DESTINATION EARTH PLATFORM: A DIGITAL ECOSYSTEM ENABLING DESTINE DATA EXPLOITATION

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ABSTRACT

This article explains the Destination Earth Service Core Platform, known as DestinE Platform, which is an integral part of Destination Earth (DestinE), a significant undertaking of the European Commission under DG CONNECT. DestinE's primary goal is to construct an incredibly precise digital replica of Earth—a 'digital twin'—to oversee and forecast changes in the environment and human impact, thereby bolstering sustainable development.

The DestinE Platform serves as an accessible gateway for DestinE users. The platform is designed to furnish decision-making tools, applications, and services founded on a cloud-based computing system that is open, adaptable, and secure. It will harmonise data, cloud, and HPC infrastructures, providing entry to an expanding array of Digital Twins as they progressively become accessible through interconnected European Commission and national initiatives.

Moreover, the platform will grant access to pertinent AI tools, high-capacity data analysis, and capabilities for monitoring, simulating, and predicting Earth-system phenomena, allocating specific resources to DestinE users, enabling them to personalise the platform, merge their data, and craft their own applications and services for the benefits of societies.

Index Terms— DestinE Platform, Destination Earth, Digital Twin, ecosystem

1. INTRODUCTION

Given the escalating frequency of severe weather incidents and fluctuating climate patterns, enhancing the precision of forecasting these occurrences becomes crucial to foresee their repercussions on the environment, human lives, and property. Destination Earth (DestinE) leverages extensive data, innovative Earth system models, and advanced computing to enable users to investigate both natural and human-induced alterations in the Earth system. This empowers individuals to analyse historical and present-day data while experimenting with potential future scenarios.

The European Commission has entrusted ESA, ECMWF, and EUMETSAT to pioneer this groundbreaking initiative in climate, weather, and computational sciences. DestinE assumes a pivotal role in fortifying Europe's digital capabilities and aligns with the objectives outlined in the Green Deal to combat climate change and environmental deterioration [1] [2].

Its primary objective is to generate additional value and instill confidence in large-scale data for policymaking by prioritising openness, dependability, and reproducibility through transparent data and methodologies.

EUMETSAT will be responsible for DestinE Data Lake (DEDL). It will bring together data from diverse sources such as ESA, EUMETSAT, ECMWF, Copernicus, and Digital Twins [3].

ECMWF is actively developing the Digital Twin Engine (DTE) and the initial two digital twins: Climate Change Adaptation for extended simulations and the Weather-induced Extremes twin for high-resolution forecasts and tailored simulations on request.

DestinE's evolution will occur progressively through critical milestones: establishing the open-core digital platform and the first two digital twins by 2024, and by 2030 achieving a comprehensive digital model of the Earth by integrating all the digital twins available in DestinE System and accessible to users through the platform.

The DestinE Platform [4] serves as the user interface—a user-friendly platform relying on the most extensive and sophisticated space-based observation data, encompassing ESA's Earth Explorers, the Copernicus Sentinel series, ECMWF data, and potentially other major data repositories in Europe over time.

The European Space Agency (ESA), in collaboration with a European consortium spearheaded by Serco Italy, oversees the procurement and operational services of DestinE Platform [5].

This paper provides an overview of DestinE Platform, its consortium, its main services, its user community topology, the attractiveness strategy and development timeline.

2. DESTINE PLATFORM CONSORTIUM

The DestinE Platform Consortium comprises important European industrial collaborators aimed at providing an

unparalleled solution, achieved through the fusion of established methodologies and capabilities, ensuring its effective deployment and functioning.

Serco, one of the leading space industry and services companies, with over 40 years' experience in supporting the space sector, is the DestinE Platform prime Contractor, and will be responsible for the service deployment and execution, leading
and coordinating the end-to-end work programme.

The other DestinE Platform consortium members are: Thales Alenia Space, B-Open, CGI, Exprivia, Elecnor Deimos, GAEL Systems, GeoVille, MEEO, Alia Space and OVHcloud. Figure 1 shows the DestinE Platform Consortium structure.

Fig. 1. DestinE Platform Consortium

3. DESTINE PLATFORM OVERVIEW

The DestinE Platform Framework represents a comprehensive structure including a suite of services, tools, and functionalities meticulously designed to unite Information Technologies (IT) with various European entities associated with DestinE. Figure 2 shows the main interactions between DestinE Platform, DTE and DEDL [6].

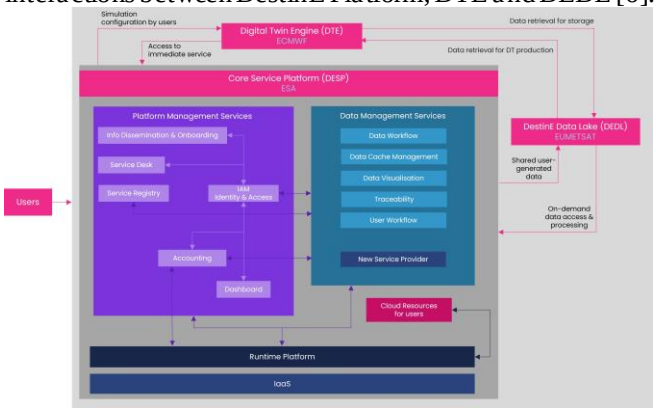

Fig. 2. DestinE Platform-DEDL-DTE interactions

The DestinE Platform Framework operates as an open architecture, deliberately crafted to cultivate an ecosystem where users and third-party activities can seamlessly interact and interoperate with other similar ecosystems. This design allows for the potential integration of existing services or operations available from other initiatives or ecosystems, such as European data spaces, the data repositories of ECMWF and EUMETSAT, or ESA Copernicus Data Access Services. This collaborative approach ensures a synergistic relationship, enabling the framework to inherit functionalities or services from other established initiatives while contributing to and benefiting from the larger European data landscape [7].

4. DESTINE PLATFORM SERVICES

Figure 3 illustrates the DestinE Platform services. In particular the Core Services, classified in Platform Management Services and Data Management Services, and ESA Advanced Services and other DestinE Platform Registered Services [8]. The cloud provider that is used to implement the DestinE Platform Core Services is OVHCloud.

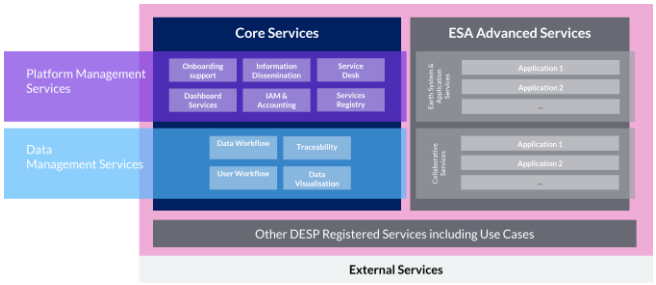

Fig. 3. DestinE Platform Services Overview

4.1. Platform Management Services

4.1.1. Identity and Access Management

It represents a unified DestinE Platform user management service, granting access to all authorised DestinE Platform Registered Services based on the same digital identity.

It allows Users to:

- Register and manage user profiles
- Authenticate in DestinE Platform with credentials from external Identity Providers (IDP Federation)
- Authenticate through Single Sign On (Service Federation)

It allows Service Providers to:

- allocate Service resources to projects or users' activities

4.1.3. Service Registry

It allows Service Providers to:

- Create and edit their services
- Obtain feedback from users
- Manage terms and conditions and license.

It allows Users to:

- Discover Services, price list and provide feedback over Services
- Perform the Onboarding process to integrate their services.

4.1.4. Specialised Service Desk

It supports Users and Services with thematic discussion forums, issue management, ticketing and technical material and information.

4.1.5. Dashboard and Monitoring Service

It provides live information about the DestinE Platform usage, performance and status of the DestinE Platform Registered Services

4.1.6. Onboarding Support

It is a specialised engineering support for new Services in integrating in DestinE Platform and exploiting at best DestinE Platform functionalities.

4.1.7. Information Dissemination Service

- Takes care of the Web information presence layer.
- Supports Users and Services providing up-to-date and accurate information on DestinE Platform Services.
- Provides engineering support for new Services integrating in DestinE Platform

4.1.8. Orchestration Platform (Runtime)

The orchestration Platform is a cloud infrastructure that offers a common baseline layer for the deployment and operation of all the internal and external DestinE Platform services. It allows to consume resources in a purely on-demand way, lowering costs and maximizing environmental sustainability. It guarantees security management capabilities.

4.2. Data Management Services

4.2.1. Data Workflow Service

It represents an entry point to access online and offline data available from

- the DestinE Data Lake including simulations generated by the DestinE Digital Twins
- federated data sources

It allows data access and retrieval, to retrieve data through:

- Harmonised Data Access API, OGC services (e.g. OpenSearch, STAC, WCS, …), Datacube API (ADAM Platform), Cloud native storage API (e.g. S3).

It implements the DestinE Platform smart cache to enable access to the DestinE Platform local cache with pre-fetched data.

4.2.2. Data Visualisation Service

- DestinE Platform Data visualisation in 2D-3D-4D (timeseries)
    - Supports geotiff, netcdf, grib, shapefile, WMS, WMTS, etc.
    - Data available on cache are pre-processed for visualisation
- User-generated Data visualisation in 2D-3D-4D
    - For supported standard formats
- Data Export in various formats
    - Collaborative environments and sharing capabilities run on client device

4.2.3. User Workflow Service

Development environment for DestinE Platform Data Exploitation:

- Jupyter, Beaker, Python, R, Julia and various size CPU/GPU

AI/ML ready environment for advanced Data Analysis:

- GDAL, RASTERIO, PyTorch, TensorFlow, Customisable frameworks
- Add storage by attaching OVHcloud containers

Processing environment for pipeline management:

- Artifact Repository, workflow creation and management, advanced processing service available via UI or API to create structure of the service implementing the algorithm via templating.

4.2.4. Traceability Service

DestinE Platform traceability services manage DestinE Platform generated data and DestinE Platform data exploitation software through two specific services:

- The Data Traceability service providing DestinE Platform generated data traceability and protection by allowing to sign the provenance, metadata lineage, and register information (i.e., traces) of all DestinE Platform Core Services-managed data. This high value service accessible via public API gives more values and protection to the signed data as it brings security, integrity and trustworthiness. This service complies with eIDAS (electronic IDentification, Authentication and trust Services) regulation.
- The Software Traceability Service aims at supporting the DestinE Platform user community to build and share in a common repository traceable controlled software (COTS but also customer developed codes). This service relies on DevSecOps/CICD industrial chain.

5. USER COMMUNITY TOPOLOGY

DestinE Platform users can be classified in:

Unregistered User: any user visiting the DestinE Platform Web Portal can discover the DestinE Platform ecosystem in the following sections:

- *General Information*: Access web pages on Updates, Onboarding and About
- *Service Registry*: View the list of all Services available in the catalogue
- *Dashboard*: Read and export the publicly available metrics
- *Support*: Send requests for general enquiries or regarding registration and find support material like FAQs and Tutorials

Registered Standard User: any user who registers an account through the DestinE Platform Identity and Access Management (IAM), the service managing users' access to resources within the platform. The solution is based on the Keycloak open source software. A Registered Standard User can access the following sections and functionalities:

- *Service Registry*: Full access to all free Services in the catalogue, including the associated data portfolio, all relevant technical resources and training material.
- *Onboarding*: Access to onboarding form, for users who want to become Service Providers
- *Support:* Request support for specialised enquiries
- *Dashboard*: Full access to restricted area of the Dashboard, featuring additional metrics

Registered Service Provider: a provider of a service that is listed in the DestinE Platform Service Registry, therefore becoming accessible to all Standard users. Service Providers on the platform comprise the Core Services (those key essential services implemented and operated under the contract), as well as all external services offering applications and algorithms that get included in the DestinE Platform Framework further to the onboarding process (referred to as Onboarded Services).

Tenant Users: tenant users are Standard users enabled to use the resources and services of a DestinE Platform Tenant. DestinE Platform Tenants are OVHcloud Public Cloud Projects that serve as logical containers for DestinE Platform resources and services. They are managed by Tenant Admins and accessible to Tenant Members.

Federated User: users whose personal data are provided by an external Identity Provider and may be propagated to the IAM Service. They are enabled to access all the DestinE Platform features, functions and services freely accessible.

6. ATTRACTIVENESS AND USER COMMUNITY BUILDING

The appeal of the DestinE Platform to users and external stakeholders stands as a pivotal factor determining the platform's success, utilisation, and evolution. A robust and expansive user community plays a vital role in harnessing and maximising the value derived from the extensive data flow provided by the Destination Earth initiative. Over time, these users will contribute significantly to enriching the platform by integrating their unique data, applications, and insights. This ongoing collaboration will serve as a catalyst for continual innovation, facilitating the creation of new services, simplifying the process for new users to join, and encouraging the exploration of fresh applications and scenarios. This process forms a positive feedback loop, fostering sustained growth and advancement of the platform. DestinE Platform's approach to enhancing the attractiveness of the service platform and fostering user engagement and loyalty encompasses several strategic elements: initiating educational campaigns to raise awareness about leveraging DestinE data, providing ongoing support and guidance for a smooth user onboarding experience, and establishing a centralised Web Portal with various resources while leveraging social media for broader dissemination. By implementing these strategies, we aim to create an ecosystem that not only attracts users but also nurtures their engagement and loyalty. This concerted effort toward enhancing the platform's appeal and user experience will ultimately foster a dynamic and thriving community, propelling continuous advancements and the sustained evolution of the DestinE Platform.

7. DESTINE PLATFORM TIMELINE

The overall DestinE Platform schedule foresees the following Phases:

- Contract Kick-off (KO) on June 1st, 2023
- Preparation phase till KO+12
- System testing with 3Es and Beta Testing Phase
- Service Opening and start of service ramp-up at KO + 12 months,
- Completion of Service ramp-up and full service capability at KO + 18 months. The duration of the contract is 18 months. Figure 4 shows the DestinE Platform timeline.

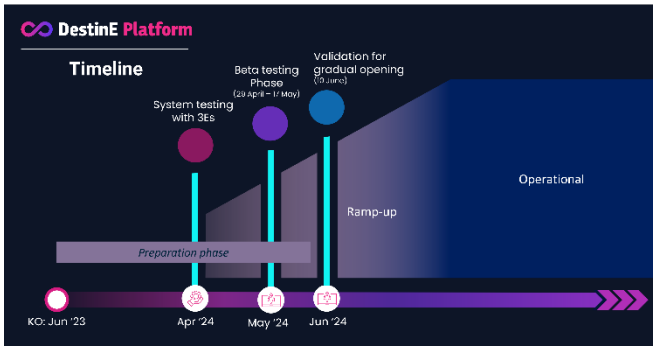

Fig. 4. DestinE Platform Timeline

8. CONCLUSIONS

In this work we have illustrated an overview of various aspects related to the DestinE Platform Project, covering its key features, collaborative efforts, structure, services offered, attractiveness, communication strategies, and the projected timeline for its development and execution.

The DestinE Platform project will contribute to fostering an innovation process so that knowledge can circulate more freely and be transformed into new products and original services for the benefits of the society and its sustainable development.

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