known architectural works that are more difficult to access or not suitable for public visits? With such crowd-appealing power, history and nature can create much more value.

Lack of value creation in traditional heritage preservation system.

Following the previous problem of funding, there is an emerging concern regarding the sustainability of current practices. Many efforts in historical preservation, while well-intentioned, often struggle to develop a robust economic model that ensures long-term viability. This challenge highlights the necessity for innovative approaches to value creation within the sector.

Anchoring and authenticity

Historical-style 3D models are flourishing in marketplaces. However, too often, they are merely a fantasy of what a historical or natural subject could have been from the perspective of a 21st-century creator. Much of the subject's richness is lost in this

reinterpretation. To move towards increasingly immersive virtual environments, it is essential to anchor them in plausibility by incorporating elements that are ever more meaningful.

Digital twin mass creation

The European Union has understood the importance of preservation and, in a 2021 report1, urged its member states to create 16 million digital twins2 of their architectural historical heritage by 2030. However, after 2 years, only thousands of these creations have been made. It is therefore urgent to take action to make this ambition a reality while also considering not only the archival aspect but also the dimensions of economic models and the usage of these twins.

Sustainability

If we consider the risks of disappearing elements or places of our cultural or natural heritage, the question of their archival becomes crucial, whether for their preservation, transmission to future generations, or non-destructive digital exploitation. Blockchain technology, although still imperfect for storing heavy data, opens highly relevant possibilities, thanks to the principles of decentralization and redundancy, allowing this digital heritage to be stored permanently and independent of a public or private organization. Efforts are still needed to address the ecological impact and speed of data access.

Accessibility and engagement

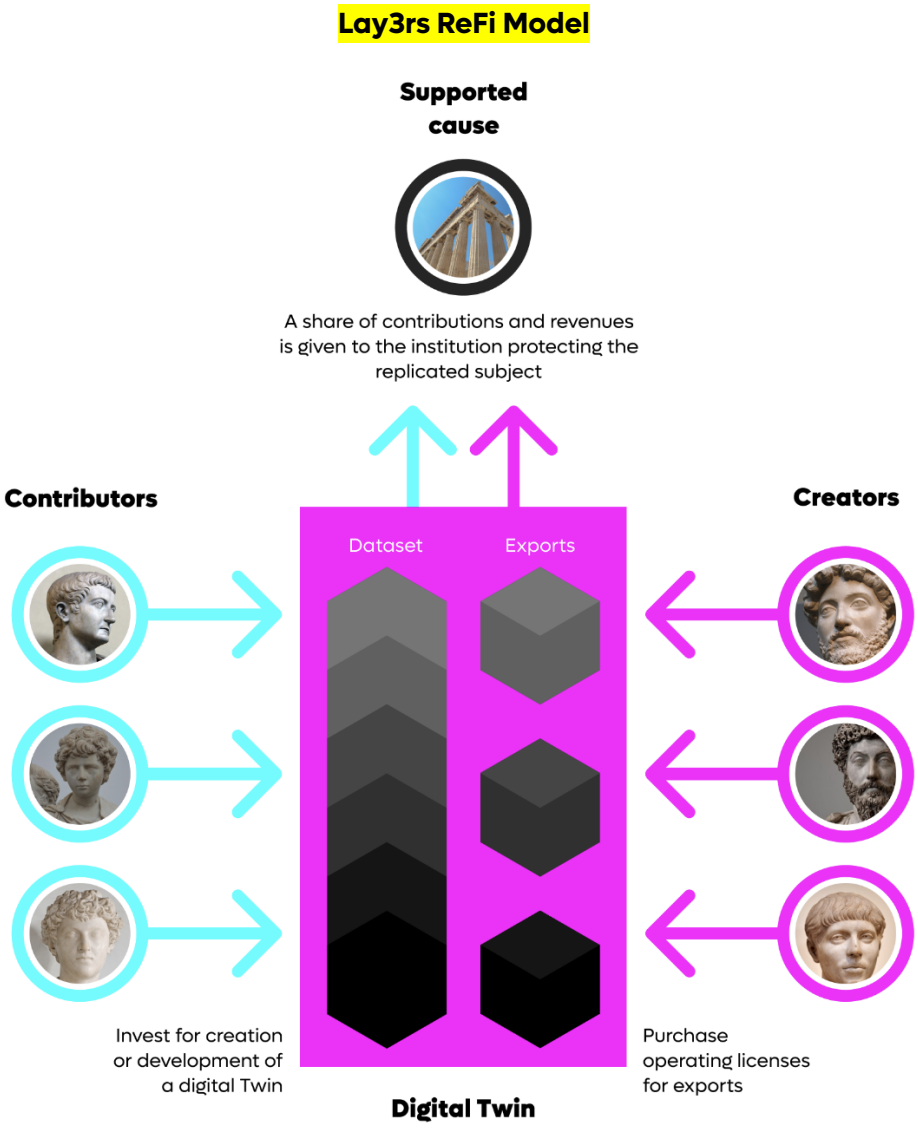
Over time, the understanding of accessibility in our society has changed. What was once purely a physical concept has now become cognitive and sensory. We must not only provide physically accessible buildings for everyone, regardless of their physical condition, but we can and should also build digital worlds that ensure access to culture (architecture, sculpture, painting, museum visits, etc.) regardless of the country we live in, our economic resources, or our physical condition. While access to cultural and natural heritage may seem like an inalienable human right, it is a privilege reserved for a few. Access to this heritage comes with economic, social, and ecological costs that inherently limit its accessibility.

[1] https://drive.google.com/file/d/166pdEIktbOtDvTuMRnQWCGB1ez9aruXU/view?usp=drive_link
[2] https://drive.google.com/file/d/1l1qCMvmciqhcAi2_cS8f4Un_EeBuRDML/view?usp=sharing

Similarly, the opportunities for individuals to engage in the preservation of this heritage are limited. In this context, it is necessary to empower the public (both existing and new audiences) in their actions of discovery, learning, conservation, and preservation.

The Lay3rs solution

To address these various and complex issues, Lay3rs assumes that part of the solution lies in empowering stakeholders (preservation institutions, digital creators, and communities) with the organizational and technological means to contribute to common projects. It is through this collaboration that new alignments of respective interests and concrete solutions to preservation, conservation, and mediation problems will emerge.



The ReFi model is an alternative to current financial systems, which operates in an extractive and exploitative manner. The aim is to develop an ecosystem model that enables the circulation and rebalanced distribution of value to the various stakeholders who contribute to a project within the company.

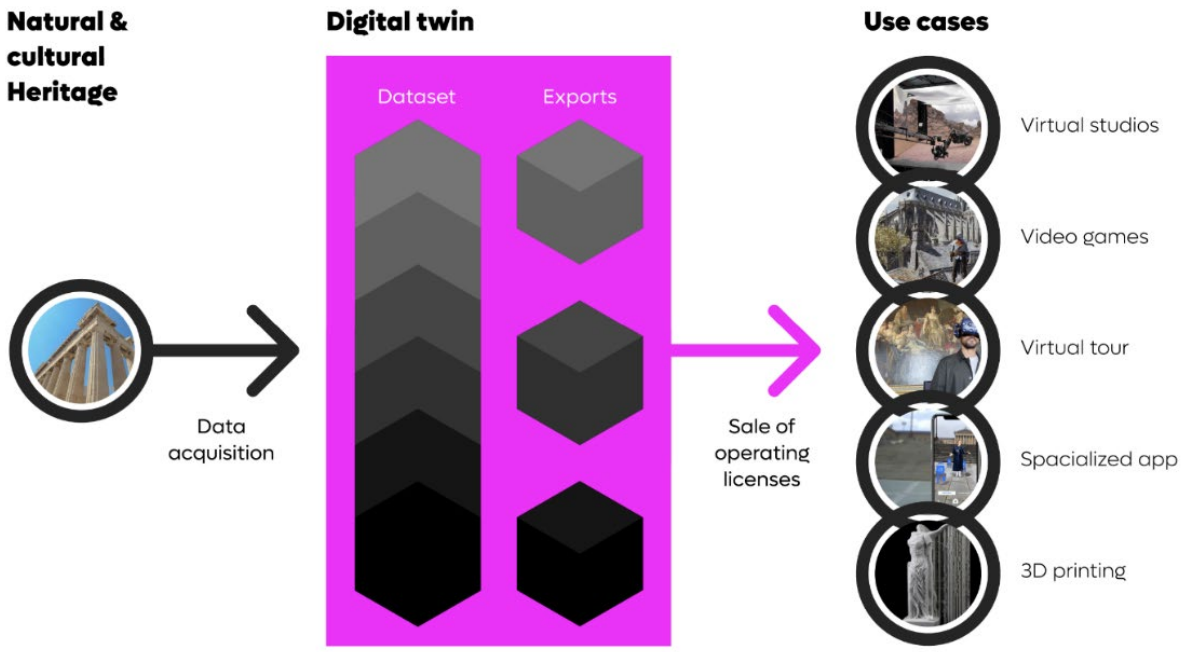
The Lay3rs project fully aligns with the ReFi ideology for the following reasons:

- Providing an additional source of income to institutions responsible for the preservation and promotion of cultural heritage in all its forms. These foundations will be able to benefit from rewards generated from the sales of exploitation licenses related to NFT Exports, enabling them to have a larger budget for renovation or the creation of new mediation initiatives.
- Improved transparency and fair distribution of value to creators of 3D Exports and datasets, through the automated payment of rewards after each sale.
- Offer a virtuous model, with inclusive dimensions for different types of contributors. Each LAY holder will be able to participate in projects at his or her own level (strategic orientations, data contribution, Milestone support, etc.) and be rewarded.
- Securely recording and timestamping each digital twin's data and history, preventing unauthorized alterations and providing a transparent and immutable record of their existence and changes over time.
- Make this archive available to everyone through libraries of digital twins and Exports derived from them.

We are convinced that digital twins are particularly relevant digital assets, around which, the contributions and benefits of these different types of actors can be coordinated. This coordination of actors and the distribution of value recalls the principles developed by Nobel Price Elinor Ostrom in her book "Governing the Commons" published in 1990 and, more broadly, in all her work on the commons.

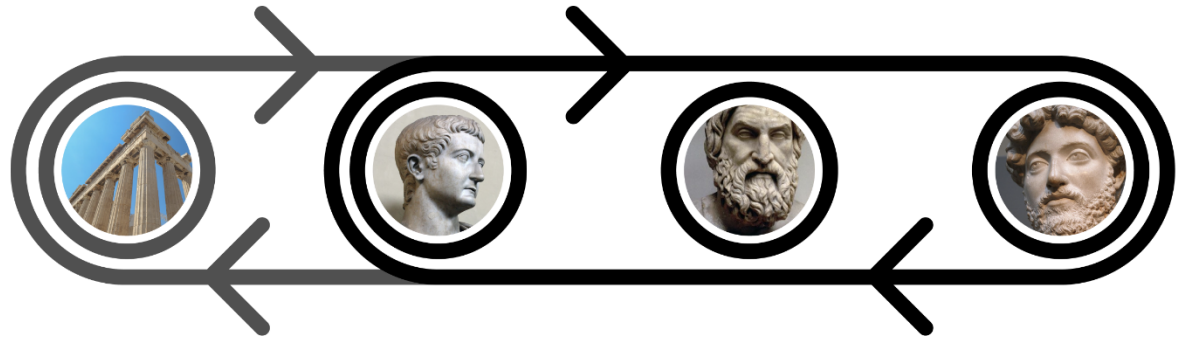
By extending her reflection, we can acknowledge that human heritage belongs to all those who wish to contribute, and that its digital twin, resulting from the collaboration of stakeholders, can be considered a digital common good.

From Heritage to Use cases



Participants roles

Lay3rs is an open ecosystem to all types of stakeholders: individuals or legal entities, public or private. Within the ecosystem, each type of stakeholder can play single or multiple roles to contribute to the development of single or multiple digital twins.



Supported cause

They work to preserve our physical heritage and bring their brand image to our digital twin.

Contributors

They guide the development of the digital twin and support its financing.

Data or code providers

They provide data to be aggregated in the digital twin, or code to enable specific exports creation.

Creators

They purchase export licenses for use in all types of digital creations

Products description

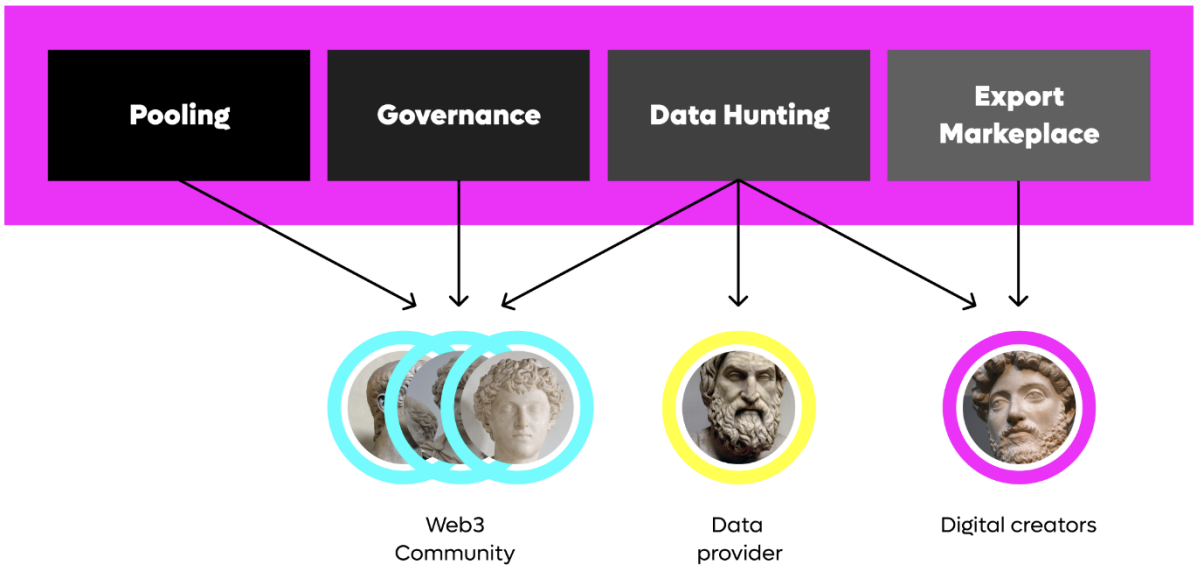
Types of products offered by LAY3RS

Lay3rs products

1. Platforms

Lay3rs develops, deploys, and enhances various platforms that are based on a financing mechanism for the creation and development of digital twins using Pooling, decentralized governance of each twin by its contributors, and the broadcasting of licenses through the sale of NFT via smart contract.

Lay3rs platforms features



We plan to develop several platforms dedicated to specific types of heritage and their user communities. These platforms may be carried directly by Lay3rs or by partners (public or private preservation or archiving institutions). This will enable us to continuously expand the use cases for the LAY token, to contribute to the preservation of a growing variety of heritage subjects and to respond to the technical specificities associated with the intrinsic characteristics of these subjects.

The first platform, Build3rs, focuses on historical monuments, and has launched its alpha testnet version on September 15, 2023.

In addition to these platforms, we envision the creation of a desktop tool that aggregates the Export libraries from different platforms, making them simultaneously accessible to creators in the most integrated way with their workflow and tools.

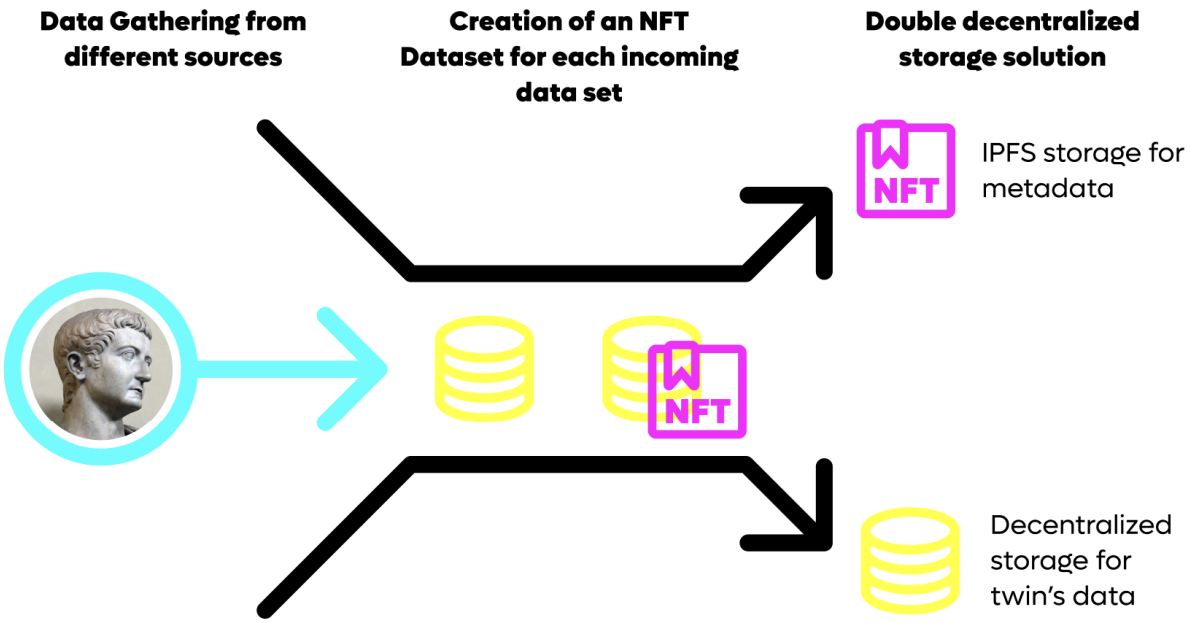
2. Digital Twins Database

As data longevity is central to Lay3rs approach, we are deploying a system that ensures the continuous input of new data, the qualification and traceability of data usage while ensuring it is accessible to its human or machine (AI) users.

For this, Lay3rs offers 3 complementary services:

- **Data Gathering:** Through the continuous creation of calls for data contributions from the community (Data Hunting) and professionals, it becomes possible to create a dynamic of intelligent data aggregation within the database, ensuring that all new incoming data is relevant because it complements/compensates for an existing gap. This data can come from professional recordings already made, documentary funds, community calls for contributions, etc.
- **NFT Dataset:** To ensure data qualification and traceability, we associate each dataset with a non-fungible token containing its metadata and the various associated rights holders, so every use of each dataset can be identified, quantified, and monetized. (Token details in section ...)
- **Double Decentralized Storage:** To ensure data longevity, Lay3rs is currently developing a double decentralized storage solution (IPFS for metadata & others for twin's data) that allows for storing large files and an access time that remains relevant in terms of usage.

Double decentralization storage process



3. Zigg-E: AI Digital Twins creation tools

Creating Digital Twins involves aggregating heterogeneous data into a 3D representation, allowing for a comprehensive and integrated view of the information. This process often requires the generation of missing data through extrapolation in 3D to ensure the 3D scene is complete and accurate.

Moreover, editing these 3D scenes can be directly accomplished through artificial intelligence tools, streamlining the modification and enhancement of the virtual representation. Additionally, it is possible to Export 3D assets that are tailored to specific workflow pipelines, ensuring that the Digital Twins can be effectively integrated into various project stages and systems. This seamless synthesis of data and technology facilitates a robust framework for digital replication and preservation.

4. Exports

Exports are digital files containing a set of data derived from Digital Twin and optimized for a specific use case. These files can be of various types:

- **Complete models**: to dress a virtual landscape, develop a geolocated application, or enable 3D printing, for example.

- **Unitary elements:** to create completely new environments using elements from reality but reassembled for the specific needs of a project.
- **Textures:** to dress or integrate various creations into a visually immersive environment.
- **Custom requests:** for specific use cases, each creator has the means to make a request to the Project DAO for the creation of a unique and exclusive Export.
- This non-exhaustive list is expected to expand to adapt to future developments in the immersive digital creation market.

Each of these files is linked to a NFT that acts as an exploitation license, setting all the rules related to its distribution and integration into digital projects. All these rules are established by the Project smart contract in accordance with the agreements made with the rights holders of the real subject.

5. LAY Token

To materialize and weight financial flows and contributions within the ecosystem, Lay3rs deploys its own token (ERC20) the LAY which will be used to:

- Contribute to the creation of Digital Twins (finance data acquisition or produce 3D models).
- Purchase licenses to use Exports in all types of digital creations.
- Automate the redistribution of products to complex and dynamic rights-holder structures.
- Weight the powers of DAO contributors and give them access to the Digital Twin when they are involved in a project.
- Participating in all the community mechanics and joining the marketing events.

While the token will be available to the public Q1 2024, a testnet called PLAY (Prototype du LAY) is already available on the Build3rs.io platform.

Technology and Infrastructure

Blockchain choices

In selecting a blockchain platform for our needs, we've opted for the Polygon network, drawn by its numerous advantages that align with our objectives. Polygon serves as a scalable solution for Ethereum, greatly enhancing transaction speed and capacity, which allows us to process a higher volume of transactions per second efficiently. This scalability comes with the added benefit of reduced transaction fees, making it economically feasible for decentralized applications that typically engage in frequent transactions.

One of the standout features of Polygon is its ability to expedite transaction confirmation times. This is achieved through the generation of blocks at a faster rate than on the Ethereum network, thus providing our users with swift transaction experiences and minimizing any delays. Additionally, the network's compatibility with Ethereum virtual machine (EVM) means that we can utilize Solidity smart contract language, enabling us to tap into the robust developer community and existing infrastructure without any compatibility issues.

Interoperability is another key feature that Polygon brings to the table, offering bridges to other blockchains which allows for a fluid transfer of assets and information across different platforms. This interoperability paves the way for enhanced collaborative opportunities and resource exchanges.

Polygon's growing ecosystem, characterized by a wide array of projects, dApps, and a broad user base, presents us with an array of development tools and a well-supported environment. It equips developers with essential resources, documentation, and libraries, fostering an environment that is conducive to innovation and development.

In terms of security, Polygon leverages the established and proven security of the Ethereum blockchain, giving users confidence in the integrity of their transactions and the safety of their digital assets. This, coupled with its scaling advantages, makes it an attractive proposition.

Moreover, Polygon's infrastructure is designed to be developer-friendly, providing tools and frameworks that streamline the development process. The portability of applications and smart contracts on Polygon ensures that developers have the flexibility to transition between Layer 2 solutions or revert to the Ethereum mainnet as required.

Lastly, Polygon's decentralized governance model ensures that our community has a voice in the network's future, allowing for a democratic approach to its evolution and governance policies. This aspect of decentralization is critical in maintaining a blockchain network that is truly by the people and for the people.

Twin technological choices

The production of 3D models currently relies on photographic and/or laser capture and the use of 3D graphics software. Although advanced technological devices and software are used, the methods remain relatively artisanal, and the workflow is not highly automated.

- For photogrammetry workflows, the capture process requires expertise in image overlap, multiple angles of view, lighting, focal length, exposure time, and more. This is because 3D reconstruction software such as Reality Capture and Metashape demand precision in these aspects for successful reconstruction.
- Drone image capture is regulated, requiring pilots to obtain accreditations and undergo specific training. Drone operators are experts in piloting drones for capturing images of monuments to perform photogrammetry.
- Laser scanning capture is less demanding than traditional photography, but it requires expertise in cleaning and assembling point clouds.

Graphics software is primarily designed for use by 3D artists, and although it is possible to develop code to automate tasks, this is rarely done outside of major entertainment companies that have the resources to augment their 3D artist teams with technical artists capable of developing code to automate the software pipeline. It should be noted that finding training programs to enhance technical artists' coding skills on these software platforms is also challenging.

- Modeling software like ZBrush has gained popularity by allowing artists to utilize traditional techniques in a digital environment. However, tasks still rely on manual work, and the complexity of the software necessitates specialization to achieve quick results.
- Asset production management tools like Shotgrid are primarily designed for collaborative work and rapid validation, rather than industrial-scale interaction with large databases of 3D models hosted on cloud services.

The current ecosystem is mainly composed of small companies that handle the capture process and provide 3D models as services, or larger players that can internalize the entire workflow. To our knowledge, demand solely for the capture process is atypical. However, such a service offers greater freedom and better control over the quality of the 3D models. Methods and tools for quality control of the 3D models provided by these service providers are a recurring topic of consideration for studios.

The fragmentation of the 3D model production workflow, along with the resulting specialization of roles, leads to complexity and significant costs. To simplify the workflow and significantly reduce production costs, we believe in utilizing AI-based tools. The objective is not to replace 3D artists but rather to provide them with new

tools that enable them to reduce the time spent on repetitive and/or low-value tasks, allowing them to focus more on tasks where human intelligence is uniquely valuable.

To illustrate this, here's a concrete example that applies machine learning tools to a real issue in computer graphics. When reconstructing a large-scale scene (e.g., a 1000 m^2 monument), photogrammetry software only yields usable results when provided with tens of thousands of photos. They are much less effective for reconstructing individual 3D assets. Furthermore, aligning georeferenced laser point clouds with the photogrammetric point cloud must be done on the complete scene. The workflow of reconstructing individual 3D assets and then assembling them is counterproductive.

However, studio organization relies on task separation because a complete scene is typically not usable with standard computation resources, and 3D artists work on unique 3D assets. Therefore, we need to provide the studio with both the 3D assets and the elements required to easily reassemble them into a scene. Thus, starting from the complete scene, a Lay3rs 3D artist must segment the 3D scene into individual 3D assets, which significantly increases production time. To reduce this time, we have begun developing AI-based tools that can automatically detect and segment the relevant 3D assets within the complete scene.

This example fits into the current workflow of 3D artists by providing assistance in a specific area. However, we have a much more ambitious vision. Our goal is to provide a universal solution to a 3D artist, as well as an entire team of artists, encompassing multiple machine learning and deep learning tools that enable them to achieve things currently unimaginable with available solutions.

To succeed, we rely on a set of optimization methods in Visual Computing called Neural Fields. "Field" refers to the physical concept of a field in which a quantity is known at every point in space and/or time. A Neural Field is a field that is parameterized by a neural network.

One of the great strengths of deep learning-based approaches compared to previous solutions lies in memory usage. Traditional 3D sampling-based solutions encounter a memory wall. While it is possible to produce individual 3D assets with sufficient resolution using these methods, reconstructing a large-scale 3D scene, such as monuments in our case, becomes prohibitively memory intensive. In other words, the major problem with 3D sampling is the scalability of memory when the required resolution increases. In contrast, neural fields are inherently continuous and adaptive. Thus, the memory required for neural fields scales with the number of parameters in the neural network, rather than the dimension of the scene. This allows us to address the memory problem by utilizing parameters only where details are necessary.

Furthermore, by combining a neural field and a generative model within an architecture, it is possible to leverage the advancements of generative models for generating 2D images, 3D objects, the shape and appearance of 3D objects, and even multimodal visual and acoustic representations.

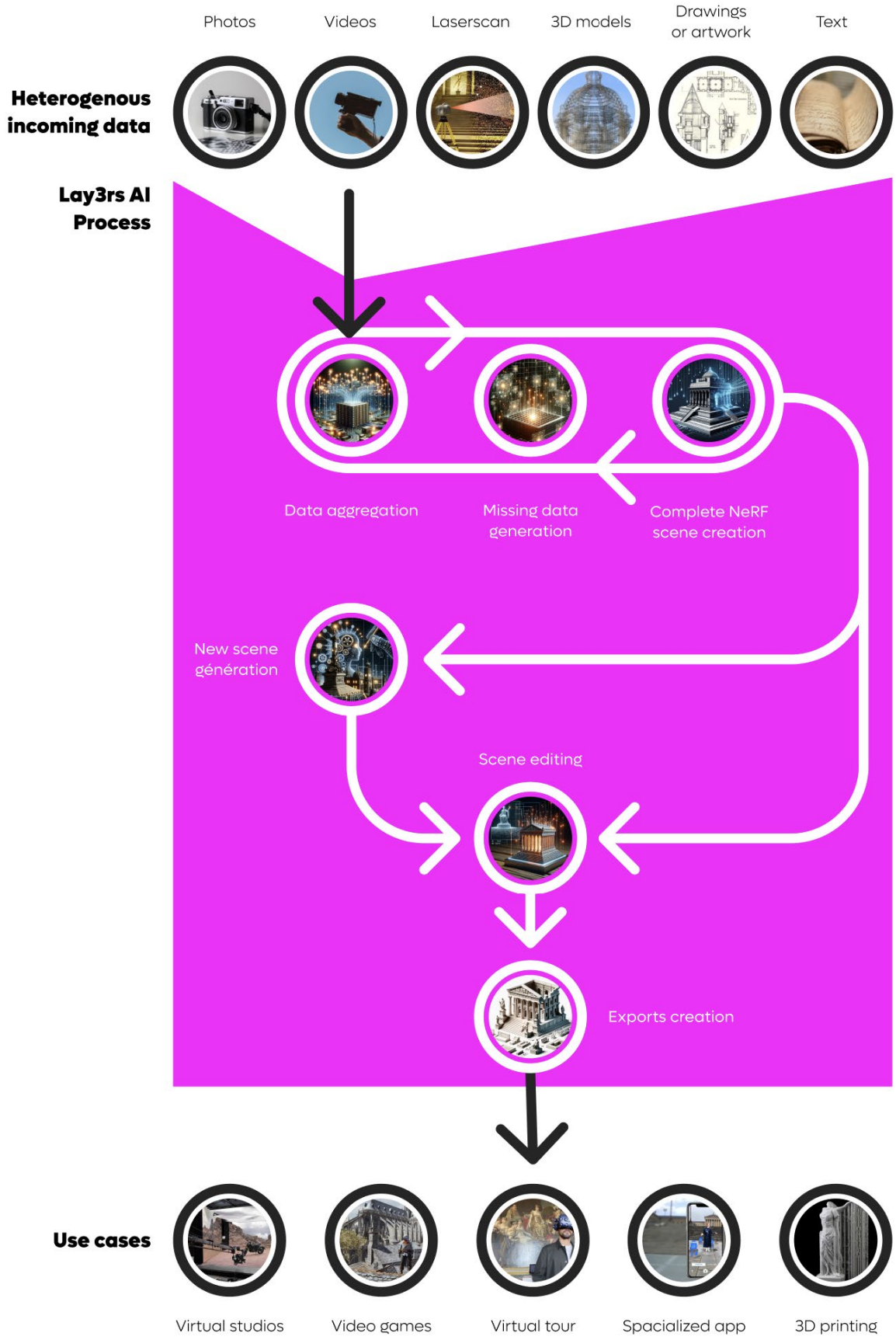
The applications of Neural Fields to 3D reconstruction and rendering are collectively referred to as NeRF (Neural Radiance Fields). In this specific case, the radiance field is encoded within the neural network. Radiance provides information on how light emitted from a surface is perceived by the eye, indicating whether an object in a scene appears bright or not. Based on a sparse capture of the scene, the neural network outputs the optical density and the color at each point of the scene. In other words, it can produce any viewpoint within the scene.

In a nutshell, NeRF encodes 3D scenes with a neural network mapping 3D point locations to color and volume density. This allows the scenes to be represented with a compact memory footprint without limiting the resolution of synthesized images. To give an example, this would solve a major problem encountered today by extended reality. To date, it is not possible to broadcast high-resolution content in real time in a headset. To do this it is necessary to add a backpack, which is a brake on adoption. NeRF would solve this problem.

More generally, NeRF is a new paradigm for seriously considering the development of a generative model for 3D. Pre-trained generative models are the well-known models now for language (1D) and images (2D). Large Language Models and Diffusion Models require a huge training database. In the case of 3D, the application of such an approach has led to a dead end because training on databases of 3D models has several disadvantages: there are no 3D databases as large as for text or images, meshes are heavy objects in terms of memory size, generated 3D models are limited to simple shapes and the resulting renderings are far too smoothed and therefore unusable. NeRF is another way to tackle the problem for which a small model (a few MB) must be trained for each 3D scene. Once the NeRF has been trained on a 3D scene, it is possible to work directly in the 3D scene to e.g. fill in the gaps during the creation of the 3D scene, identify objects directly in the 3D scene, modify objects in the 3D scene, modify the appearance of the 3D scene, including in "text to 3D".

NeRF has been actively studied for the past three years by researchers in both public and private laboratories Building upon the abundant literature, numerous available codes, and our initial work at Lay3rs, we will focus on the following projects until the end of 2025, with the aim to develop such a generative model for 3D.

The exclusive Lay3rs AI Digital Twin production process



NeRF Editing

- **Deep Neural Network:** NeRF uses a deep neural network to model this field. For a given point in space (defined by its x, y, z coordinates) and an observation direction, the network predicts the color and density which corresponds to transparency of the light passing through that point.
- **Volume Density:** Instead of focusing on surfaces or voxel grid, NeRF views the entire space as a volume. Each point within this volume has an optical density.
- **Integration Along Rays:** To generate an image, NeRF cast rays from the camera through the scene. For each ray, it samples several points along its path, uses the neural network to get the color and density of each point, and then combines these pieces of information to produce the final color of the pixel in the image.
- **Learning from Data:** To train the network, we generally use a set of data (photos, videos, maps, etc.) of the scene taken from different angles. The network learns to reproduce this data and once trained, can generate images of the scene from new angles and then transform these different views into a 3D model.

NeRF offers high-quality rendering, especially concerning the handling of fine details and complex lighting effects like refractions and reflections. However, they require substantial computational power and can be slow to generate. A lot of work is in progress to reduce the need of computational power and to accelerate the training and rendering

Objective:

Provide a NeRF-based solution that allows access to all relevant properties for a 3D Artist.

Challenge:

The success of NeRFs primarily stems from their ability to synthesize new photorealistic views. However, to integrate seamlessly into a studio's real-world workflow, it is essential to extract and modify properties of a 3D scene, including geometry extraction, adding or removing lighting, adding or removing objects, and generating a mesh. The original NeRF architecture was too rigid, making these pieces of information inaccessible.

Preferred solution:

A NeRF produces an initial representation of the scene, which can then be used to incorporate a mesh for modeling specific features of interest. For example, to obtain a high-quality mesh, the representation is directly baked into the mesh. Similarly, to modify lighting, a mesh reconstructed from the NeRF is used to model secondary beams that produce lighting effects such as shadows or specular reflections.

Inputs preprocessing

Objective:

Reduce the number of images and camera poses required for training a NeRF.

Problem 1:

Photogrammetry requires a minimum overlap of 60% between two images to function properly. As a result, a significant quantity of images is needed, ranging from a few hundred for an object to tens of thousands for a building. The capture time is consequently long, leading to substantial costs and, less obviously, difficulties in capturing publicly accessible monuments under optimal conditions. Heritage institutions cannot immobilize a monument, especially if it is highly visited, and being able to minimize the capture time greatly facilitates the feasibility of a capture project. For these two primary reasons, there is a strong interest in reducing the number of images required for NeRF reconstruction.

Preferred solution 1:

Generate new views from a small number of images using generative models such as GANs (Generative Adversarial Networks) or Diffusion. The basic idea is to synthesize and refine a set of virtual views based on one or a few available images.

Problem 2:

A current limitation of NeRFs is the need to provide camera poses as input to teach the NeRF how to represent the scene. Obtaining these camera poses after the capture stage typically requires conventional techniques using software such as Reality Capture or Metashape. This step is time-consuming and can introduce errors. Furthermore, if multiple sensors have been used for the capture (e.g., public-contributed photos), the camera pose data can be erroneous or incomplete.

Preferred solution 2:

This problem is a classic challenge in computer vision and has been extensively studied over the past 30 years through the class of algorithms known as SLAM (Simultaneous Localization and Mapping), which simultaneously determine the sensor's position and reconstruct the captured environment. Adjustment techniques derived from this research can be employed in the NeRF context, allowing the model to learn both the scene representation and camera poses.

Generative Modeling of 3D

Objective:

Generate elements of the scene that were not captured.

Problem 1:

NeRFs can interpolate between captured views in a scene, but they cannot extrapolate to infer parts that were not captured. During a capture process, even with meticulous effort, it is not possible to capture every part of the scene without occlusions, as the required time quickly becomes prohibitive. At best, this reduces the rendering quality, and at worst, it creates gaps in the scene. In such cases, a specialized 3D Artist (sculptor/modeler) must intervene to create the missing parts, which is extremely time-consuming and costly.

Problem 2:

NeRFs need to be optimized for a specific scene. A fundamental limitation of NeRFs is that they cannot represent multiple scenes within a single model. Therefore, in the case of monuments that contain multiple separate rooms with openings and require to follow a trajectory, it is currently not possible to represent all the rooms using a single model.

Preferred solution:

It is possible to create an architecture where NeRFs and a generative model are linked to aid in the generation and fine-tuning of 3D views. The generation of new virtual images can directly contribute to the process of improving areas where data is missing. It is worth noting that prior to the advent of NeRFs, the resolution and quality of 3D renderings obtained using generative models were inferior to those achieved in 2D. This was due to the limitations of previous architectures used for 3D generation and rendering. Both types of models are thus naturally linked to obtain the most accurate results.

Dynamic Scene

Objective:

Add dynamic 3D objects to a static 3D scene.

Problem:

By design, NeRFs are only applicable to static scenes. This poses a major problem when it comes to integrating moving objects into the scene or deforming elements of the scene. Resolving this problem is particularly important for the cultural and creative

industries, which have produced a vast number of images (films, series, sports events, concerts, etc.) that could be used to reconstruct immersive 3D experiences using NeRF and generative models. For example, it is conceivable to be immersed in a series from a chosen point of view rather than the camera's. However, to achieve this, it is necessary to be able to reconstruct and track humans and moving objects in 3D.

To understand the complexity associated with introducing the temporal dimension, let's provide two examples:

- The spatio-temporal signal is sparser than the spatial signal. While it is possible to generate additional views for a static scene (as discussed in inputs preprocessing), it is more complex for a dynamic scene, and therefore, less input data is available.
- The dynamic content in a video typically changes significantly from one frame to another, while the background changes little. An inappropriate temporal frequency will result in poor interpolation along this dimension.

Preferred solution:

To successfully add the temporal dimension, it is necessary to code at least one additional field to the NeRF, which learns the dynamics of the scene and can predict the future positions of each point in the scene. It is evident that from a computational power standpoint, adding the temporal dimension is demanding, as it requires at least doubling the computational requirements.

We are aware that the above presentation is exclusively dedicated to artificial intelligence and seems to be uncorrelated to Web3 developments. Yet we have begun to think about linking these two dimensions more closely. This would be possible in different ways such as the tokenization of datasets, the tokenization of calculation parameters, the use of decentralization of AI models. It is necessary to have made more progress on the roadmap before being able to prioritize the different tracks envisaged.

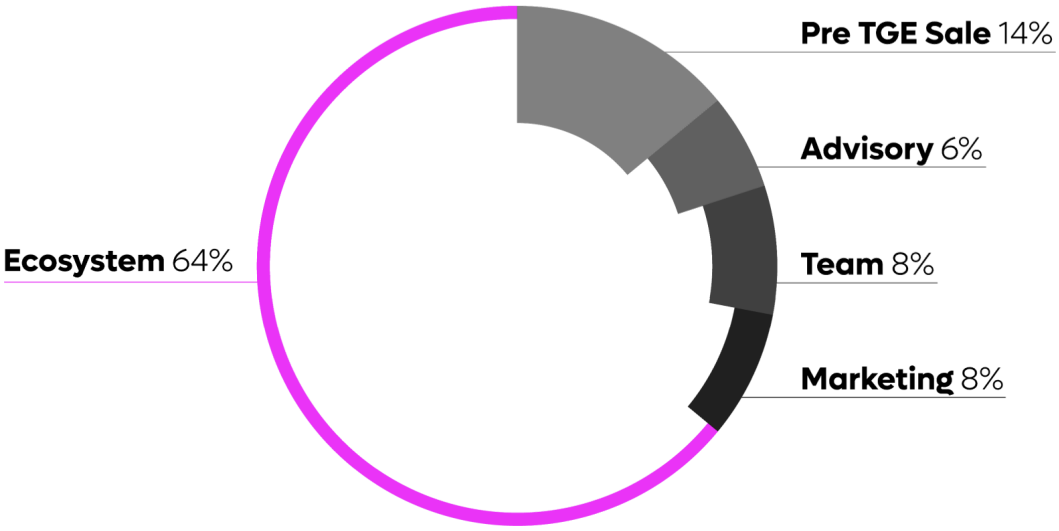
On-chain Organization

Smart Contract 1: Token LAY (ERC-20)

We intend to deploy a Fungible Token with the following characteristics:

- **Total supply:** 1,000,000,000 tokens
- **Decimals:** 18
- **Name:** Lay3rs
- **Symbol:** LAY
- **Burnable, Non-mintable**

Token allocation



Smart Contract 2: NFT Dataset (ERC-721)

Each dataset contains a certain amount of data related to a Digital Twin and can be uniquely identified through a Non-Fungible Token.

That's why we have repurposed the ERC-721 standard and customized it to adapt to our use case.

Indeed, different levels of scarcity will qualify each dataset and have an impact on the share of rewards that will be distributed to the rights holders, namely the data providers.

The file size, measured in kilobytes, will also be tracked for each dataset, along with the governance smart contract of the project, which will be detailed further below.

Thus, each mint of an NFT will associate a structure of objects defining a dataset in a unique way, to which we link a URI that is hosted via IPFS to define additional metadata.

Smart Contract 3: Multi-token Export (ERC-1155)

The purchase of an exploitation license for a 3D Export will be digitized using the ERC-1155 standard, which defines the multi-token functionality.

In practice, it involves an NFT that can be minted multiple times for one or multiple addresses representing buyers. It also allows for bulk purchases of exploitation licenses for different Export IDs within a single transaction, which streamlines usage and reduces gas fees.

Each exploitation license for an Export is uniquely identified by an ID, which is associated with the following data:

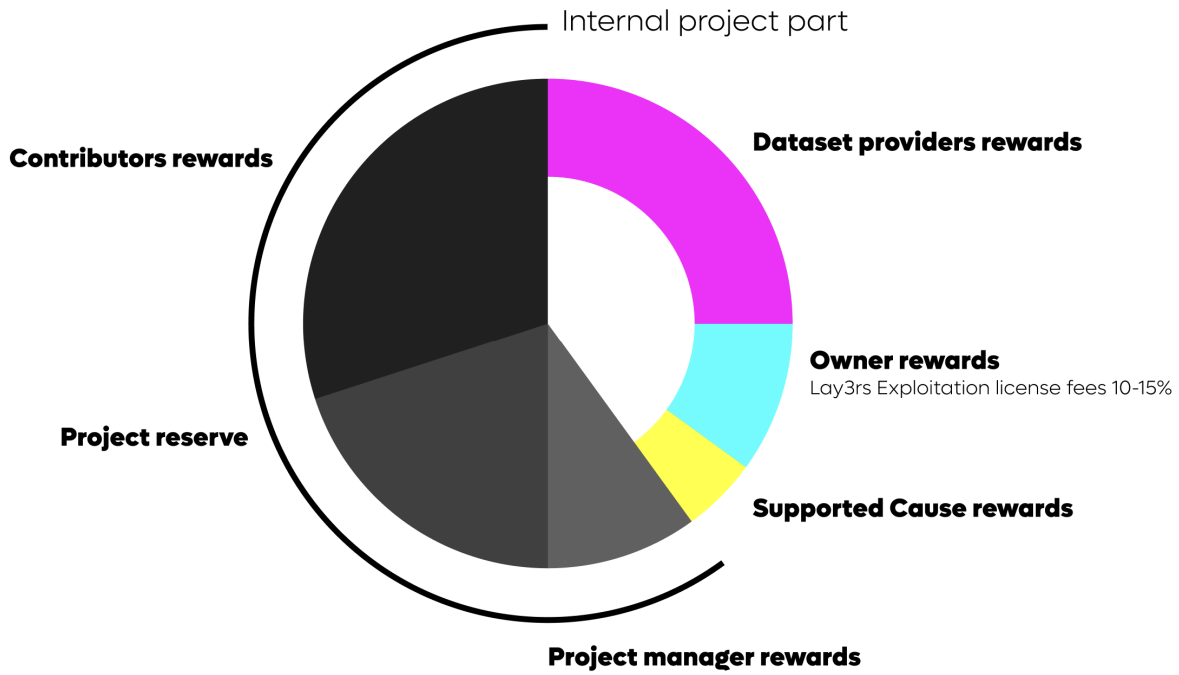
- The owner of the Export
- The smart contract of the project it depends on
- Uri of IPFS metadata
- The coefficient size related to the export, that will be used to define its price
- The list of different NFT dataset IDs that were used to create this Export, along with their weighted scarcities to quantify their shares within the file.

The purchase price of the license linked to the Export is calculated by multiplying the corresponding file's coefficient by the price per coefficient in LAY (information defined and updatable within the smart contract of the project it depends on).

$$Export\,\mathrm{Pr}\,ice\;=\;CoefficientSize\;\times\;Lay\,\mathrm{Pr}\,iceByCoefficient$$

It is important to note that an Export can be composed of multiple files, which will require the existence of distinct NFT Exports with different identifiers to offer a higher level of granularity for buyers who only wish to pay for the formats they need.

Exports rewards allocation



The purchase of the exploitation license is represented by minting a new NFT Export, and the rewards are automatically distributed to the addresses:

- The wallet of the associated Lay3rs Supported cause.
- The wallet of the export owner
- The wallet of the project manager of the contract
- The smart contract of the project related to the purchased NFT Export, allowing contributors to be rewarded at each sale, and a specific amount of it will be reserved for potential future milestones.
- The data providers of the different datasets used to create the Export.

Regarding data providers rewards, they will be distributed as follows:

$$DatasetOperatorRoyaltiesLAY = \frac{(DatasetRoyaltiesLAY \times DatasetScarcityPondered)}{DatasetTotalScarcityWeight}$$

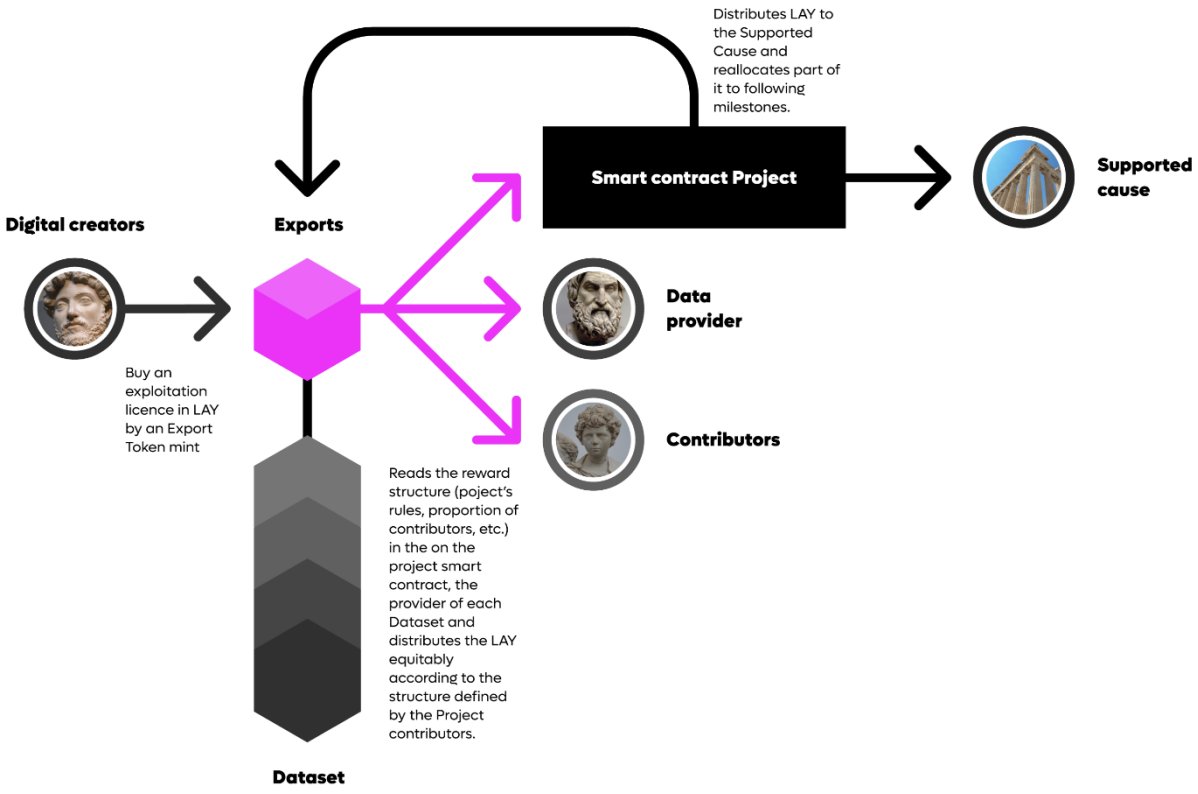
$$DatasetRoyaltiesLAY \ : Royalties\ allocated\ for\ all\ data\ providers\ related\ to\ an\ export\ purchase$$

$$DatasetScarcityPondered : Share\ pondered\ of\ a\ dataset\ with\ its\ scarcity$$

$$DatasetScarcityPondered = DatasetScarcity \times DatasetPercentageWeight$$

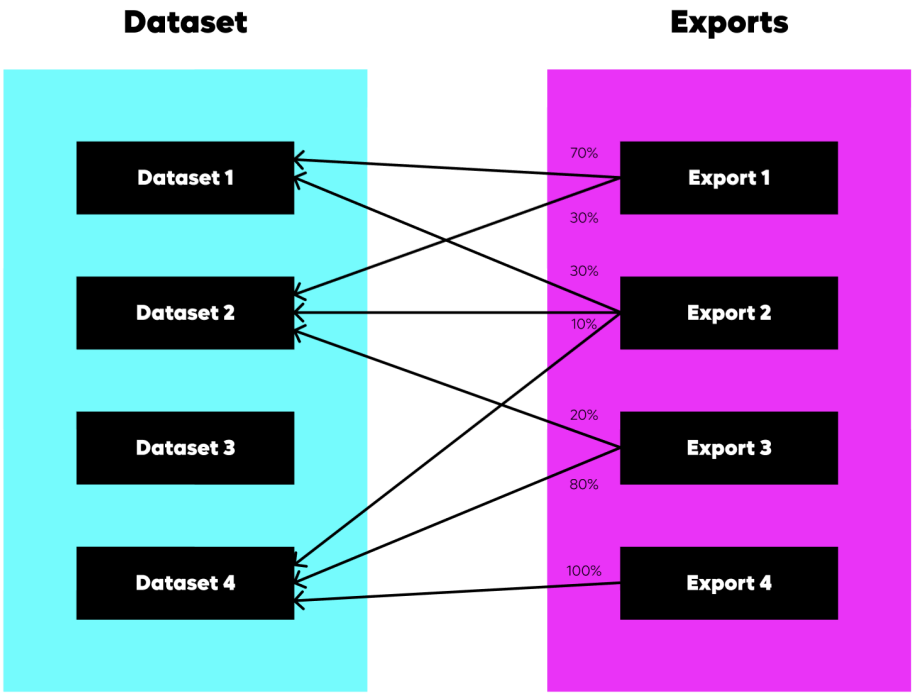
$$DatasetTotalScarcityWeight = \sum_{i=0}^{N} DatasetScarcityPondered_i$$

The Export token role



Each Export is linked to one or many datasets like following:

Structure of interaction between Dataset & Exports



So, this distribution of shares of datasets in each Export will have an impact on the rewards that each owner of dataset will receive

General principles of Digital Twins governance

Human heritage can be associated with a common good and, by extension, with its Digital Twin. It therefore seems appropriate to consider a new governance model for this specific type of asset. Decentralized autonomous organization (DAO) models are perfectly suited to this use case. To ensure the smooth running of the service, enabling real community involvement in projects linked to everyone's personal commitments, we decided to create a two-tier governance structure. A global level governing all Digital Twins (DAO Master), and a project level for each twin (Project).

DAO Master

- Validates the attributes and metadata of raw data and 3D Exports.
- Votes on the creation of new projects (smart contracts).
- Can activate specific emergency functions within project smart contracts.
- Sets the quorum for decision-making.

Project

- Can update certain attributes of Dataset and Export smart contracts (e.g., Rarity level).
- Updates the current version number of Terms of Use of Exports.
- Sets the price of Exports based on file size.
- Votes for data acquisitions and future Export creations.
- Creates new funding rounds, called "Milestones", for data acquisition or Export creation projects.
- Handles redistribution of values among different contributors in this smart contract.

Each contributor has a weighted power based on the numbers of LAY they hold within the project for DAO Project governance, and an aggregation of their various voting powers over Projects within DAO Master. Each decision is subject to voting, and every contributor can submit a vote to the community.

Smart Contract 4: Smart Contract Project

The smart contract related to a project defines a specific DAO operation for a community of contributors who wish to pool their resources together to support the creation of 3D Exports collectively.

Each round of funding is defined by a "Milestone", that should reach a specific hard cap before a predefined deadline. The money collected will be spent on data acquisition or Export creation according to the previously validated votes by the community of contributors on the project.

After each sale of an Export funded by this smart contract:

- A portion of the rewards from the sale is retained within the contract to finance future Exports.
- Another portion is distributed to the different participants this smart contract proportionally to the number of LAY tokens they hold within the organization.

When a contributor to one of these smart contracts is eligible to "claim" rewards following the sale of an exploitation license for an NFT Export, they have two options:

- They can claim the amount in LAY corresponding to that sale.
- They can reuse these LAY tokens as a new contribution, in the smart contract, to increase their voting power.

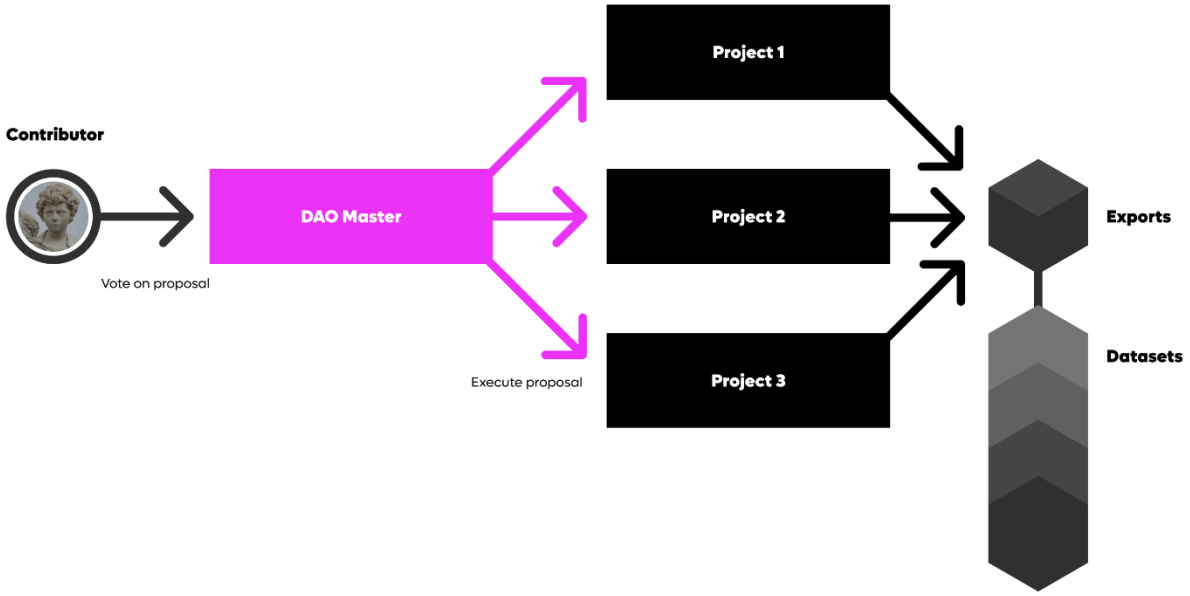
It is also important to note that each LAY token allocated to a smart contract Project grants voting rights within that contract, as well as within the defined DAO Master smart contract described below.

Smart Contract 5: Smart Contract DAO Master

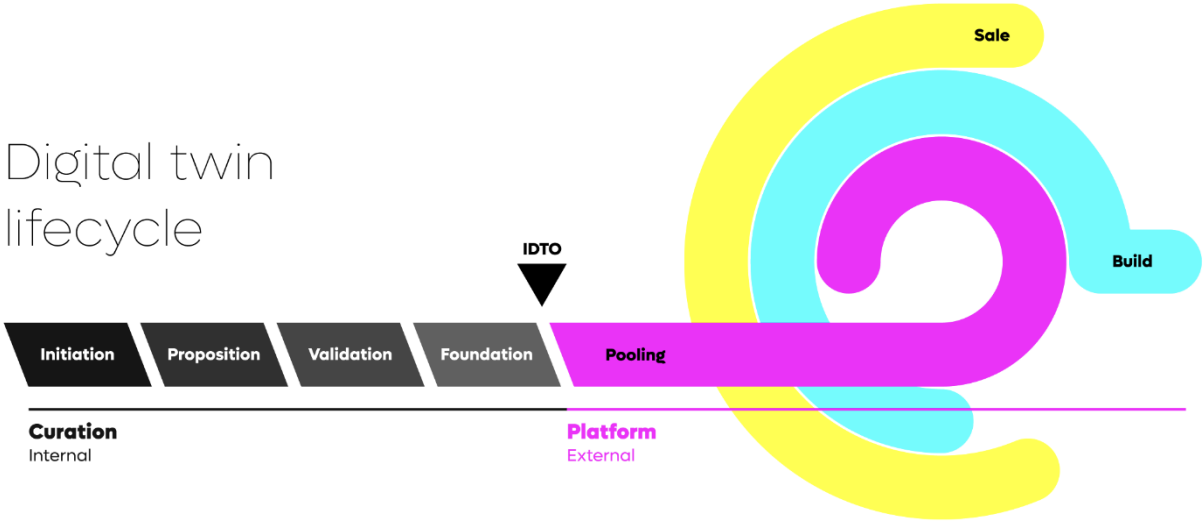
The DAO Master smart contract governs the common organizational rules for all smart contracts related to the Lay3rs project.

Each token allocated within one of the project smart contracts grants voting rights within that specific contract. Similarly, each token withdrawal within a project contract decreases the "voting power" within the DAO Master smart contract by the same amount.

The DAO Master Smart contract role



Lifecycle of a Digital Twin



The cycle of life of one monument is divided in two stages divided by a precise stage named Initial Digital Twin Offering (IDTO)

Curation Phase

The aim of this phase is to select the future Digital Twins to be created and to define the needs and opportunities for creating IDTO, as well as defining the Supported Cause. This phase also enables the legal aspects of the twin and its use to be defined with the institutions.

This phase consists of 4 stages: Initiation, Proposition, Validation & Foundation. The precise and definitive process for this phase will be detailed after the listing, according to the Community decision-making process.

Platform Phases

The aim of this phase is to create, develop and distribute Digital Twins and their derived products. This cyclical phase is structured in 3 stages, which are carried out in parallel.

Stage 0 / IDTO: Initiation of Digital Twin projects

One IDTO initiates one Digital Twin project on the platform, offering publicly the contribution with LAY token on the Digital Twin project, and opens the Pooling stage for the first Milestone. It concludes the following steps:

1. A dedicated project smart contract is deployed
2. An IDTO framework document is published on the platform

By the initiation of each IDTO, a framework document is presented by Lay3rs curation team to LAY token holders on the platform, detailing: historical, business and technical research conducted by the team, and requirements, costs and timeline that is necessitated to produce this Digital Twin. The document consists of:

- Identification and estimation of pre-existing datasets.
- Components of a first Milestone enabling the creation of a first version of the Digital Twin. This Milestone is therefore made up of tasks, each valued in LAY. The sum of the value of each of these tasks constitutes the Hard Cap of the Pooling phase. This Milestone consists of:
    1. Data acquisition batches (to be created or pre-existing)
    2. For each batch, data acquisition rules (external acquisition, external creation or by the community, purchase or sharing of rights), allocated amount and scarcity of the future dataset token.
    3. Creation of first Exports that can generate value.
    4. The deadline for the first Milestone.
- Identification and contractualization with the institution supported by the Digital Twin and with any beneficiaries.
- Identification of potential first use cases for the Exports, enabling their creation to be prioritized.

Stage 1 / Pooling: Pool resources and data to create or develop the Digital Twin.

In the case of a first Milestone, the Pooling stage starts in the conditions announced by the IDTO, with the following steps:

1. The IDTO is opened for LAY contribution
2. IDTO project in Pending Status: the community data acquisition tasks that make up one Milestone are published, yet not open for acquisition.

In the case of a subsequent Milestone, part of LAY contributed to precedent Milestone can be directly self-financed by the project contract at the time of the Milestone vote.

The Pooling stage is terminated by:

1. **Reaching Hard Cap with LAY before reaching the Deadline.**

- In the case of a first Milestone: Reaching a Hard Cap gives contributors the right to engage and benefit from the Digital Twin project's governance.
- IDTO project on Contribution Status: data providers contribute first data according to the community data acquisition task published.
- All LAY contributed are transferred to Project smart contract, then allocated to the various tasks and the share reserved for the Supported Cause and platform fees.
- In the case of a subsequent cycle, the first step is irrelevant, but the process remains unchanged.

2. **Reaching the Deadline before the hard cap is reached.**

For both first and subsequent cycles:

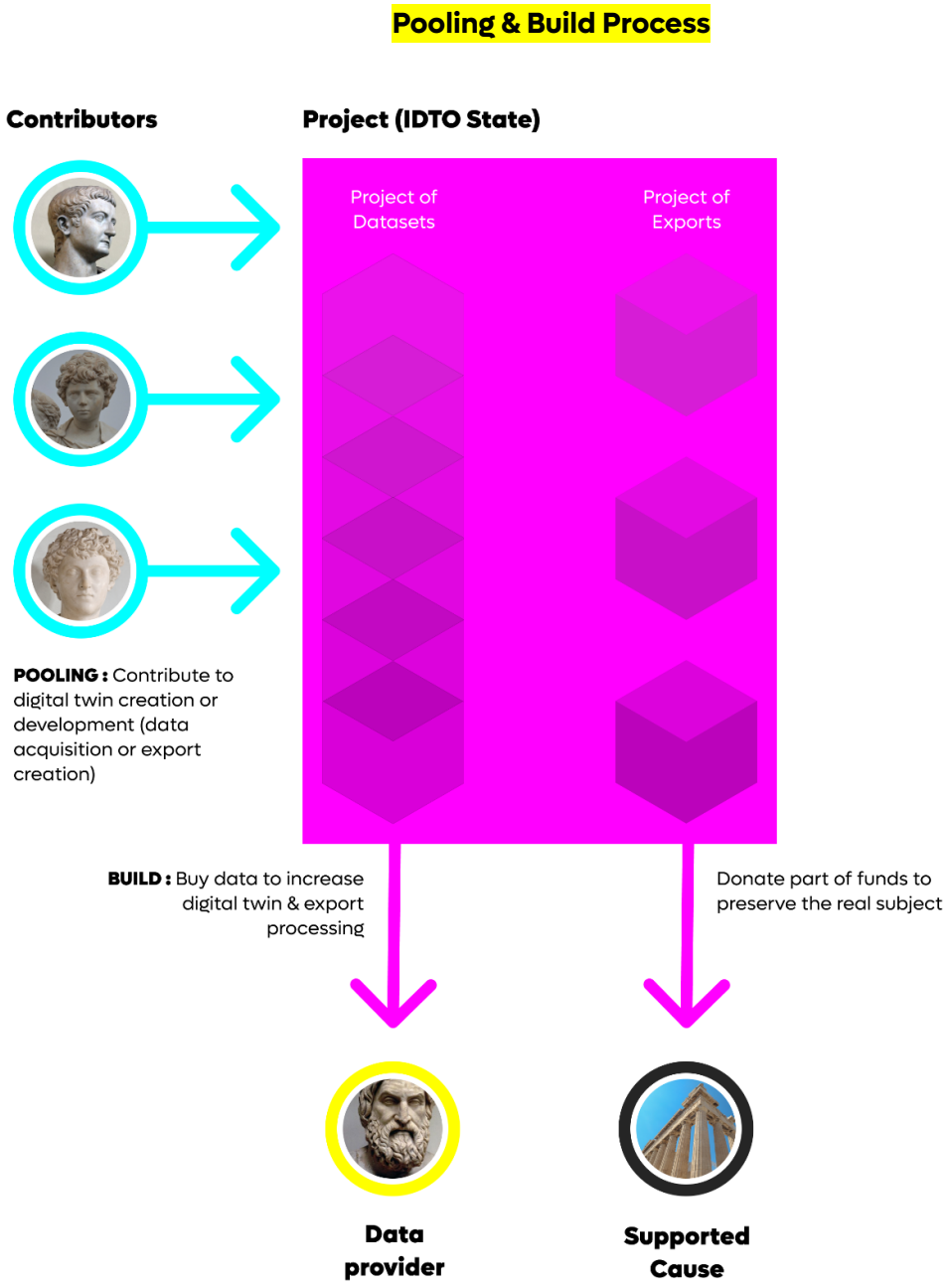
- Funds collected are returned 1:1 to contributors.
- IDTO Project in Abort Status: all data acquisition tasks linked to the IDTO is aborted.

Once a first Milestone has been successfully completed, contributors can vote for a new Milestone to initiate a new Pooling cycle.

Stage 2 / Build: Aggregate data into a Digital Twin and create Exports for distribution.

The Build stage consists of achieving the Milestone goals. It is structured as follows:

1. Receipt of data sourced externally or acquired from the community.
2. Validation of data for aggregation of the Digital Twin.
3. Mint of a dataset token for each batch of incoming data.
4. Production of a global scene integrating all data.
5. Production of Milestone Exports.



Stage 3 / Distribution & Sale: Generating value from the Digital Twin.

The Sale Stage represents the commercial life of all the Export/uses of the Digital Twin on the market. When we "sell' an Export that means that we sell an exploitation license of this Export defined by the 4 criteria that may change the price independently of the one chosen by the Pool DAO:

- Geographic area
- Duration

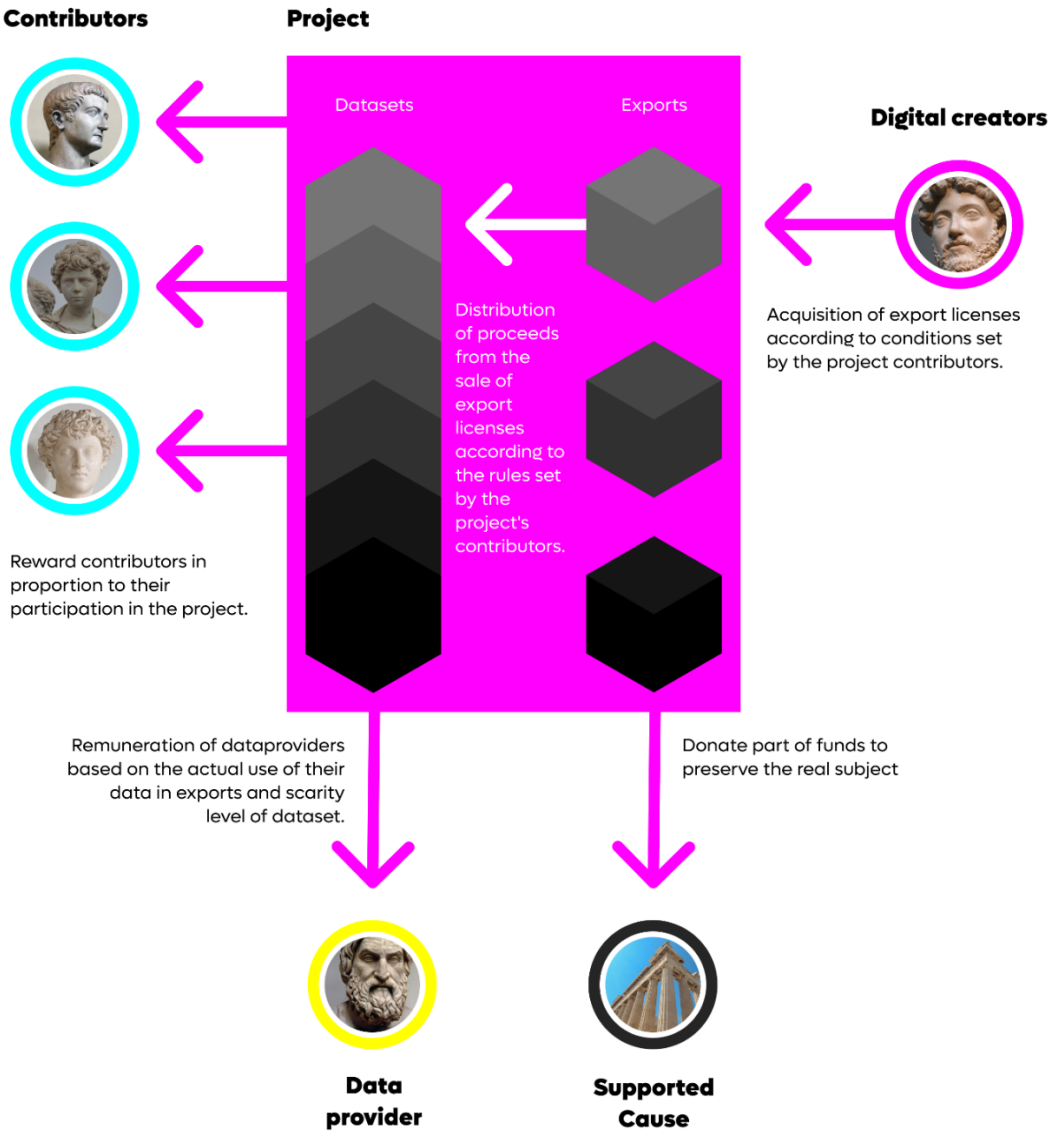
- Support of exploitations
- Exclusivity or not

The acquisition of an operating license corresponds to the mint of a smart contract Export token following EIP-1155 standard.

Any income generated by the sale of those license will automatically be shared as a key of partition defined by the smart contract Project between:

- Contributors according to their participation in the project
- Data Providers according to the proportion of a data set used in the Export and its scarcity
- Supported Cause
- Project manager
- Build3rs platform fees

Sale process



Rewards model for data or code provider

General principles of remuneration for data or code providers

The redistribution of value to data or code providers can take two cumulative forms:

- **The purchase of data:** When each Milestone is created, a sum is allocated to each task. This sum is paid directly and in full to the provider who fulfills the

objective. This sum is paid to the provider as soon as the transmitted data has been validated.

- **The opening of** rewards**:** When each Milestone task is created, a scarcity level (0-9) is assigned to each upcoming dataset. This value is then used to measure the actual use of datasets within Exports to determine the reward for each provider. The higher the scarcity value is , the greater is the reward for the provider.

Types of data or code provider

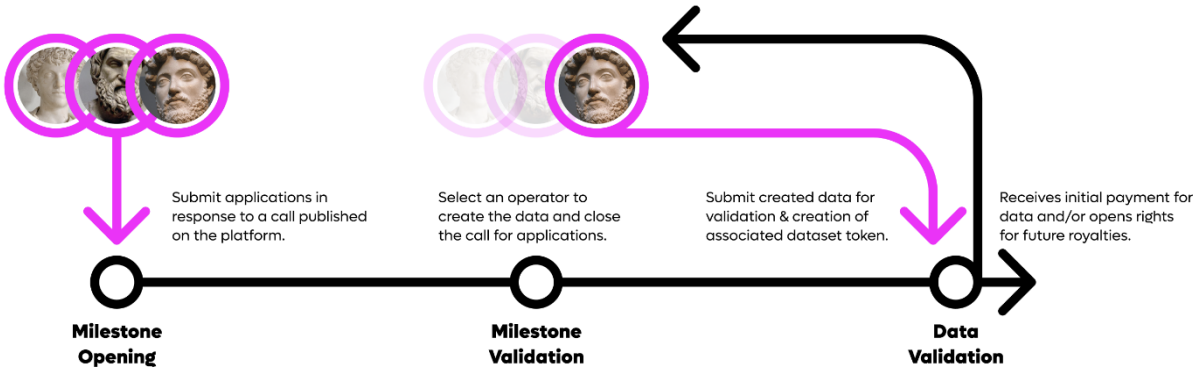
1. **External Data or code provider**

Some data are only held by professionals because of the nature of this specific data. For example, it would be unusual to find the acoustic data in the community. In that specific case we are going to negotiate the access of this data from the owner with a revenue share deal or a flat buy to own the data required.

2. **Community Data provider: the Data Hunting**

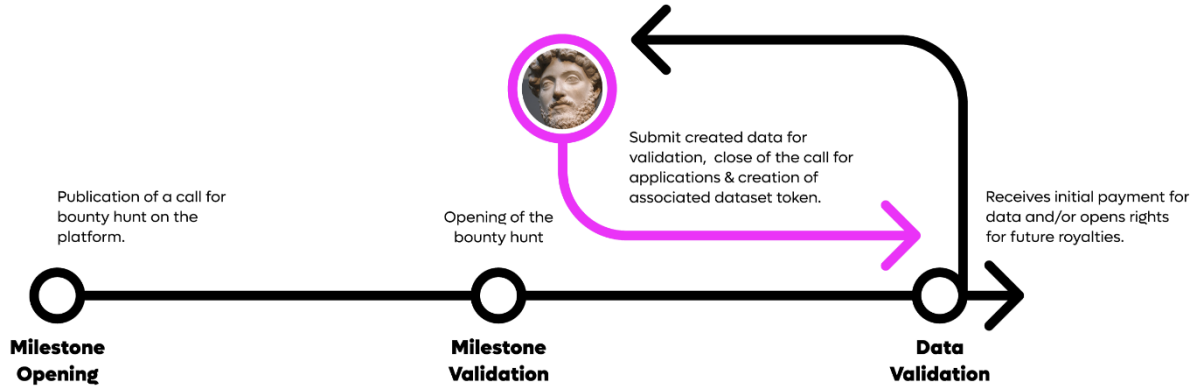
There are various forms of data hunting, depending on the nature of the data to be collected.

- **Call to applications:** In the case of data to be created that requires significant cost or know-how to capture, the call for contributions will take the form of a call for applications. Applications will be examined by the curation team, and the selected candidate will receive the full amount defined in Milestone once data has been submitted and validated. Depending on the level of scarcity defined in the Milestone, this validation opens rights to future rewards.

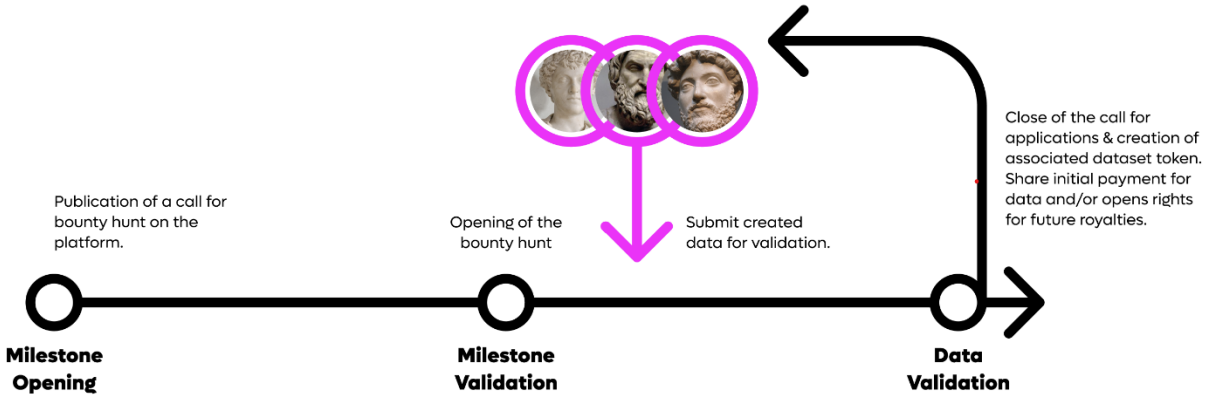


- **Bounty Hunt:** In the case of specific data to be captured but not requiring specific access or skills, the call for contributions then takes the form of a contest. A request for data is published in advance, and once the Milestone has

been validated, the first community member to submit a validated data set wins the sum set aside when the Milestone was created. Depending on the level of scarcity defined in the Milestone, this validation opens rights to future rewards.



- **Mass data call:** In the case of generic data requiring no specific access or skills, the call for contributions takes the form of mass aggregation. A request for data is published and opened upstream, all validated data transfers are integrated into the Digital Twin and the sum allocated to this call is shared between providers according to the volume of their contribution. Depending on the level of scarcity (probably low in this case) defined in the Milestone, this validation opens rights to future rewards.



Business Model of Lay3rs Platforms

The business models of Lay3rs Platforms will be the following:

Project Management Fees 15-20%

Every time the platform must handle the creation of an Export or the legal aspect of creation / diffusion of a Digital Twin, a fee will be taken on the amount of the Milestone.

Exploitation license fees 10-15%

On every sale of an Export and the exploitation license linked to it. There will be part of this sale that is going to be held by the platform.

AI gas fees

When the AI is going to go through the data to verify it of generate a model, there will be a fee to pay related to the inference time needed.

Platform Licensing

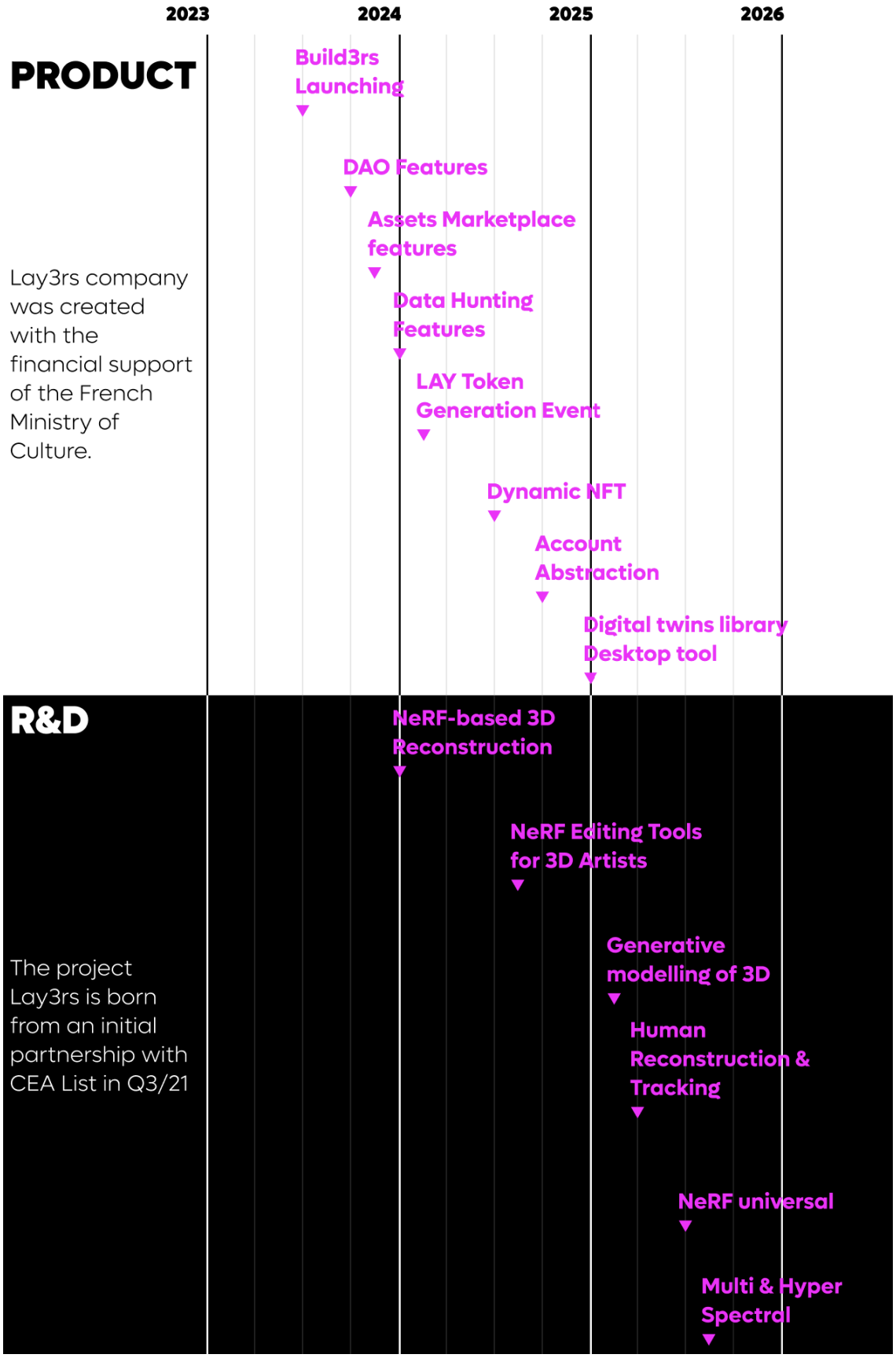
The Build3rs system can be duplicated for proprietorial uses, the price of such a license will depend on different factors:

- Geographical zone
- Duration of the license.
- Uses and applications planed
- Exclusivity or not.

AI Plugins Fees

Insofar as we are open source, we can imagine that people will propose code to complement our initial one. If we use these codes in our system, it seems normal to compensate them and take a share for business contribution.

Prospective Roadmap



Team & partners

Core Team

Sébastien MALCOTTI CEO

Xavier AUBERT CTO AI

Benjamin JORNET CTO Web3

Yann TOULLEC CSO

Gamora YU COO

Jingcan ZHU CMO

Sebastien CASAERT Head of Product

Jonathan ZHONG Business Developer

Rebecca Cervasio AI Researcher

Victoriya Kashtanova AI Researcher

Mateusz Baranowski Lead Community Manager

Mathieu DA SILVA Communication

Môssieur Pierre Asset Management

Advisory Team

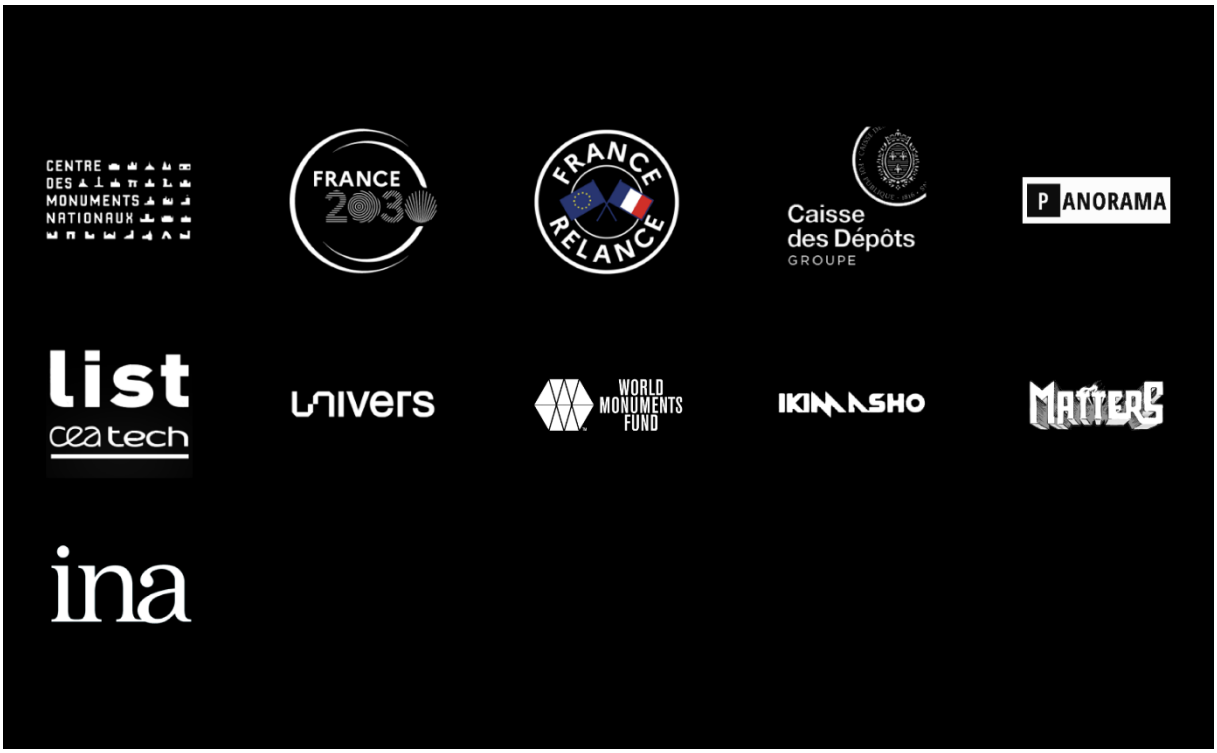
François-Xavier Petit Public Partnership Advisor

Emmanuel Ea Development Advisor

Adrien Basdevant Web3 Legal Advisor

Clara Benyamin IP Legal Advisor

Partners



Main partners portraits

Caisse des Dépôts et Consignations: The Caisse des Dépôts et Consignations (CDC) is a French public financial institution established in 1816. Its main mission is to safeguard the savings of French citizens. However, over time, its functions have diversified to include areas such as housing, insurance, transportation, and pensions. With 22 subsidiaries and a total balance sheet of 1.2 trillion euros, the CDC is now the world's largest public financial group. It constantly works in the public interest with the ambition to "contribute to the growth of France." It is currently Lay3rs' primary financial partner.

CEA List: Since 2021, we have been collaborating with the Ambient Intelligence and Intelligent Systems department of CEA (French Alternative Energies and Atomic Energy Commission), which is the main applied research center in France. We work daily with different laboratories to provide LAY3RS with access to a range of expertise that is both specific and rare. This already fruitful partnership will continue to develop in the coming years, enabling LAY3RS to achieve its most ambitious and innovative technological goals.

Centre des Monuments Nationaux (CMN): The Centre des Monuments Nationaux (CMN) is a French institution that manages over 100 monuments throughout the

country. These monuments include historical sites, castles, gardens, arches, and towers. The CMN organizes various events and activities to promote these monuments and raise public awareness of their significance. The CMN is also active in the field of innovation and actively supports Lay3rs by providing access to monuments for experimentation and aims to initiate work on opening the management of Digital Twins through a DAO model.

Matrice: Matrice is a French institute for technological and social innovation founded in 2016. It operates entrepreneurship and digital training programs, startup incubation programs, as well as research and technology transfer programs. Matrice distinguishes itself by bringing together students, entrepreneurs, researchers, and artists within a single community, transcending disciplinary boundaries. In addition to its teaching and incubation activities, Matrice is also a research center and a place for artistic creation. Matrice was the first partner to believe in the project by supporting the company's structuring and securing initial funding.

Ministry of Culture (France): As the organizer of the "France 2030" call for projects on the theme of "digitization of architecture and heritage," the French Ministry of Culture has supported the project, which was awarded laureate status in recognition of its relevance to the addressed issue and the means put in place to address it.

Univers: Since we realized the potential of Web3 for our project in early 2022, Univers has been working with Lay3rs on the development of services that effectively address the specific challenges of Web3 and new creative environments (VR, AR, Metaverse, etc.). As a hub between different metaverses, Univers has incubated the project, placing interoperability and decentralization at the core of its approach and services.

Awards and distinctions

- Winner of France 2030 on the theme of "digitalization of heritage and architecture," which identifies and funds the most promising startups to address priority issues for innovation in France.
- Ongoing Deep Tech labelization by BPI France.
- Ongoing Young Innovative Company (JEI) labelization.