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Artificial intelligence for improved production efficiency, quality and maintenance

Deliverable

D5.4: Integration with AI4EU's AI on-demand platform

WP 5: AI-PROFICIENT system integration and deployment

T5.4: Integration with AI4EU platform, data sources and services

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Executive Summary

The Deliverable D5.4 is a public document of AI-PROFICIENT project delivered in the context of WP5, <u>Task 5.4</u>: Integration with AI4EU's AI on-demand platform, with regard to the activities of the project about integration on AI-on-Demand platform.

The Deliverable describes AI-PROFICIENT's actions in terms of Task 5.4 to align activities with the results of AI4EU project, including the action to build upon the results of the collectively populated platform. To this scope, a description of the AI4EU platform is presented in the current document, both from the technical and software architecture point of view, and also from the functional operation perspective and services offered to the end user.

At the same time, the Deliverable presents the project's integration with AI-on-Demand platform setting the foundation for bidirectional communication and exchange. With respect to the direction of acquiring and integrating software modules from AI-on-Demand platform, the project undertook the activity to explore the platform for available components relevant to scope and objectives of AI-PROFICIENT, download these to inspect implemented capabilities, and (if appropriate) build upon and integrate them into AI-PROFICIENT. Regarding the reverse exchange aspect, project partners engaged in the activity to contribute to the AI-on-Demand platform (whenever allowed from corporate confidentiality restrictions) by submitting AI-PROFICIENT's results to the platform and make them available for future initiatives to build upon and enhance. This includes publishing AI models or complete modules via the corresponding mechanisms of AI4EU platform.

1 Introduction

This document provides a high-level description of the AI on-demand platform initially created and hosted by the AI4EU project, with the scope to collect in a central point software components relative to Artificial Intelligence models/algorithms, serving thus as a repository for other EU projects, developers, and all potentially interested parties engaged in design and implementation of related software modules.

The current Deliverable also presents the interaction of AI-PROFICIENT project with the AI on-demand platform, since it is a fundamental part of AI-PROFICIENT to be integrated with the platform and profit from already available components, trying to download, test and integrate these in AI-PROFICIENT's platform and if possible structure new development around these existing tools. Finally, this document presents the effort of AI-PROFICENT to contribute to the AI on-demand platform by trying to on-board its own software modules developed in the context of project activities.

2 AI4EU Technical specifications

The current section gives an outline of the platform with respect to the technical specifications that have been used during its initial implementation phase by the AI4EU project. These also describe structural architectural components, such as Databases and other services present in the infrastructure, which is hosting the platform, as well as parameters applicable to its subcomponents formulating the overall AI on-demand solution as part of AI4EU project implementation.

2.1 Platform elements

The elements formulating the platform and its structure is presented in Figure 1 below, in an overview representation using as a reference the various website areas.



Figure 1: Overview of platform's elements

The platform contains eight basic components, namely: Home, AI Community, Business and Industry, Research, Education, Ethics, Services, and News and Events which are represented by different colors in this figure.

Grey boxes represent elements available on all pages of the platform such as the menu which can be found at the top of every page and is illustrated by the top grey box. The seven elements in the menu are further populated with different drop-down menus, which are also shown in the grey box. The bottom grey box contains the four elements, namely: Report page, About Al4EU, Legal notice and Social media

that can be found at the bottom of every page. All pages except for the Services page provide a link to the Collaboration page where content can be added to the platform.

2.2 AI4EU platform architecture

This paragraph presents a Helicopter view of the AI4EU platform architecture, made of the static view depicted in Figure 2 below. This figure shows three vertical layers, presents components (e.g., AI4EU Experiments, Identity/Access Management, Orchestrator) and activities (e.g., Runtime operations, Build development, Governance, etc), and demonstrated binding of each component to implementation blocks.



Figure 2: Static view of the Architecture

Architecture components are structured in three layers:

- End user layer: includes the web applications and the services, dedicated to end users,
- Orchestration layer: addresses the orchestration of the applications and services of the end user layer,
- Infrastructure layer: provides the low-level resources (laas: VMs, network, storage) and related services (configuration, security and more).

The platform architecture is based on two main concepts:

- Container based (with a Kubernetes orchestrator),
- Software factory.

These concepts are used to ease the On-boarding of new software components, and provide software developers, with all required software engineering tooling. At the same time, these also help support performance scalability (scale-up the number of running containers).

2.3 AI4EU System overview

From a technical perspective, the platform consists of three major components:

- 1. AI4EU experiments,
- 2. Content management system,
- 3. Search.

We will further describe the first one (AI4EU experiments) since it is the component facilitating the creation of AI-on-Demand by allowing users to profit from the Content Management system and search mechanisms so as to contribute with their components and search for existing ones. It is also the part of the platform enabling integration with other platforms such as AI-PROFICIENT platform.

2.3.1 Structural design of AI4EU experiments

The AI4EU experiments, with regard to the software design and technical specifications point of view, is a fork of the Acumos AI project. Acumos project uses microservices design pattern with RESTful communication for internal interactions. Figure 3 below, illustrates a typical AcumosAI architecture, which is also followed in the implementation of the AI4Experiments area of the AI4EU platform.

Two databases are used to realize the data layer of the architecture: MariaDB for relational data and NEXUS for file management. The deployment of the solution is done in a Kubernetes cluster using the NGINX-Ingress-Controller, which provides the interface to the external traffic.



Figure 3: Typical AcumosAl architecture followed by Al4EU experiments.

2.4 Al-on-Demand

The Al-on-Demand (AloD) platform is a sliced subcategory of Al4EU, built upon the overall platform architecture as shown in Figure 2, profiting from:

- The Infrastructure layer provided by AI4EU and the resources provisioned for "Other Hosting" regarding storage, Virtual machines and core workspaces,
- The Orchestration layer already in place in AI4EU platform, to ensure a Dockerized environment for deployment/execution, scalability, availability and end to end encryption,
- The End User layer putting in place the website interface to host the resources catalogue, and the AI4EU Experiments area with the search mechanism and the Marketplace.

The AloD also utilizes core services of the Al4EU Experiments section, such as Common Services (Model export, Microservices orchestration), the Design Studio Services, the On-boarding functionalities and the MarketPlace, as illustrated in Figure 3. Several of these structural mechanisms are offered to the end-users as platform functionalities to implement some of the AloD services, as described in sections 3.3.1.1 - "Design Studio", 3.3.1.2 - "On-boarding", 3.3.1.3 - "Marketplace" and 3.3.1.4 - "Playground" of the current document.

3 AI on-demand Functional overview

The current section presents the AI-on-Demand platform (AloD) from the user perspective, focusing on functionalities, capabilities and services offered to the users in order to achieve the objective of a one-stop shop hosting AI related applications.

The AI-on-Demand Platform is designed as a community-driven channel to empower research and innovation performed in the field of Artificial Intelligence (AI), by European initiatives, while ensuring the level of quality, trustworthiness and explainability required by European Union. The mission of the platform, being community-driven is to serve as a central point for all stakeholders to cumulatively collect development results of numerous initiatives and also to make AI and ML accessible to developers who do not necessarily have prior data engineering experience.

In this context, AloD is a common environment for the Al community, open and easily accessible, comprised by Al researchers from academia and industry, students, SMEs, Tech providers and EU funded projects, Digital Innovation Hubs and other EU bodies. Accessing the platform from a user perspective, all above entities can use AloD by:

- Contributing with AI-related knowledge, assets, services or tools,
- Making use of the numerous resources available, including educational courses,
- Learning about the potential and opportunities of AI applications,
- Engage with other peers and experts.

Users can navigate to AloD and access the following areas, according to their individual purpose of visiting the platform and profit accordingly from collected knowledge and resources. In the following subsections, the distinct areas formulating the AloD platform are presented.

3.1 Al-on-Demand Preparatory actions

The user can get acquainted with the comprehensive requirement analysis carried out during the preparatory phase for different stakeholder groups, mainly SMEs, industrial sectors, and public administration, which lead to the overall creation of the consolidated platform. This offers an overview of the concept to provide trustworthy AI assets into the platform to support European leadership on trustworthy AI and to offer AI "Made in Europe" and the connection of the platform with other DIGITAL Europe initiatives.

3.2 Contribution Gateway

This is the area of the platform for users to share their work, showcase achievements and contribute with their own content, meaning register new assets and information for:

- Organizations including companies, SMEs, universities, research centers,
- Al-related assets,
- New articles to announce news,
- Upcoming events,
- New projects, project associations and Networks,
- New case studies relevant to the activities of the platform,
- Open calls, academic and/or industrial vacancies, and generic expressions of interest,
- Educational courses, training resources, resources for skilling and upskilling organizations and individuals and in general all possible education content,
- Research Bundles relevant to AI activities potentially interesting to platform stakeholders.

3.3 Al-on-Demand Services

This platform area is dedicated to the scope of showcasing services available in the platform, so that the user can get familiar with the ones that could provide value to its business. Specific services offered are related to Experimentation service for AI developers with access to platform resources, open space to develop AI solutions, DIH support service for SMEs/tech governmental services, planning and scheduling services for companies/SMEs/innovators, scalable AI-as-a-Service services for Deep Edge, Matchmaking service for connecting businesses and AI experts, Earth observation service for users of Copernicus data, and AI-in-Energy service for SMEs reshaping their energy value chain.

Finally, the option for Experiments and Sandbox is offered to the users, which constitutes of an Open space for AI developers that offers visual and intuitive design methods and facilitates the creation of human-centered AI-solutions, building modular structures and using hybrid AI technologies.

Thoroughly investigating the offered AI-on-Demand Services, three distinct areas are available from user perspective, on the platform. These are:

- 1. AI4EU Experiments,
- 2. Education resources,
- 3. Al-Assets Catalog.

The above areas of the platform, serving the scope of experimentation with AI services and also of a repository to be used in various purposes are further analysed in the following sub-sections.

3.3.1 AI4Experiments

The Al4Experiments platform, with regard to services and functionalities offered to the Al community is an open space for Al developers to build Al solutions in a collaborative and intuitive way. The platform offers visual and intuitive design methods. It facilitates the creation of human-centered Al-solutions, building modular structures and using hybrid Al technologies. Building pipelines is facilitated, with the ability to choose from the re-usable, existing building blocks, for example Al models for object recognition, classification or segmentation.

Sharing the solutions is possible by uploading the final building blocks to the AI resources catalogue, whilst navigation is offered to the user to view components available in the Marketplace, as shown in Figure 4 below.



Figure 4: AI4EU Dashboard page

Further functionalities are offered to users in this platform section, which namely consist of the Design Studio, the On-boarding process, the Marketplace and the Playground.

3.3.1.1 Design Studio

The "Design Studio" platform component is offered under Al4Experiments, an application to visually compose Al-pipelines from already published models. The visual environment is used to illustrate connections and dependencies among models and components, providing users with an overview of the final tool they are creating and internal connections.

In the example illustrated in Figure 5 below, several models which have been selected, are matched according to their specifications so that they finally form a new solution.



Figure 5: A typical design view

3.3.1.2 On-boarding

The process required to publish a model to the AI4EU Experiments catalogue is called On-boarding and is divided in two main parts.

The first part is the On-boarding where a form containing technical properties must be filled out, as shown in Figure 6. After that, the model can be used in the design studio and shared with specific users via share model functionality, but it is not visible in the catalogue, yet.

The second part is the Publication process, which adds all properties to the model to create a complete catalogue entry. A time delay is usually observed in this Publication step since a verification time period needs to elapse for the model to be approved by AI4EU committee.

🔂 НОМЕ	On-Boarding Model				
MARKETPLACE	Home / Un-soarding Middel				
A MY MODELS	•		Ē⊕		
ON-BOARDING MODEL	Create	Add	Artifacts		Not yet on-boarded
DESIGN STUDIO	Solution				
Q AND A	ON-BOARD DOCKERIZED MODEL URI				
ML LEARNING PATH				Onboarding History	
	Model Name *			View On Bearding History	
	test	8		view On-Boarding History +5	
	Docker URI +			Onboarding Documentation	
	Dockerhub image example: docker.io/myimageilatest General public registry image example: rind sideurdey eur 7444/myimage v1			On-board a dockerized model URI	
	docker.lo/dockeruritest			Graphene Portal for Modelers	
	Upload Protobuf File *				
	Upload Protobul File	Browse			
	Supported files type: .proto				
	Add License Profile				
	On-Board Model Reset Form				

Figure 6: On-boarding

3.3.1.3 Marketplace

This section is composed of a dedicated space for searching and retrieving models that have been published by other users or researchers. Users can navigate and search for required models and/or components so that they can download and integrate these into new development efforts. Thus, reusability of previous research is achieved and new users can profit from modules that have already achieved an initial development level.

As shown in Figure 7, filtering, tagging and catalogue grouping functionality are supported for rich user experience.



Figure 7: Marketplace of the Experiments

3.3.1.4 Playground

Taking into account all developer needs in an overall manner, the platform provides a staging environment with minimum resources to be used by all users in order to experiment with developed components, assess capabilities and fine-tune the final result. The users can take their solutions and deploy them in a kubernetes cluster which is used as a playground for experimenting with their ideas.

Figure 8 demonstrates the deployment process along with checks provided by the system to confirm successful operation of all stages.



Figure 8: A successful playground deployment

3.3.2 Education Resources

A separate area is created to include AI education resources indexed in the AIoD platform, including remote and onsite courses. The ability to upload and publish educational resources is also offered to the user.

Resulting from the above, a multitude of courses is already uploaded in the platform addressing a variety of content types, such as Surveys, Video courses, presentations and methodology approaches on several subjects.

3.3.3 Al-Assets Catalog

Al-Assets Catalog is a portal where users can browse, search and download all the assets currently indexed in the Al-on-Demand platform, including Al libraries, datasets, containers, and more. Furthermore, users have the chance to publish their own Al assets directly from their accounts.

As a result, a great number of assets appear in the Catalog, which are made available as services, libraries, Jupyter Notebooks, ML Models, Datasets or in Executable form, whilst search functionality is given to users as demonstrated in Figure 9.

Al on Demand	Discover Use Learn Contribute About Q +D ==
Home > Research > AI Ass	ers
All research areas	Collaborative AI Explainable AI Integrative AI Physical AI Verifiable AI
Asset Type - None -	Technical Categories Business Categories Search Keywords Sort by Order - None - - None - - None - Authored on V Desc V
Welcome to the libraries, dataset the <u>Submit new</u>	AI Assets Catalog! Here you can browse, search and download all the assets currently indexed in the AI-on-Demand platform, including AI ts, containers, and more. You are welcome to publish your own AI assets here! To do so, <u>log in</u> in to the platform, go to your <u>dashboard</u> and use <u>content</u> button to access the submission forms.
	ML Model QuantEO a service for automated clustering of Sentinel-2 pixels which allows its users to focus on Earth surface changes rather than on remote sensing problems, and hence to develop their own downstream applications. read more
	TomAbd An autonomous agent combining Theory of Mind and abductive reasoning. read more

Figure 9: Search functionality of Catalog

4 AI-PROFICIENT in AI4EU

4.1 Scope and objectives

AI-PROFICIENT's actions in Task 5.4 were dedicated to aligning development activities with the results of AI4EU project funded under the ICT-26-2018-2020 Call. This includes building upon the results of the AI on-demand platform developed in the context of AI4EU. It aims both at alignment of development activities and at exploitation of the AI4EU's results as part of the AI-PROFICIENT solution. Since AI4EU is aimed to deliver the AI on-demand platform to serve as a one-stop-shop, the task seeks for means to integrate its building blocks and key AI enablers. As the initial point of actions is defined, exploitation of the datasets for early testing of AI services, as well at the fast-prototyping studio, serving as a prototyping environment, for the definition of the workflows, algorithms and data formats had to be considered.

It was defined at the beginning of development activities, that AI services and tools relevant to AI-PROFICIENT's scope and objectives, which are already hosted by the AI on-demand platform need to be thoroughly analyzed and taken into account for exploitation and integration into the AI-PROFICIENT platform. Following this decision, technical partners of the consortium were instructed to explore the AI4EU platform for already existing software modules and datasets relevant to the services they had undertaken to develop in the project. The next step is to carefully examine the capabilities offered by the existing modules and assess whether it is possible to extend the model/algorithm functionalities, build on it with further code development, thus achieve code reusability and exploit the components in AI4EU platform to this new instance. It is also foreseen, that activities of this task will try to build upon the results and lessons learnt from AI4EU's pilot experimentations, in particular the AI4Robotics (Intelligent Performance Analytics for Industrial Robots) and AI4Industry (AI-Driven Digital Companion for Production Facility) case studies, always provided that these case studies are relevant to software components needed in the context of AI-PROFICIENT.

Finally, at the beginning of task activities, as part of defining an internal roadmap for task duration, Al-PROFICIENT technical partners agreed to try for further integration of the project outcomes with Al4EU, by on-boarding modules developed in terms of the project to Al4EU platform if this does not violate internal corporate rules about proprietary software of the partner(s) who developed the software component(s). This action was further supported by ICT-38 Cluster activities, where all projectsconstituting the cluster were enforced to collect contributions in Al4EU under a common account, in order to better represent the cluster's contribution in Al4EU. Extensive details related to this issue will be reported in D7.3 "AI-PROFICIENT clustering and networking".

4.2 Implementation actions

In the duration of this task's implementation, AI-PROFICIENT partners performed both steps of i) trying to integrate modules already uploaded in AI4EU platform and ii) trying to integrate the results of AI-PROFICIENT development to the platform.

As part of the task roadmap to assess the possibility of integrating software modules already present in AI-on-demand platform, project technical partners performed the steps of defining user needs and concluding the software requirements. Then, all partners searched in the AI-on-Demand repository to allocate components and models potential useful to be reused and integrated in the project development actions. Results of these actions are analyzed in Section 4.3 - "Consuming AI4EU assets".

Regarding the objective set internally by AI-PROFICIENT partners to integrate tools in AI4EU platform this resulted to on-board two tools in AI4EU platform, as thoroughly described in performed, as explained in the upcoming Section 4.4 – "On-boarding of AI-PROFICIENT software modules".

Finally, regarding the Al4Robotics (Intelligent Performance Analytics for Industrial Robots) and Al4Industry (Al-Driven Digital Companion for Production Facility) case studies, these were examined by the partners, but since the content of the case studies proved to be not relevant to AI-PROFICIENT

scope and objectives, no further action was taken to integrate software tools originating from these case studies.

4.3 Consuming AI4EU assets

An initial effort was done to allocate modules appropriate for integration in AI-PROFICIENT. After clarifying the Use Cases to be implemented by the project and consequently concluding end-user needs derived from the Use Cases, all technical partners engaged in software development performed an outline of what they need to develop as part of their software implementation. According to this definition of needs and priorities, the partners explored the marketplace of AI4EU platform to find existing modules with similar models, algorithms or other end user functionalities as the ones that they have decided to include in their software components. During this effort several concerns arose regarding the possibility to select the appropriate components from AI4EU.

As a short overview, we can allocate three main reasons for not being able to integrate Al4EU's existing modules in the AI-PROFICIENT:

- a) AI-PROFICIENT requires the creation of software modules based on models which need to be developed upon and trained with data specific to the Use Cases they were developed for.
- b) Many tools already uploaded in the AI4EU platform have a structure bound to the Use Case they were developed for, a structure too generic, whilst at the same time AI-PROFICIENT requires a structure specific to the purposes of the end users (factories) of the project. Therefore, in both cases (generic and non-generic structures) existing modules are not fitting to AI-PROFICIENT development needs, derived from very specific end users' (factories) requirements.
- c) Several tools already existing in AI4EU platform, whilst at first view are seemingly appropriate for AI-PROFICIENT's scope, however upon examination by the technical partners, these seem completely non-functional, they do not operate properly.

Due to these previous reasons, the technical partners were confronted either with the issue that modules are not available for their needs (case a above), either with the issue that existing modules are totally not appropriate for their needs (case b, above), either with the fact that modules existing in AI4EU platform are not operational (case c, above).

In an effort to summarize the problems that appeared, the partners were confronted with an issue of tools in AI4EU platform being very specific to the Use Case requirements that led to the conceptualization of the software component in the original projects they were developed for. At the same time, due to the nature of AI-PROFICIENT many models had to be developed and trained with data specific to the Use Case these will be used to. This leads to the fact that in many cases, no relevant tools could be found in the AI4EU platform. As an example, tools related to Digital Twins of the factories facilitating the project Use Cases cannot be found in a previous repository, since the Digital Twin of an asset is built based on precise representation of the physical asset. Similarly, when tools related to Anomaly Detection at machine level within the same factories are involved, software developers need to base their development in models created within the factory and trained by real time data, also originating from the factory.

In the table below, we provide a list of the modules already present in AI4EU platform, which have been considered and carefully examined by AI-PROFICIENT technical partners to define the possibility to build project solutions upon and integrate them into AI-PROFICIENT platform so as to further exploit their initial potential.

No	Title		Туре	Description
1	Live Recognition	Speech	Docker container	Live speech recognition reliably translates spoken information into digital text in real time. Its main characteristics include: highly reliable speech

Table 1: AI4EU assets tested for integration in AI-PROFICIENT

			recognition, robustness against noise (e.g., in an industrial setting), ability to be combined with automatic speaker recognition, language models available for German and English, word and phoneme output to subsequent systems.
2	Fraunhofer OCR Engine (recognize- ocr)	Docker container	Extracts the geometrical structure and the textual content from scanned and digital-born documents. Additionally, it implements various pre-processing algorithms, like document skew angle correction and image binarization. The OCR is performed using Deep Learning algorithms.
3	VisioRed	Docker container	This component introduces a visualization tool incorporating interpretations to display information derived from predictive maintenance models, trained on time-series data.
4	Altruist	Docker container	Altruist provides the local maximum truthful interpretation, as well as reasons for the truthfulness justification, and can be used as an easy-to-choose tool between X number of different interpretation techniques based on a few specific criteria.
5	Ai4agriculture NDVI component	Docker container	This component is served as a docker image to rectify NDVI computed from sentinel 2 images with the help of drone images.
6	DIDA Platform	Docker container	The DIDA (Digital Industry Data Analytics) Platform enables the development of applications in several industrial domains (e.g., production system optimization, zero defect product quality assessment, energy and waste management, predictive and prescriptive maintenance).
7	AI REGIO Intelligent Computer Vision for Digital Twin	Docker container	The Intelligent Computer Vision for Digital Twin allows for Cyber-Physical Systems, particularly robotic systems, to rely on their perception systems to keep a digital representation of a manufacturing environment updated, through the usage of Cloud, Edge, and Local Al capabilities.
8	Semagrow	Docker container	Semagrow is a dynamic data integration system that presents multiple (syntactically or semantically) heterogeneous datasets as a unified, homogeneous virtual dataset.

Resulting from the above, unfortunately, no modules from AI4EU platform have been integrated in the AI-PROFICIENT platform.

4.4 On-boarding of AI-PROFICIENT software modules

As already described in Section 4.1 - "Scope and objectives", the internal roadmap set between technical partners of AI-PROFICIENT included the integration of as many as possible modules developed in the project, to the AI-on-Demand platform of AI4EU. The project contribution to the platform was planned to be implemented via the On-boarding section of AI4EU as described in Section 3.3.1.2 - "On-boarding", to publish AI models or complete modules. This integration step was designed, both to highlight AI-PROFICIENT's alignment with AI4EU platform according to Task 5.4, but also to serve as a wide dissemination activity, since this ensures the project results get known to the entire community of Artificial Intelligence and are made available for future initiatives to build upon and enhance.

4.4.1 Assessment and feasibility of On-boarding modules

Towards the end of the project implementation phase, after finalizing development actions, AI-PROFICIENT technical partners assessed final software results. Having incorporated collected end user requests to implemented modules, all components had reached their final status depicting business needs, restrictions and requirements for day-to-day tasks dictated by operators in manufacturing shopfloors. As a result, technical partners were able to examine options about potential models/datasets/modules to upload to the AIoD platform and overall feasibility of the above plan.

In most cases, the performed assessment highlighted some negative aspects in the effort to upload all implementation results:

- a) Many tools developed in the context of AI-PROFICIENT are highly dependent to datasets provided from the project end users (Continental and Ineos), leading to software modules, which will not be able to operate outside the context (i.e., the relevant dataset) their initial creation was based upon.
- b) Several tools created for AI-PROFICIENT purposes, incorporate datasets either in their model training, either in the restrictions (boundary values) used to identify a problem and suggest corrections (e.g., alert the operator for an occurring anomaly if a value exceeds the predefined boundary value). These datasets have been accumulated from the project's industrial partners, resulting to models trained, and software fine-tuned according to data and boundary limits provided by the end users. This is done in a way that can be reverse engineered to deduct the parameters set internally by the users.
- c) In other cases, the developed modules are not relevant to Artificial Intelligence, since the spectrum of technologies used in AI-PROFICIENT also includes technologies such as Digital Twins to represent a physical asset, then use mathematical models to represent the cyber physical system and achieve simulation and optimization. These modules are by definition not suitable to be uploaded to the AloD platform.

Due to the reasons above, in most cases the partners faced either the problem of modules being developed in a manner too specific to the original Use Case (case a, above), either the problem that the developed component (model or software) can be reversed engineered to reveal a dataset or a boundary value (machine setting, product parameter, etc.), which is treated as confidential by the project's end users (case b, above). Finally, in a few other cases the partners were confronted with the issue of software implementation, which is not using Artificial intelligence methods, therefore are not relevant to AloD platform.

Further analyzing the issues encountered by technical partners setting obstacles in on-boarding Al-PROFICIENT modules to AloD, the main reasons presented above can be further explained when examining the specific nature of project-related modules. As an example, components developed for machine-level Anomaly Detection, product-level Quality Analysis, and Generative Holistic Process Optimization, are using models trained with data originating from the production line of Continental, therefore are related to parameters (e.g., extrusion temperature, screw speeds, tire length, width, weight, etc.) specific to the shopfloor and produced tires of Continental. Thus, the software is trained to detect machine/product-related anomalies valid only in the context of the specific machines and manufactured products and most specifically the exact type of machines used in Continental and the type of tires produced by the same industry. Consequently, the components are able to suggest corrections to optimize machine operation and product creation only focused in the specific niche production area, rendering these unusable if a future user tries to feed the software modules with data from another industry (either machines, either product). Under the same perspective Digital Twins developed for Ineos industry are obviously useless to apply in other production lines, since by definition the Digital Twin of an asset needs to mimic in an exact manner the specific asset. Therefore, no matter how similar the future industry that might try to incorporate the Digital Twin, the component will not function since not all parameters can be exactly the same.

Therefore, despite the willingness of partners to integrate a great number of modules in the AloD platform this was usually not feasible.

4.4.2 On-boarded modules

However, in some few cases, the modules developed (models or complete software components) are based on Artificial Intelligence development and at the same time are generic enough to be able to function outside the preconditions of the project. These are the few modules finally selected by the partners to be incorporated in the AloD platform, constituting AI-PROFICIENT's contribution to the platform.

The table below, describes the modules that have been on-boarded in the AloD platform on behalf of AI-PROFICIENT, marking thus the project's contribution to the platform.

No	Title	Partner	Туре	Description	Link
1	Atcrecognize	ATC	Docker Container	Atcrecognize extracts text from images that contain label tags. Using its underlying deep learning technology, Atcrecognize enhances the image, removes the unnecessary parts of the image, and feeds the enhanced image into the OCR model that extracts the text with more precision. The app is developed and used for the H2020 project AI-PROFICIENT.	Access <u>here</u>
2	Atranscribe	ATC	Docker Container	ATransCribe is a speech to text service. It uses whisper model for transcription. Whisper is a general-purpose speech recognition model. It is trained on a large dataset of diverse audio and is also a multi-task model that can perform multilingual speech recognition as well as language identification and speech translation. Also using its underlying deep learning technology, it processes sound clips and removes background noises etc., for better results. The app is developed and used for the H2020 project AI-PROFICIENT.	Access here

Table 2	On-Boarded	modules	of AI-PR	OFICIENT

During the stage of integrating AI-PROFICIENT's results in the AloD platform of Al4EU project, we followed the on-boarding area of the platform, which is described in Section 3.3.1.2 – "On-boarding". The exact steps taken to on-board the selected components are demonstrated below, followed by explanations about all required details in each phase of the on-boarding.

In the following paragraphs, screenshots from on-boarding the AI-PROFICIENT modules "*Atranscribe*" and "*Atcrecognize*" are included to demonstrate step-by-step the process and provide a visual representation of the details asked from the user and the assets that should be available, such as an already functioning and tested Docker container.

To make the components accessible by AI4EU platform, the components must be containerized and pushed on a public container repository. Figure 10 demonstrates the description, tags and Docker information for the component ai4eu-Atranscribe, which is on-boarded by AI-PROFICIENT project in the platform.

docker hub			Explore	e Repositories	Organization	is Help 🗸	🧑 atchub 👻
atchub Reposito	pries ai4eu-atra	nscribe Genera	al Sottings				
© atchub Description Speech2Text whis) / ai4eu-atra sper implementatio	n + some improvem	nents for al4eu			Docker commands To push a new tag to this repository, docker push atchub/ai4eu-atran	Public View
Tags This repository co	ontains 1 tag(s).		Ø	MAGE INSIGHTS II	NACTIVE <u>Activate</u>	Recent builds Link a source provider and run a build	to see build results here.
Tag	OS	Туре	Pulled	Р	ushed		
latest	۵	Image		20 hou	rs ago		
See all			<u>Go to Advanc</u>	ed Image Mana	<u>gement</u>		

Figure 10: Including the components in the public container repository.

The process continues on the AI4EU platform. Figure 11, demonstrates the On-boarding model section of the platform, where the necessary information regarding AI-PROFICIENT's module (Atranscribe) was filled in, to provide a Model name, Docker image and specify a license to be used.

€ НОМЕ	On-Boarding Model
MARKETPLACE	Home / On-Boarding Model
MY MODELS	
ON-BOARDING MODEL	Create Add Artifacts
DESIGN STUDIO	Solution
Q AND A	ON-BOARD DOCKERIZED MODEL URI
ML LEARNING PATH	
	Model Name *
	atranscribe UB Docker URI * Dockerhub image example: docker.lo/my/mage/satest
	General public registry image example: cicd al4eu-dev.eu:7444/my/imagev1 docker.ip/atchub/al4eu-atranscribe
	Upload Protobuf File *
	Upload Protobuf File Upload
	atc_sitproto 1HB ×
	Supported thes type: proto
	Add License Profile
	Upload O Select License Profile OR Create New
	Apache-2.0 Y Modify
	On-Board Model Reset Form

Figure 11: On-Boarding Model section

When the on-boarding model process is completed, the model will be available on "My Models" section on my unpublished models subsection as illustrated in Figure 12 (screenshot refers to AI-PROFICIENT's module, Atranscribe).

П НОМЕ	My Models	
MARKETPLACE	Home / My Models	
MY MODELS	Show All	
ON-BOARDING MODEL	Searchinere	MY UNPUBLISHED MODELS SHOWING - 1 TO 2 OF 2 MODELS
DESIGN STUDIO	Filter By Category =	
Q AND A	Data Sources Data Transformer	
ML LEARNING PATH	Prediction Regression	
	Deleted models	atranscribe Antonis Mpantis 05/17/2023 New
	Tags 🔊	\diamond
	Text Detection ocr speech to text	

Figure 12: "My Models" section

The next step is to make the model available on the public catalog, which is to be accomplished by filling out additional information. The fields are available in "Manage My Model" section, displayed in Figure 13 (already containing information about AI-PROFICIENT's module, Atranscribe) and can be found on model's page.

Home / My Model / atranscribe -	- 1.0.0 🗸			Deploy for Execution Version 1.0.0 0 Downloaded
Created by Antonis Mpantis	Created on 05/17/2023 Manage My Model	STATUS: UN	IPUBLISHED	📮 0 Write Comments 🐵 3 🛓 0
Description	INTRODUCTION CATEGORY:Prediction			
License Profile				
ar Signature		(<u>`</u> _)	
Documents		ATRA	NSCRIBE	
Model Artifacts				
Author/Publisher Details				
Tags	RATE: atranscribe			
speech recognition speech to text				
speech2text		0	5 star 0	
		Out of 5 stars	4 star 0	
		0 ratings and reviews	3 star 0	
Other Prediction Models		Rate This Model	2 star 0	
atcrecognize			1 star 0	

Figure 13: "Manage My Model" section.

Information on model publisher and/or authors is collected in the relative screen (Figure 14).

MY MODELS	MANAGEMENT OPTIONS	Manage Authors	
ON-BOARDING MODEL	On - Boarding	PUBLISHER	
DESIGN STUDIO	Share with Team Shared with 2 co-workers	Publisher Name *	
Q AND A	Anage Publisher/Authors	AI PROFICIENT	
ML LEARNING PATH	Publish to Marketplace	Save	
	$\underline{\Psi}$ View Downloads	Antonis Mpantis 🗙	
	A Reply to Comments	Please add additional names of one or more author of this mode	el.
	Delete Model	Name *	Centact info *
		Add author	You can mention Email Address.URL and Phone Number

Figure 14: Publisher/Author information

As shown in Figure 15, regarding AI-PROFICIENT's module (Atranscribe), final steps to submit publication are performed via the "Publish to Marketplace" tab under "Management Options". These include selecting the appropriate catalog, specifying the model Category and Tags, and accompanying this with extra documents or images, if needed.

MANAGEMENT OPTIONS	Publish to Marketplace	
On - Boarding Completed on 05/17/2023	Select Catalog acumos-int-fhg Internal (Restricted)	
Share with Team Shared with 0 co-worker		
R Manage Publisher/Authors	Model Documentation Request Approval	
Publish to Marketplace		
⊥ View Downloads	STEPS TO SUBMIT PUBLICATION (7/7 COMPLETED)	
→ Reply to Comments	Model Name Completed on 05/17/2023 atranscribe	
🕆 Delete Model	Model Description Completed on 05/17/2023 ATransCribe is a speech to text service. It uses whisper model for transcription. Whisper is a general-purpose speech recognition model. It is trained on a large dataset of diverse audio and is nology it process soundclips and removes background noises etc. for better results. The app is developed and used for the H2020 project AL-PROFICIENT.	also a mu
	Description Rating: ****	
	Model Category Completed on 05/17/2023 Model Category: Prediction Toolkit Type: TensorFlow	
	Model Documents Completed on 05/17/2023 Add documents (such as a README file) to give more details and show how to use your model.	
	ATransCribe html X Use the Documents you have for Other Revisions. Version - Copy Copy	
	Model Tags Completed on 05/17/2023 Choose tags to help describe your model. Add new tags if needed. Tags can have 32 characters only. speech/zitext X speech recognition X speech to text X Enter a tag	
	Upload Image for Model Completed on 05/17/2023 Upload an image that will identify your model in Marketplace. You can upload jpg, jpeg, png and gif file with maximum size of 1MB.	
	Submit To Publication Unpublish Preview Model	

Figure 15: "Publish to Marketplace" section with model details.

After completing the above steps and proceeding with submission to publication, the component will be on "Pending for approval" state and can be viewed on my models section (Figure 16).

My Models Home / My Models		
BROWSE BY	Show All	Sort By-All 🗸 🚦 🔠
Search here	٩	MY UNPUBLISHED MODELS SHOWING - 1 TO 2 OF 2 MODELS
Filter By Category	₹	
Data Sources Data Transformer Prediction Repression		Perding for approval
Deleted models		atranscribe Amerialityenta (2011/2022 See-
Tags	8	
Text Detection our sp	eech to text	
speech2lest speech rec	galtion	MY PUBLISHED MODELS SHOWING - 1 TO 1 OF 1 MODELS

Figure 16: "Pending for approval" status.

Once the component is checked by the AI4EU committee it will be accepted and be available on public catalogue, as depicted in Figure 17, regarding AI-PROFICIENT's module (Atrecognize). As a result, users of the platform will be able to use the component standalone, create pipelines etc.



Figure 17: Public Catalog

To finish the contribution to the AI4EU platform, an additional step has to be performed. Regarding each component that has been on-boarded, a dedicated card about its specificities has to be created at ai4europe.eu platform. To fulfill this step, the publisher of the module has to access the platform using the url: <u>https://www.ai4europe.eu/</u>, login with their AI4EU credentials, and then finish the contribution by filling in a form with details about the component, as demonstrated in Figure 18, where relevant steps are performed for AI-PROFICIENT's module Atranscribe.

Al on Demand	Discover Use Learn Contribute About Q 🚨 🔂 :
	Add your Al Asset
	Title*
	atranscribe I
	Summary *
	ATransCribe is a speech-to-text service. It uses <u>Whisper</u> model for transcription. Whisper is a general-purpose speech recognition model. It is trained on a large dataset of diverse audio and is also a multi-task model that can perform multiflugual speech recognition as well as speech translation and language identification. Also using its underlying deep learning technology it process soundclips and removes background noises etc. for better results <u>The</u> app is developed and used for the H2020 project AI-PROFICIENT.
	~ 6
	Main Characteristic *
	B I U S x ^e x _e I _x ∞ ∞ (□ ⊒ ⊒ *) ≣ *) ≣ Styles - ≫ ⊠Ω Ω ≅ - ⊙ Source ⊒
	Speech to Text Removes background noises Enhances Speech Correct misspelled words
	@
	body ul li
	Asset Type
	ML Model × •
	Technical Categories
	× AI services

Figure 18: Finalizing the contribution with an AI-Asset

Upon form submission a card is created and as a next step can be shared and accessed by users to view the description of the module.

5 Conclusion

Summarizing the previous sections, this document provides an overview of all actions the project performed resulting from obligations described in related project Task 5.4 in order to be integrated with the AI4EU platform. This platform is a collectively populated one-stop shop for AI-related services, designed as a point to gather the results of software development performed in the context of projects, national or European synergies, and academic/corporate research upon models/algorithms, all focused on the improvement of Artificial Intelligence achieved in the research and innovation community.

In this context, a technical and functional overview of the platform has been presented, to provide the perspective of technical assets available to AI-PROFICIENT partners but also of functionalities and services offered to them, the scope being to create the environment to profit from and contribute to enhancing AI activities.

The document displayed efforts of the partners to achieve integration with AI4EU platform in a bidirectional manner. To this scope, the Deliverable presents action taken to import into AI-PROFICIENT modules from the AI-on-Demand platform already put in place by the AI4EU project and also presented the reasons it was not possible to realize this for the current project. At the same time, the Deliverable demonstrated actions of the partners to on-board modules created in terms of AI-PROFICIENT to the AI0D platform, facing related obstacles and challenges.

In conclusion, the project interaction with the AI4EU initiative has been successfully performed and all partners engaged in related actions to implement integration with the platform, create a broader AI-related community and achieve dissemination of project results to a wider audience. Finally, in some cases the effort to on-board modules was successful and resulted to fruitful contribution in the platform, signifying thus that the project managed to align its activities with AI4EU initiative and project results are available for other stakeholders to profit from, exploit them and (whenever possible) to perform next steps.

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