

STAIRwAI

Stairway to AI: Ease the Engagement of Low-Tech users to the AI-on-Demand platform through AI, H2020

D2.2 Requirements for AI-on-demand platform

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Author(s)	Ville Tenhunen, Andrea Borghesi, Roberta Calegari, Malika Elkharraz, Michele Lombardi, Marco Rorro, Renato Santana
Contributors	Miguel de Prado, Gabriel Gonzalez, Melissa Brunner
Deliverable reviewers	Javier Vázquez-Salceda, Ilhan Aslan



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Acronyms

Acronym	Explanation
AI	Artificial Intelligence
API	Application Programming Interface
CMS	Content Management System
CPU	Central Processing Unit
GDPR	General Data Protection Regulation
GPU	Graphics Processing Unit
GUI	Graphical User Interface
HPC	High Performance Computing
HMI	Human-Machine Interface
HW	Hardware
IaaS	Infrastructure-as-a-Service
ML	Machine Learning
MVP	Minimum Viable Product
NLP	Natural Language Processing
PaaS	Platform-as-a-Service
QoS	Quality of Service
RAM	Random-Access Memory
RTO	Research and Technology Organisation
SME	Small and Mid-size Enterprise
SaaS	Software-as-a-Service
SSD	Solid State Drive
SW	Software
URL	Uniform Resource Locator
WP	Work Package



Glossary

Term	Explanation
Infrastructure as a Service (IaaS)	Cloud resources can be accessed by Internet and the user manages the Operating System, Data, applications, middleware, and runtimes.
Platform as a service (PaaS)	Type of cloud services where users manage only data and applications.
Software as a Service (SaaS)	Type of cloud services where all infrastructure, including applications, are managed by the service provider.

See also: <http://go.egi.eu/glossary>



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1. Executive Summary

The StairwAI project aims to create a bridge between users at a low-tech level to the higher-level AI resources. The project will do this by facilitating low-tech users' engagement on the AI-on-demand Platform. This will be achieved through a new service layer enriching the functionalities of the on-demand platform and containing:

- (1) a **multi-lingual interaction layer** enabling conversations with the Platform in the user's own language,
- (2) a **horizontal matchmaking service** for the automatic discovery of AI assets (tools, data sets, AI experts, consultants, papers, courses etc.) meeting the user requirements and,
- (3) a **vertical matchmaking service** that will dimension and provision hardware resources through a proper hardware provider (HPC, Cloud and Edge infrastructures).

This means that it is needed to define user requirements on several levels among low-tech users, resource providers and those who develop or integrate these elements as a one service layer. This document presents the final version of requirements and architecture components for multi-lingual interaction, horizontal matchmaking and vertical matchmaking.

The deliverable also describes AI4EU integration aspects and StairwAI platform relations with it.

2. Introduction

2.1. Purpose of the Document

This deliverable reports the requirements for multi-lingual interaction, the vertical and horizontal matchmaking layers. The purpose of this deliverable is to be the final version of high-level requirements for the AI-on-demand platform StairwAI service and its interoperability with AI4EU.

This deliverable follows D2.1 "Requirements for the AI-on-demand platform-1st version" which reports the first version of requirements.

2.2. Scope of the Document

Deliverable D2.2 is produced within the WP2 and it affects specifically on WP4 (Multi-lingual interaction with the platform), WP5 (Horizontal matchmaking), WP6 (Vertical matchmaking and integrations) and later WP7 (Open calls and especially T7.4 Call to Identify Experts and HW Resources Providers).

2.3. Structure of the Document

The present deliverable consists of three main sections. Section 3 describes the main system components highlighting the desired functionalities. System analysis and design - in terms of high-level conceptual architecture and reference architecture- are discussed in Section 4. Then, Section 5 describes functional and



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non-functional requirements for the StairwAI components. Finally, Section 6 focuses on interoperability requirements with particular emphasis on the AI-on-demand platform integration (i.e. AI4EU).

3. Main System Components Overview

This section describes the main components or software blocks that allow the matchmaking service to operate and interact with the final users. Foremost among all components, the three core ones are:

- Multilingual interaction - Chatbot (NLP),
- Horizontal Matchmaking, and
- Vertical Matchmaking.

Furthermore, each of these components have associated a set of subcomponents that have been identified and will be described in some extent in this deliverable and more in detail and extensively in either subsequent deliverables of this WP (D2.3) or on specific deliverables associated to the WPs 3, 4, 5 and 6, where these components will be living and implemented.

3.1. Multi-lingual Interaction - Chatbot (NLP)

The multi-lingual interaction with the platform is made through the StairwAI chatbot which offers a *Multi-Lingual Virtual Assistant*.

The purpose of the StairwAI chatbot is to provide an easy way for the users to interact with the platform by using their preferred language (e.g. native language) and then easily get value from services provided by the Horizontal Matchmaking, and the Vertical Matchmaking modules. This chatbot is based on Natural Language Processing techniques.

Figure 1 shows the interaction of a user with the StairwAI platform:



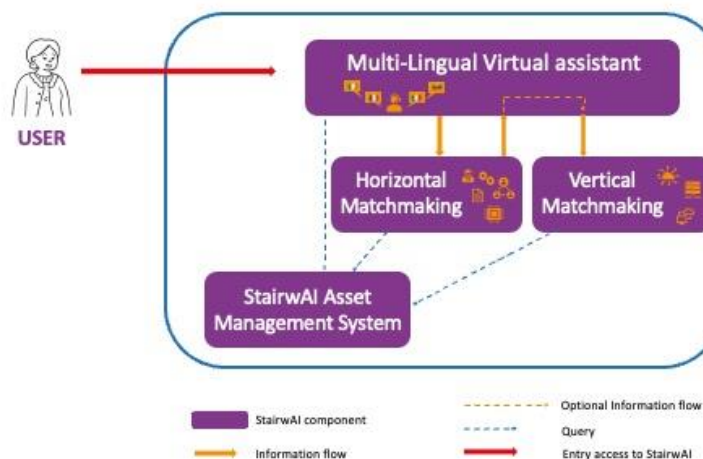


Figure 1 Multi-Lingual Virtual Assistant

The Chatbot features are implemented by Tilde using NLP processing tools developed within Tilde.ai platform. The Chatbot collects information from the user about his needs, and the dialog system analyses the request and extract intents to access the good resources through, for example the advanced search engine implemented by Thales. Especially when a user needs AI resources (AI tools; datasets), the indexed catalogue of AI4Experiment (from AI4EU platform) is requested with a structured query based on catalogue design.

To solve some simple queries not requiring matchmaking, the Chatbot is assisted by an Advance Search Engine. The advance search engine provides services through an API and has been developed by THALES with the AI4EU programme¹, and it is currently interconnected with the AI4Experiment module of the AI4EU platform.

The first version of the StairwAI Chatbot Prototype has been released by WP4 in Month 17 (May 2022). The “StairwAI Bot” is available for experimentation as a MVP of the VA Webchat 4.0 By Tilde². The documentation describing in detail the Chatbot is included in HYPERLINK "https://liveunibo.sharepoint.com/:w:/r/sites/StairwAIproject/_layouts/15/doc2.aspx?sourcedoc=%7B97875749-1B6D-4D5B-845B-688621148CAF%7D&file=Deliverable%204.1.docx&action=default&mobileredirect=true&cid=9c95c074-db98-4449-8987-be16e8c614d1" Chatbot MVP"³ by WP4.⁴

¹ ai4europe.eu

² <https://dev-botplatform.tilde.com/api/aireadiness0/chat/default.htm>

⁴ StairwAI Deliverable 4.1: “StairwAI Chatbot MVP”



3.2. Horizontal Matchmaking

Horizontal matchmaking is a service that enables easy access and discovery of AI assets (i.e. relevant AI experts, datasets, HW resources, benchmarks etc.) on the AI-on-demand platform. It takes as input a textual query, which is processed via NLP techniques to yield namely symbolic information. This consists mainly of scores assigned to a set of labels corresponding to ontological categories. The system then retrieves resources that (either in isolation or in combination) can address the user query or are relevant to that.

Figure 2 shows the blocks that describe the conceptual components of the Horizontal matchmaking and the inputs and outputs of this block.

To enable matchmaking, it is essential to construct a common language (a proper ontology), which will act both as an intermediate format between the NLP and the matchmaking components, and as a schema for describing the available resources (e.g. tools, people, data sets, benchmarks, courses). This is provided by the AI Assets Conceptual Semantic Model, defined in Deliverable D3.2 “Design of the knowledge representation in the StairwAI AI Asset Management System – version 2” within WP3.

The mapping will be performed by algorithms that will be developed during the project by relying on a combination of Machine Learning and user-defined metrics and constraints: identifying the requirements for such algorithms is among the goals of this document.

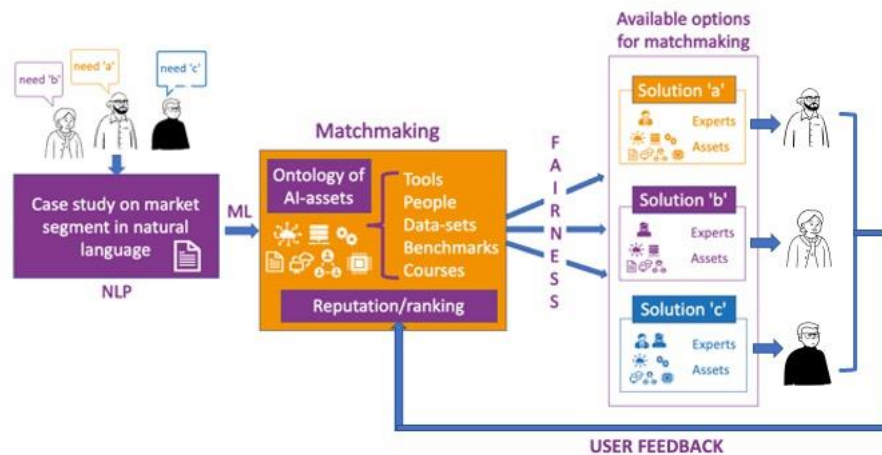


Figure 2 Horizontal Matchmaking

Fairness and transparency are essential properties of the matchmaking system and they should be guaranteed for every result. In StairwAI, we have opted for providing flexible mechanisms and interactive tools to handle such aspects, rather than for using an implementation based on pre-selected metrics and solutions. Additionally, we will design and implement a reputation mechanism to handle user feedback to the platform. More information on this topic will be provided in Section 5.2.3.

The matchmaking system will need to be designed so that it could be extended to deal with multiple query and resource types. Initial efforts will focus on mapping description of *industrial problem descriptions* to *AI assets* (algorithms, libraries) that could be used to address them. Later in the project, other types of queries



(job offers, training requests) and resources (experts, papers, courses) will be considered, after an additional feasibility check for standing regulation (e.g. GDPR).

3.3. Vertical Matchmaking

The time to reach a converged solution for some AI algorithms is unpredictable since it depends on several parameters such as learning rate, number of inputs etc. Moreover, implementation optimization and software releases may vary substantially the performance of a specific algorithm. All this makes the dimensioning of hardware resources for some AI algorithms unpredictable. Nevertheless, during the project lifetime, a dataset of algorithm resource demand needs on specific hardware platforms will be built by benchmarking and profiling AI algorithms in the AI-on-demand platform, and whenever possible, by gathering results from other sources, such as MLperf⁴, OpenML⁵ or even from user feedbacks.

Such a dataset will be used to train a machine learning model that, performing regression, will be able to extract the running time, memory and hardware resources required by a given algorithm.

The vertical matchmaking service, further fed with the set of constraints from the end user – time, costs, privacy, or any other constraints that can be identified during the project development – and with the available hardware resources from the hardware provider marketplace, by using a conjunction of machine learning and optimization approaches, will select the type of hardware and resource provider that best suits the end user preferences.

The workflow of the Vertical Matchmaking is depicted in Figure 3: through the NLP services it receives the following inputs from the user:

- The set of algorithms or services, e.g., neural networks, optimization algorithms, that need to be deployed as previously identified by the horizontal matchmaking service.
- The user constraints such as runtime, cost (solution quality), specific hardware resource requirements (e.g. RAM memory consumption), budget envelope, etc.

and, by using machine learning and optimization techniques, it will select the best hardware resources provided by those entities selected in the open call for HPC, cloud or embedded providers (WP7).

The underlying benchmarking service, essential to build the training set for the vertical matchmaking, has value by itself, since it allows to benchmark specific algorithms on different hardware resources.



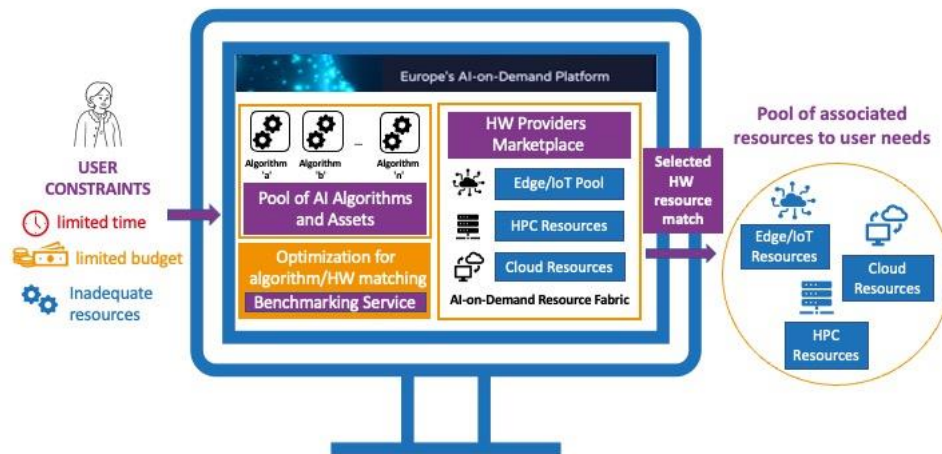


Figure 3 Vertical Matchmaking

4. Analysis and Architecture Definition

4.1. User Stories

The purpose of user stories is to explain the roles of users in a system like the StairwAI platform, their desired activities, and what they intend to accomplish by successfully completing a user story. For Agile teams, user stories are the primary method of identifying user needs.

Following the interviews and the use cases analysis the following user stories for the StairwAI platform have been identified. They are described through the usual format: « *As a (type of user), I want to (perform some action) so that I (can achieve some goal/result/value).* » The acceptance tests of each user story specify the conditions under which a user story is fulfilled, it helps development teams to avoid ambiguity about the users' needs.

In the next subsections details for each user story are provided.

4.1.1. User: Expert on AI

Title: Expert registration	US01	
<i>As a <Expert on AI></i> <i>I want to <register in the platform></i> <i>So that I can <monetise my knowledge>, <get data for my research></i>		
Acceptance criteria <i>Given <the expert profile></i> <i>When <a form is filled on its desires and the expertise / pointer to LinkedIn / CV></i> <i>Then <the expert receives an admittance receipt to the system></i>		



Title: Expert deregistration	US02	
<i>As a</i> <Expert on AI> <i>I want to</i> <deregister from the platform> <i>So that I can</i> <remove my data>		
Acceptance criteria <i>Given</i> <the expert profile> <i>When</i> <the expert presses on delete profile> <i>Then</i> <the expert receives a confirmation of deletion from the system>		

Title: Expert data modification (modify profile)	US03	
<i>As a</i> <Expert on AI> <i>I want to</i> <modify some of the data from my profile> <i>So that I can</i> <enhance the options for getting more hits>,		
Acceptance criteria <i>Given</i> <the expert profile> <i>When</i> <the expert presses on edit the profile> <i>Then</i> <the expert accesses to the data from the form, modify data and save it again >		

Title: Expert data visualization	US04	
<i>As a</i> <Expert on AI> <i>I want to</i> <revise some of the data from my profile> <i>So that I can</i> <have a full view on my profile or show/explain to other people>,		
Acceptance criteria <i>Given</i> <the expert navigating on AI on demand on his profile> <i>When</i> <the expert press on expert matchmaking profile> <i>Then</i> <the expert will access to his/her data on the platform.>		

4.1.2. User: HW provider

Title: HW provider registration	US05	
<i>As a</i> <HW provider> <i>I want to</i> <register in the platform> <i>So that I can</i> <offer the hardware resources>, <get customers>		
Acceptance criteria <i>Given</i> <HW provider> <i>When</i> <a form is filled on its desires> <i>Then</i> <the HW provider receives an admittance receipt to the system>		

Title: HW provider deregistration	US06	
<i>As a</i> <HW provider> <i>I want to</i> <deregister from the platform> <i>So that I can</i> <remove my data>		
Acceptance criteria <i>Given</i> <the HW provider profile> <i>When</i> <the HW provider presses on delete profile>		



Then <the HW provider receives a confirmation of deletion from the system>

Title: HW provider data modification (modify profile)	US07	
<i>As a < HW provider on AI> I want to <modify some of the data from my profile> So that I can <enhance the options for getting more hits>,</i>		
Acceptance criteria <i>Given <the HW provider profile> When <the HW provider presses on edit the profile> Then <the HW provider accesses to the data from the form, modify data and save it again ></i>		

Title: HW provider data visualization	US08	
<i>As a < HW provider on AI> I want to <revise some of the data from my profile> So that I can <have a full view on my profile>,</i>		
Acceptance criteria <i>Given <the HW provider navigating on his profile> When <the HW provider press on HW matchmaking profile> Then <the HW provider will access to his/her HW data on the platform.></i>		

4.1.3. User: A Developer or Researcher on AI

Title: Benchmark AI software for matchmaking	US09	
<i>As a <AI developer> I want to <benchmark my AI software> So that I can <make it addressable for matchmaking in automated fashion></i>		
Acceptance criteria <i>Given <the AI asset developed and containerised following the criteria required by the AI on demand> When <The user uploads the asset to the platform and selects to benchmark the asset> Then <The system will benchmark the service if there is hardware available and will provide a report. Moreover, the asset will be addressable for automated matchmaking></i>		

Title: Benchmark AI software for research	US10	
<i>As a <AI researcher> I want to <get a report on how my AI asset (software) behaves> So that I can <speed up my research and do not have to benchmark it myself>,</i>		
Acceptance criteria <i>Given <the AI asset developed and containerised following the criteria required by the AI on demand> When <The user uploads the asset to the platform and selects to benchmark the asset> Then <The system will benchmark the service if there is hardware available and will provide a report.></i>		



4.1.4. User: SME

Title: Simple request from Low tech user to better understand AI	US11	
<p><i>As a</i> <low tech SME> <i>I want to</i> <understand how to use AI> <i>So that I can</i> <invest on some advances that makes me increase the production>,</p>		
<p>Acceptance criteria <i>Given</i> <user with low understanding on AI, but enough knowledge to be navigating the web to look for solutions. Ideally, he/she will be driven to a path where they can find the Chatbot (NLP) and to ask for solutions> <i>When</i> <the user describes that he/she wants to understand better AI> <i>Then</i> <the user will have access to courses / experts that will explain better how to help them ></p>		

Title: Request from low tech user to find a solution to a specific AI problem	US12	
<p><i>As a</i> <low tech SME> <i>I want to</i> <look for a specific solution to a problem using AI> <i>So that I can</i> <invest on some advances that makes me improve the production>,</p>		
<p>Acceptance criteria <i>Given</i> <user with low understanding on AI, but knowledge to be made deployments of tools and solutions. The user does not want to hire a person that works on AI, but wants a deployable solution. Ideally, he/she will be driven to a path where they can find the Chatbot (NLP) and to ask for solutions> <i>When</i> <the user describes that they want to address a specific problem using AI> <i>Then</i> <the user will have access to a combination of software / experts / recommendation on hardware resources that will make them to satisfy their conditions></p>		

Title: Upload a job description for hiring need	US13	
<p><i>As a</i> <SME/Company/RTO> <i>I want to</i> <look for experts> <i>So that I can</i> <hire them according to a job description>,</p>		
<p>Acceptance criteria <i>Given</i> <company or SME with low or medium understanding on AI, but knowledge to be make know what they need. Ideally, the company will be driven to a path where they can post the job descriptions.> <i>When</i> <the company upload the job description > <i>Then</i> <they will receive a notification that Experts are notified, and when a user agrees to revise the offer, they will receive a notification. So, number of views, number of applicants.></p>		

Title: Deployment of models	US14	
<i>As a</i> <researcher/SME>		



<p><i>I want to <make a deployment of some models on a cloud></i> <i>So that I can <save money>,</i></p>
<p>Acceptance criteria <i>Given <The user has an already implemented tool that wants to deploy></i> <i>When <The user analyses the availability, and gives his/her economic and time constraints></i> <i>Then <the system recommends the best clouds or resources to make the deployments></i></p>

4.2. StairwAI Reference Architecture

Reference architecture diagrams are used to represent system’s recommended structures and components.

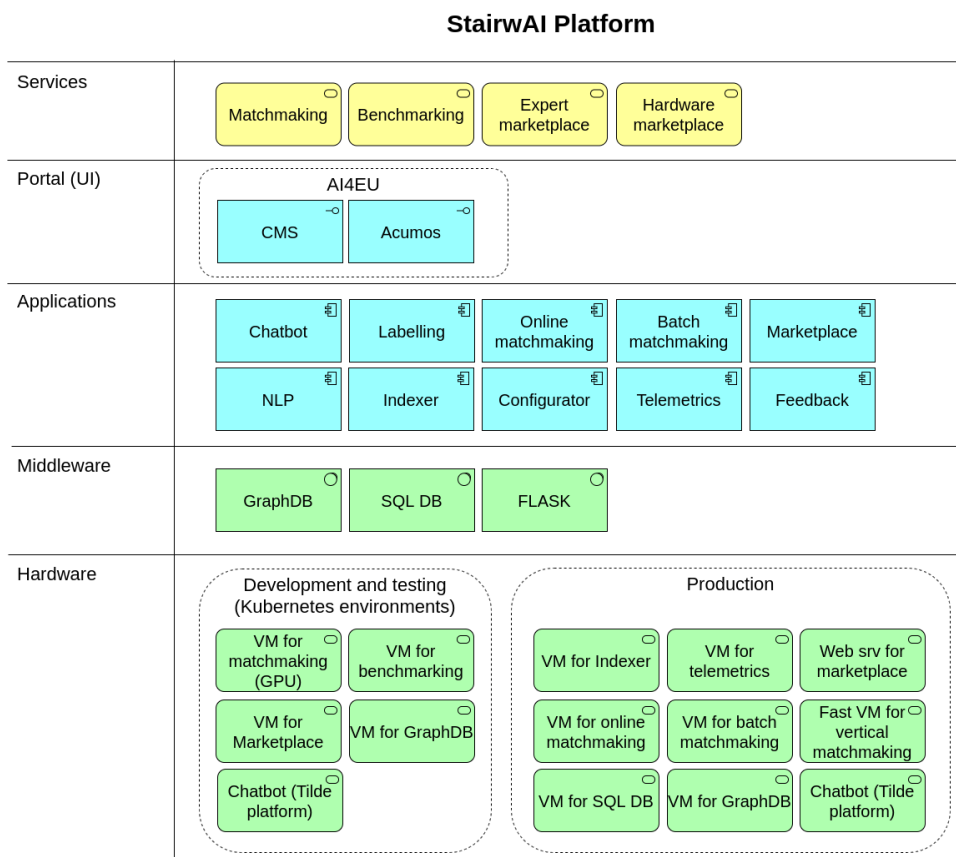


Figure 4 StairwAI Platform

StairwAI reference architecture contains the following layers:



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Services are the way to provide value to customers through bringing about results that they want to achieve (by the general definition).⁵ Services are matchmaking (both, vertical and horizontal matchmaking), benchmarking (of hardware), expert market places and hardware marketplace.

Portal (UI) represents the channels for users to get access to resources delivered by StairwAI platform. In the StairwAI the portal is on AI4EU with two components; CMS for normal web content management and Acumos for AI tools and resources.

Applications contain those software components which are possible to use via Portal and which realize services described above. In this layer some applications are not straight visible to users but are integrated parts of some other applications.

Users can see some of those applications i.e. chatbot and NLP, matchmaking applications and marketplace. Labelling is connected with chatbots and NLP but also with indexer. Indexer, configurator and telemetrics are supporting matchmaking applications and feedback linked to marketplace.

These applications will provide functionalities which are needed for Horizontal matchmaking and uses data from Vertical matchmaking.

Middleware layer represents those software components which have to be installed and maintained for applications. Typically, these are for example database servers, orchestrators, software frameworks or similar.

Hardware layer represents server environments which are needed for middleware and applications. There are normally three environments such as development environment, testing environment and production environment. In StairwAI has been decided that development and testing environments are one common environment. Production environment will be separate one.

StairwAI reference architecture and its components will be defined more specifically in the StairwAI deliverable D2.3 Architecture design of Service Layer.

4.3. High Level Conceptual StairwAI Architecture

Here is the overall conceptual architecture diagram where integration between resources and processes can be found. Requirement and onboarded resources have to be compliant with these architecture level requirements.

⁵ FitSM-0 Overview and Vocabulary file:///home/ville/b2drop.eudat.eu/EGI/Trainings/FitSM/FitSM-0_Overview_and_vocabulary_V3.0_PRE-RELEASE-1.pdf



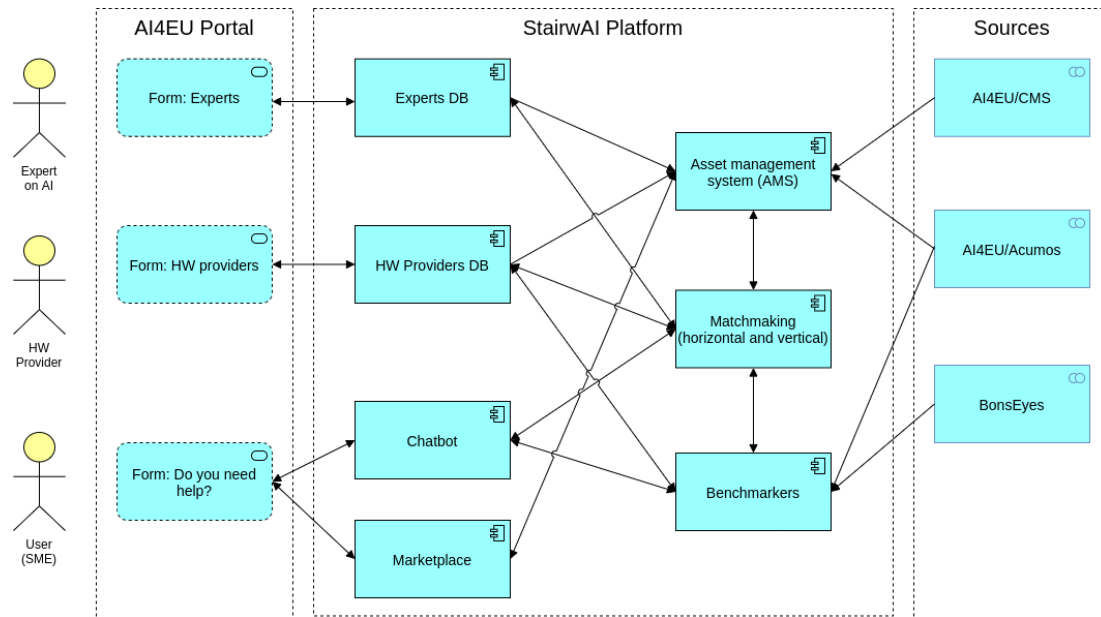


Figure 5 Conceptual Architecture

The conceptual architecture diagram represents StairwAI platform applications and their integrations as users experience them. Conceptual architecture diagram is very high-level representation. In practice there will be more applications for the platform and they will be specified in StairwAI deliverable D2.3 “Architecture design of Service Layer”.

User access to the StairwAI platform will happen via AI4EU Portal and StairwAI applications and components will be integrated to this portal.

Main components for users of the StairwAI platform are Chatbot, Expert Database, Hardware Database, Marketplace. They need Asset Management System (AMS), Matchmaking applications (horizontal and vertical) and Benchmarks. These components have clear interoperability between each other. Especially integrations with asset management system (AMS) and matchmaking applications are crucial.

StairwAI platform use also external data sources such as AI4EU CMS and AI4EU Acumos which offer data to the matchmaking and benchmarking. Additionally, BonsEyes will offer also benchmark data.

Data flows between different components will be defined more specifically in the StairwAI deliverable D2.3 “Architecture design of Service Layer”.

5. Functional and Non-Functional Requirements

5.1. Introduction

In this chapter requirements for the StairwAI on-demand platform are specified. Users are low-tech SMEs and their representatives, but also experts, developers and researchers. This has to be taken into account in requirements and deployment of the system.

Functional requirements for specifying what the system should do such as:



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- Business Rules
- Pricing and payment models (possible methods for users and service providers)
- Authentication (which methods users can use)
- Authorization (which levels users need)
- Deployment mechanism
- Possible licenses
- Ordering

Non-functional requirements for specifying how the system performs a certain function such as:

- Usability (regulations and guidelines)
- Performance and QoS (for example response time, throughput, utilization)
- Scalability (component's scalability)
- Capacity (capacity specification on vertical matchmaking)
- Security and data protection – regulations and guidelines
- Interoperability
- Other regulatory requirements

5.2. Functional Requirements

Functional requirements define the input-output behaviour of the system, so as to define its behaviour.

5.2.1. Generic Functional Requirements

The main aim of the StairwAI project is to enable low tech SMEs to adopt AI solutions to improve their business. It will rely on the AI-on-demand platform and will enhance it with its services whose specific requirements are described in the following sections. This section reports those functional requirements envisaged for such services as a whole.

As described in the user stories, in order to drive low tech SME towards their goals, other actors need to be involved: AI experts, developers, researchers and hardware resource providers. All these users have to be managed and their user profile supplemented with the AI-on-demand one.

RG.1 User management

The service layer shall implement user management (register, modify and delete users) by relying on the AI-on-demand platform.
essential

The trade-off between the integration with the AI-on-demand platform and the interoperability with other platforms and services has to be carefully considered. Details on the interoperability with the AI-on-demand platform and its authentication mechanism are provided in Section 6.

RG.2 AI-on-demand platform integration



The service layer shall consider the trade-off between integrating itself into the existing AI-on-demand platform and integrating itself into a dedicated platform. This trade-off should take into consideration aspects such as hosting, performance, infrastructure and user authentication and authorization.
essential

One objective of the WP7 of the StairwAI project is to develop business model/s for the use of the services developed and the work plan of the post-project market penetration of the extended AI-on-demand platform.

RG.3 Business rules

StairwAI services shall follow the StairwAI WP7 definitions and rules.
essential

Ordering process shall be defined and it also has to contain pricing information and suitable payment methods.

RG.4 Ordering

Ordering process shall be defined and it shall contain also pricing information and suitable payment methods such as pay per use, project contracts, billing and other.
essential

RG.5 Pricing

Pricing information has to be fairly transparent and available for potential users.
essential

RG.6 Payment methods

Payment methods of services and resources have to be clearly defined even when a method is not needed.
essential

RG.7 Licenses

Licenses between end users and resource providers have to be included in the service or resource information as clearly as possible. The information has to contain a link to the exact license description.
essential

Monitoring and logging provide essential information, and are also needed to satisfy other requirements such as scalability and capacity.



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017142

RG.8 Monitoring and logging

The service layer shall provide monitoring and logging. <i>essential</i>

For the continuous improvement of the services, it is important to allow users to raise help desk requests, provide feedback and display quality ratings of services and solutions.

RG.9 Help desk

The service layer shall allow users to raise help desk requests. <i>essential</i>
--

RG.10 Quality ratings

The service layer shall display the quality ratings of the available services and solutions proposed. <i>essential</i>

The deployment mechanism is the action used to put built application or resource into platform where users can find and use it.

RD.1 Deployment mechanism

StairwAI services deployment mechanism must be well described and as open as possible for multiple resource sources. <i>essential</i>
--

5.2.2. Functional Requirements for Multi-lingual Interaction (NLP)

The documentation describing the functional requirements of the StairwAI Chatbot (WP4) covering the multi-lingual interaction is in D4.1⁶. The “StairwAI Bot” is also available for experimentation as a MVP⁷.

5.2.3. Functional Requirements for Horizontal Matchmaking

⁶ Deliverable 4.1: "StairwAI Chatbot MVP"

⁷ VA Webchat 4.0 (tilde.com): <https://dev-botplatform.tilde.com/api/aireadiness0/chat/default.h>



In the case of the Horizontal Matchmaking, the system input consists mainly of textual information describing a user need. The description will follow a semi-structured format (i.e. a few text boxes) coming from the NLP component. The use of multiple boxes is meant to support the user and prevent the omission of critical information. For example, queries related to industrial use cases will be structured as follows:

Field	Definition/Help Text
Use Case Context	The physical or digital system that benefited/may benefit from the use of AI
Use Case Motivation	How the problem arises (or has arisen) in the company business, what makes it challenging
Data Availability/Provisioning	Which data are (or were) available, what needs to be still collected?
Use Case Objective	What the AI system is supposed to do and which benefits you got/plan to get
Additional requirements	Any property of the AI system that is not immediately tied to its function, but is still needed for the application (e.g., fairness, “explainability”, energy or power efficiency, latency)

The format is the same used in the “business consultancy questionnaire” that was used for offline data collection in the early stage of the project (Questionnaire Outline described in the Annex 1). From a technical point of view, the textual information will be merged before being processed by the matchmaking pipeline: for this reason, support for additional query types (e.g. training requests) can be added with minimal modifications.

In Tasks 5.2 and 5.3, additional request types will be considered, including professional profiles (e.g., to be matched to open positions) or request for courses. In later stages, it may be possible to integrate the textual input with symbolic information provided directly from the user (e.g. the location for an expert).

The system output can be characterized at two distinct stages:

- At the first stage, the output will consist of a labelling of the input requests in terms of a reference ontology, representing the applicable classes of AI content. Multiple categories, with different weights or intensities) will be considered.
- As a second stage, the above mapping will be used to retrieve relevant resources and (internally) rank them, also characterized in terms of a mapping over the same ontology. The resources may include tools, libraries, datasets, papers, information about experts, and courses. The resource will be ranked primarily on the basis of the degree of matching between their mapping and that of the request.

RH.1 Input Labeling
The Horizontal Matchmaking shall receive input in the form of textual description of the user needs through the multilingual component. This input will need to be translated in symbolic form by assigning



relevance scores to zero or more labels, corresponding to ontological categories. Later in the project, we will consider the possibility to supplement the labels with symbolic information provided directly by the user.

essential

RH.2 Matchmaking Algorithms

User input translated in a symbolic format will be processed by matchmaking algorithms to identify relevant resource from a list. Relevance will be determined via expert-designed or ML approaches based on the scores assigned to labels, corresponding to ontological categories. In case the query contains symbolic information provided by the user, this will be used to improve the matching quality. The first resources to be considered will be AI resources (algorithms, techniques, datasets), but multiple resource types (experts, courses/training material, papers) will be included as the project progresses.

essential

RH.3 Resource Repositories

The matchmaking component will need to rely on one or more repositories to obtain the resources to be ranked. These will include data from the AI-on-demand platform, but it is advisable to have ability to handle external data sources as well. Viable approaches to achieve this include the implementation of resource wrappers, indexing multiple sources and storing the resulting information in a single database, or a mix of the two.

high priority

RH.4 User Consent Management

Resource repositories related to personal (including sensitive) information will need to be designed to handle user consent in compliance with the GDPR.

essential

RH.5 Fairness and Transparency

The matchmaking system will need to incorporate mechanisms to handle fairness and transparency in the matching. These may include explanations about the returned resources, tools to clarify how the query was interpreted by the system, self-assessment tools for resources provided by the users (e.g. expert profiles), support for constraints on fairness metrics, or adjustments to the user interface. These aspects will be investigated in detail in Task T5.4.

essential

RH.6 Reputation Mechanism

The system will need to feature a reputation mechanism, designed to collect feedback from the users and make sure that it reflects on the resource ranking, so that higher-quality or more reliable resources will be given some degree of prominence. These aspects will be investigated in detail in Task T5.4.

essential

5.2.4. Functional Requirements for Vertical Matchmaking



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In the case of the Vertical Matchmaking, the system input consists of a request for the deployment of the selected solutions proposed by the Horizontal matchmaking along with a natural language description of constraints and parameters such as runtime, cost (solution quality), specific hardware resource requirements (e.g., RAM memory consumption), budget envelope, etc.

The system output will consist of benchmark metrics describing the needed resources and available providers allowing to deploy the solutions under the input constraints, as can be elicited from the benchmarks and deployment user stories US09, US10 and US14.

RV.1 Benchmark as a Service
The Benchmarking service shall benchmark and profile AI solutions and models on several HW platforms. <i>essential</i>
RV.2 Performance Prediction
Vertical matchmaking shall predict performance (running time, memory, I/O bandwidth) of AI solutions and models against different input and hardware resources. <i>essential</i>
RV.3 Performance Database
Benchmarked AI solutions and models performance shall be stored so as to provide an easy access, comparison and visualization. <i>essential</i>
RV.4 Vertical Matchmaking Algorithm
Vertical matchmaking shall receive user input such as constraints (time and costs) and any other useful information through the multilingual component. Then, it shall return the hardware resource providers that best fit the user constraints and the selected solutions by the horizontal matchmaking. The vertical matchmaking process will combine machine learning models (trained using the performance database – see RV.1-RV.3) and optimization techniques. <i>essential</i>

5.3. Non-functional Requirements

Non-functional requirements define properties of the system that, while being critical to ensure proper behaviour, are less directly tied to its input and output.

5.3.1. Non-functional Requirements for StairwAI

Usability

Standardization organization ISO defines usability as "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."⁸

⁸ <https://en.wikipedia.org/wiki/Usability>



In case of web-based services this means merely “a small learning curve, easy content exploration, findability, task efficiency, user satisfaction, and automation”.⁹

R7.15 Usability
Usability of upcoming services have to follow W3C Guidelines ¹⁰ <i>essential</i>

Accessibility

Web accessibility allows everyone, including people with disabilities, to perceive, understand, navigate and interact with the Internet.

R7.16 Accessibility
StairwAI on-demand platform and vertical matchmaking user interfaces have to take into account regulations like The Web Accessibility Directive (Directive (EU) 2016/2102) ¹¹ <i>essential</i>

Performance and QoS

Quality of service (QoS) is the description or measurement of the overall performance of a service, such as response time, throughput, utilization.

R7.17 Performance and QoS
During the project, based on users’ needs and requirements, target level of performance and QoS have to be defined and measures which are needed taken. <i>essential</i>

Scalability

Scalability in network-available services, which might be defined as the ability of an application to handle growth efficiently, is typically achieved by making them available on multiple devices.¹²

R7.18 Scalability
StairwAI on-demand platform components have to be scalable enough to support uptake resources and services users' needs. <i>essential</i>

Availability and Capacity

Capacity means in this context that there are sufficient resources available to fulfill users’ requests.

R7.19 SLA

⁹ https://en.wikipedia.org/wiki/Web_usability

¹⁰ <https://www.w3.org/WAI/test-evaluate/>

¹¹ <https://digital-strategy.ec.europa.eu/en/policies/web-accessibility>

¹² <https://www.w3.org/2001/03/WSWS-popa/paper33>



During the project service level agreements (SLAs) will be negotiated with resource and service providers.
essential

R7.20 Capacity and Availability

StairwAI project has to identify service performance requirements based on users' needs, plan the resources required to fulfil the requirements and ensure performance monitoring.
essential

Security and data protection

Data security and protection are regulated with multiple laws and other regulations.

R7.21 Security and Data Protection

StairwAI services have to take into account applicable regulations like General Data Protection Regulation (GDPR)¹³. Additionally, guidelines from the StairwAI WP9 Ethics requirements have to be implemented also in these activities.
essential

Interoperability

R7.22 Interoperability

Interoperability of the StairwAI services has to follow New EIF i.e. European Interoperability Framework by ISA2 programme principles¹⁴
essential

Standards and architecture framework

Architecture definitions have been described in this document.

R7.23 Architecture Compliance

Solutions have to follow standards and architecture definitions described in this document.
essential

5.3.2. Non-functional requirements for horizontal matchmaking

R7.24 Use Case Description in Multiple Languages

In an effort to maximize the system impact across Europe, especially on so-called low-tech industries and SMEs, the horizontal matchmaking system should accept use case description in multiple languages. Only a limited set of languages will be supported in the project timeline, the precise list to be defined based on the availability of training data and technology for Natural Language Processing, on the expertise of the consortium partners, and on the population size
essential

¹³ <https://gdpr.eu/>

¹⁴ <https://joinup.ec.europa.eu/collection/nifo-national-interoperability-framework-observatory/european-interoperability-framework-detail>



R7.25 Sufficiently General and Flexible

The ontology used for the characterization of both use case description and AI resource should be sufficiently general and flexible to ensure longevity and wide applicability for the matchmaking system. <i>essential</i>
--

R7.26 Response Time

The matchmaking system will need to be designed to have low response time, or to amortize the computation time by providing the results in an incremental fashion. <i>high priority</i>
--

5.3.3. Non-functional Requirements for Vertical Matchmaking

To support the Vertical Matchmaking and the right match of AI Algorithms and SW assets to existing hardware resources – previously added to an AI on demand resource fabric – StairwAI has a variety of hardware available (during the project’s lifetime) with the objective of having the best match for the users’ requirements and the resources to be provided.

In other words, heterogenic hardware resources should be available so the matchmaking applications can have distinct options at their disposal.

R7.27 Availability of cloud services

Cloud resources are available at the IaaS level via APIs or Web GUIs. <i>essential</i>

R7.28 Heterogeneity of architecture

To increase heterogeneity, it should be possible to run on various HW architectures, i.e., X86, ARM, RISC-V for what concerns CPUs, and AMD or NVIDIA for accelerators. <i>essential</i>

R7.30 Availability of low-power resources

There should be also several “low-power” resources available to be matched with user’s requirements such as nodes/clusters based on X86 or ARM architecture, NVIDIA Jetson-TX1/X2, Intel low-power system-on-chip, <i>essential</i>
--

R7.31 Storage resources

It has to be possible to preserve data in at least two QoS: spinning disk and low latency devices such as SSD. <i>essential</i>
--

R7.32 Failover strategy



Multiple replicas for high availability and failover strategy implementation should be possible on the EGI Cloud federated storage.
essential

6. Interoperability requirements

6.1. Requirements - Interoperability with AI4EU On Demand Platform

This chapter describes a first version of the technical information from AI4EU platform that help to understand:

- What is needed to know about AI4EU Platform to integrate with.
- How to integrate StairwAI platform with the AI4EU Platform.

6.2. AI4EU Platform

AI4EU means Artificial Intelligence for Europe.

In January 2019, the AI4EU consortium was established to build the first European Artificial Intelligence On-Demand Platform and Ecosystem with the support of the European Commission under the H2020 program¹⁵. An ambitious project has been launched to create and support a large European ecosystem spanning the 28 countries to facilitate collaboration between all Europeans actors in AI (scientist, entrepreneurs, SMEs, Industries, funding organizations, citizens...). AI4EU platform serves as a catalyst to facilitate AI-based innovation, resulting in new AI models, products, services and solutions to benefit European industry, commerce and society. The AI4EU Platform acts as the one-stop-shop for anyone looking for AI knowledge, technology, services, software, and experts and is a facilitator of knowledge transfer from research to business application. AI4EU provides a European AI market driver, offering a critical mass of resources, community networking effects, and rapid development and growth.

Figure 6 shows some AI4EU platform screenshots:

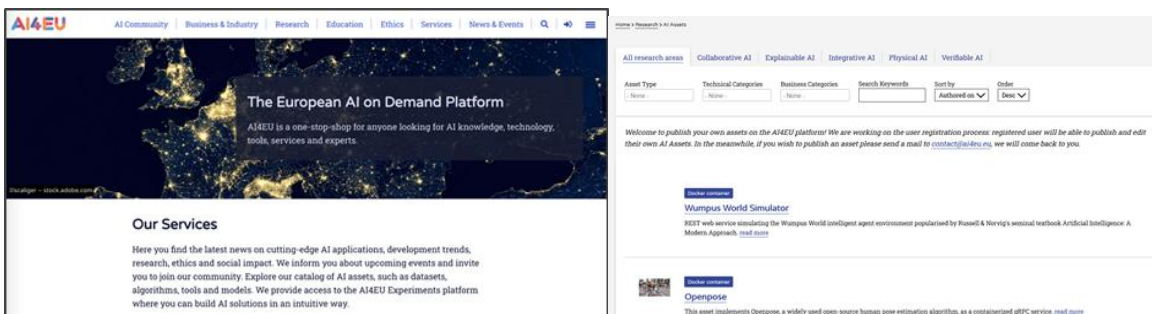


Figure 6 The AI4EU Portal Screenshots

¹⁵ <https://www.ai4europe.eu/AboutthePlatform>



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101017142

6.3. AI4EU Platform Architecture Overview

The 3 main systems that compose AI4EU currently are:

- Content Management System (Drupal Space)
- AI4EU Experiments
- Advanced Search (Thales Search Engine)

Figure 7 illustrates an overview of AI4EU architecture:

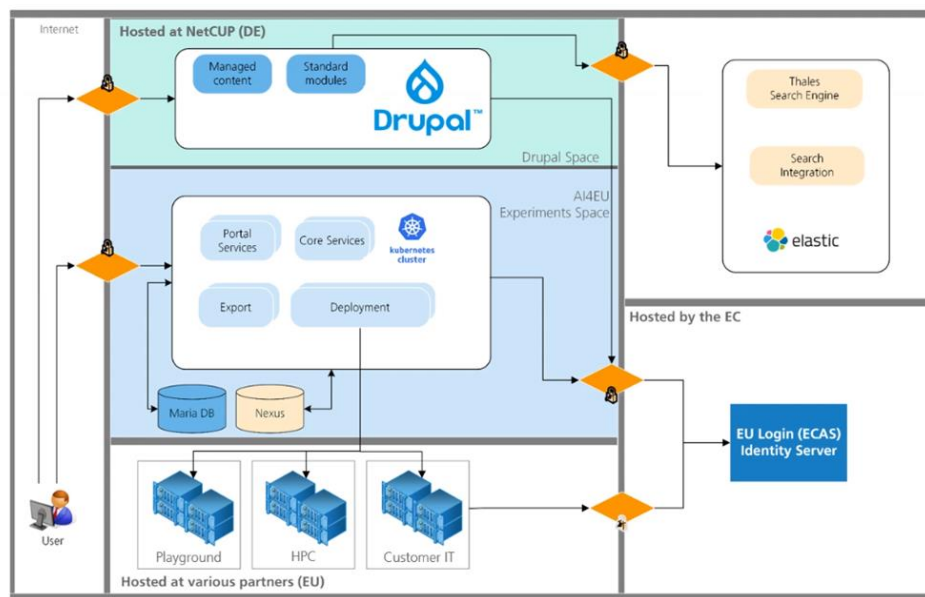


Figure 7 The AI4EU Architecture Overview

Presentations of the AI4EU On Demand Platform are available in the dedicated You Tube Channel^{16 17}.

Public repositories of the AI4EU Consortium are accessible on the AI4EU GitHub¹⁸.

¹⁶ <https://youtu.be/MC264ZzAYeo>

¹⁷ [AI4EU - YouTube](#)

¹⁸ AI4EU · GitHub: <https://github.com/ai4eu>



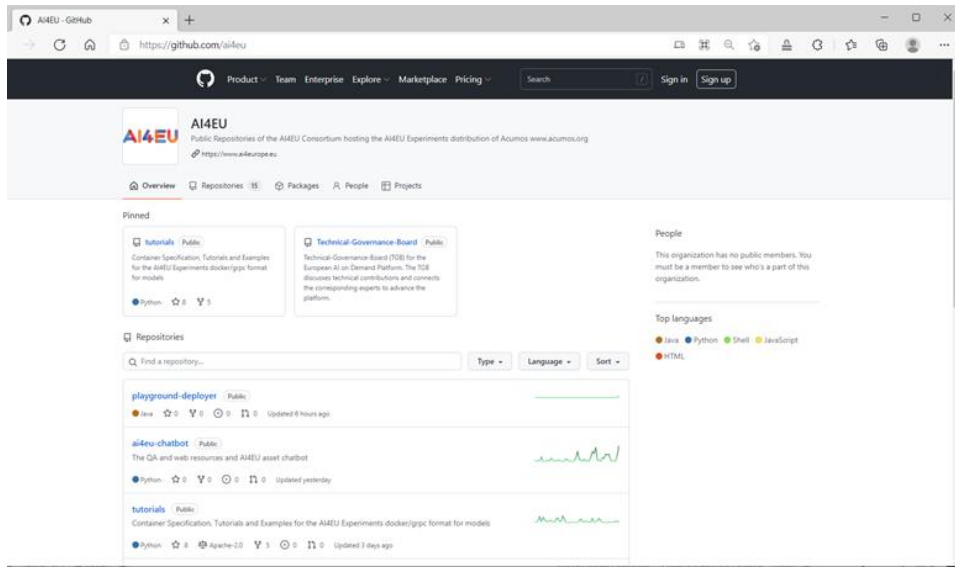


Figure 8 The AI4EU GitHub

Content Management System (Drupal Space) gathers a one-stop shop service accessible through a CMS at AI4EU¹⁹ with latest news on applications, development trends, research, ethics and social impact. In addition, it also includes a first catalogue of AI resources, such as datasets, algorithms, tools and models.

AI4EU Experiments is where people can reference and build AI Solutions in an intuitive way. It is based on a fork of Acumos²⁰. It allows a package to share and license, and deploy AI models in the form of portable, containerized micro services. AI4EU Experiments Design Studio can be used to chain together multiple models, along with data translation tools, filters and output adapters into a full end-to-end solution which can then be saved as a composite solution.

¹⁹ <https://www.ai4europe.eu>

²⁰ Acumos: <https://www.acumos.org/>



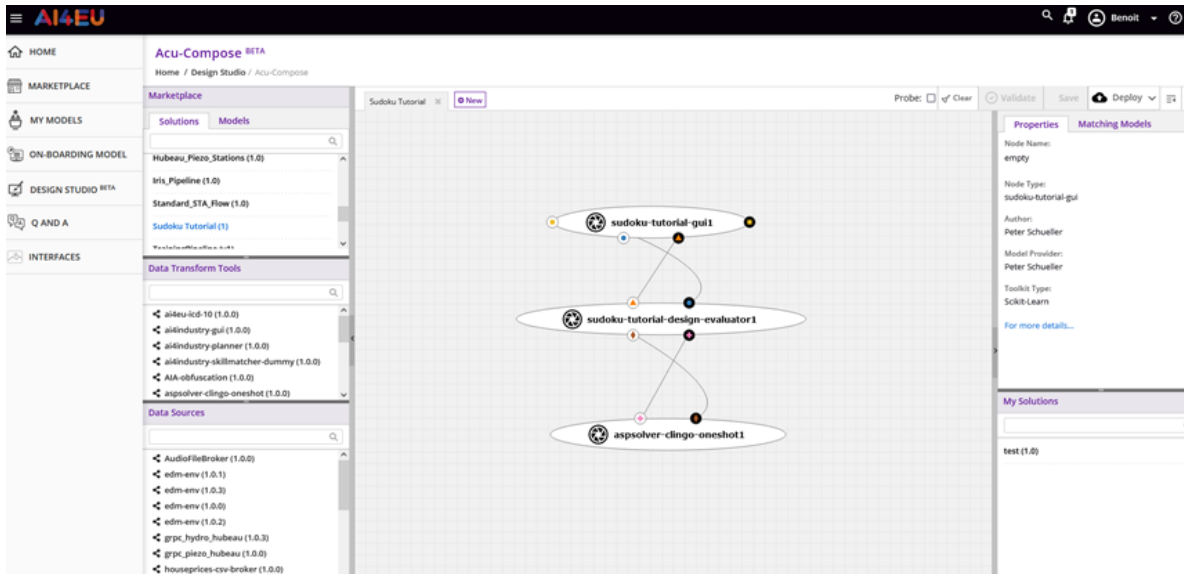


Figure 9 The AI4EU Experiments pipeline example

Advanced Search (Thales Search Engine) is where the search engine is stored and accessed. The search includes indexing, natural language processing and aggregation operations.

The search module of the platform acts as an enhanced aggregator of different information sources:

- Textual content of AI4EU CMS.
- AI resources in the AI4EU Experiments.

The search engine web page displayed as results to AI4EU platform users integrate high-level information extractions and a Question/Answering system based on BERT neural network architecture.

This high-level information is extracted by using a linguistic analysis, it develops the following features:

- Named entities
- Knowledge graph
- Automatic summary
- Unsupervised classification
- Sentiment Analysis
- Suggesters
- Semantic index with semantic relation
- Relation clustering



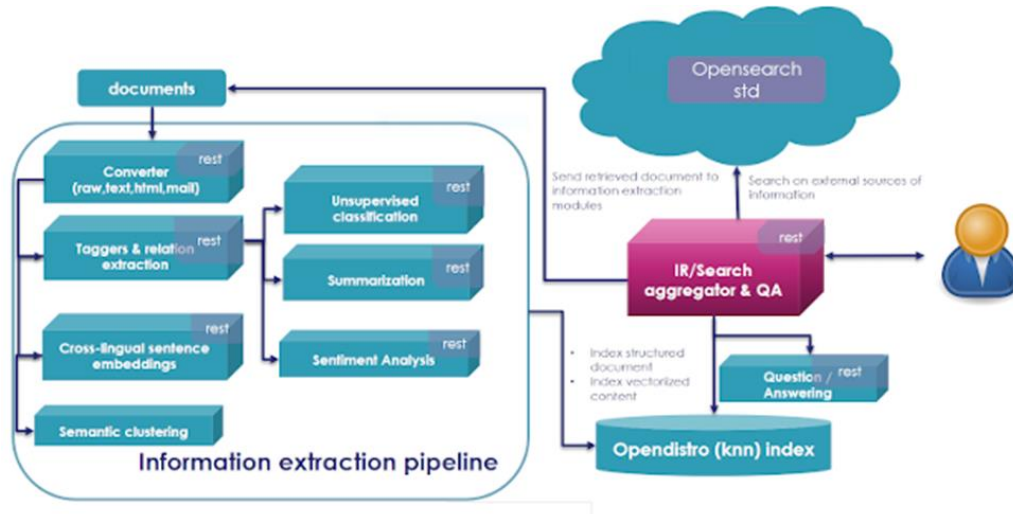


Figure 10 Architecture of the Advanced Search Component

SSO Space (Identity Server): the Single-Sign-On (SSO) is realised through the widely adopted EU Login, the authentication service of the European Commission. EU Login is hosted by the European Commission. It is the overall Authentication service used by European Commission Website.

Figure 11 shows the EU login User interface:

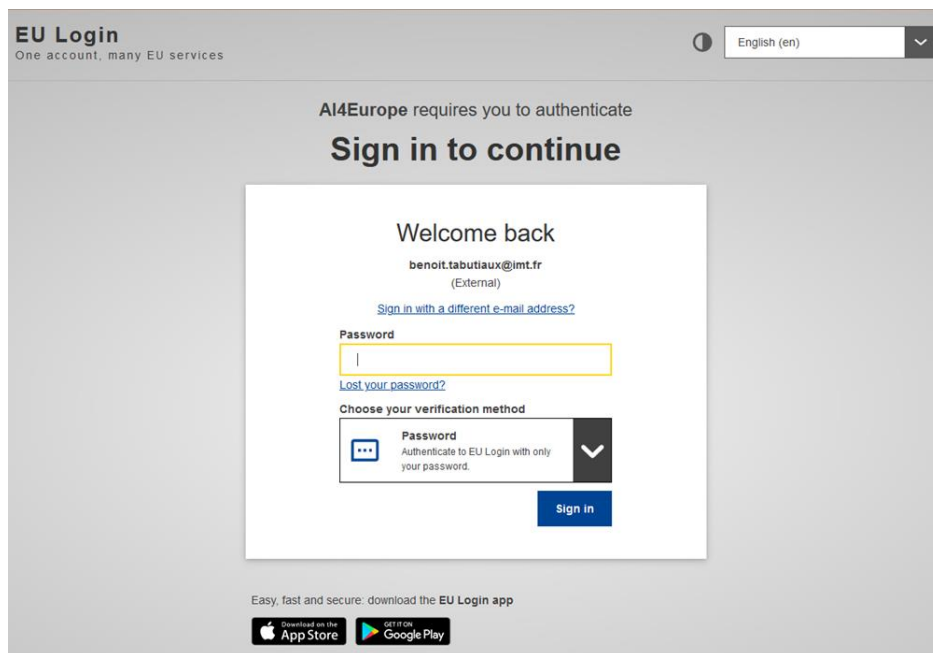


Figure 11 The EU Login Screen

6.4. Methodology Requirements - Interoperability with AI4EU Platform



This project has received funding from the European Union’s Horizon 2020 research and innovation programme under grant agreement No 101017142

To gather the needed technical information and to identify how to integrate with the AI4EU On Demand Platform, we followed 3 steps:

1. The internal StairwAI workshop on Oct, 2021 to figure out and define:
 - What is the scope of AI4EU platform (components) we will need to interface with for Horizontal Matchmaking & Vertical Matchmaking?
 - What are the technical information and documentation needed with a priority ranking as inputs and enablers for the integration of Horizontal Matchmaking & Vertical Matchmaking?
2. Two main components of AI4EU platform identified to interact with for StairwAI needs:
 - Search of the CMS to know what is in the AI4EU catalogue: resources, educational etc.
 - AI4Experiments: to build pipelines with available resources in Acumos.
3. Discussions with the AI4EU TGB to present StairwAI project and share interoperability questions and expectations. The TGB gave first responses which are described in the following chapters.

More details on the identification of what is needed or excepted from AI4EU On demand Platform is available in the Annex 2.

6.4.1. AI4EU Integration Request Process

The AI4EU TGB has defined the following AI4EU integration requests process:

- A questionnaire to share interoperability needs is accessible ²¹
- A dedicated request workflow is illustrated in Figure 12.



²¹ <https://forms.gle/bs76pDETSKaNgpeT6>



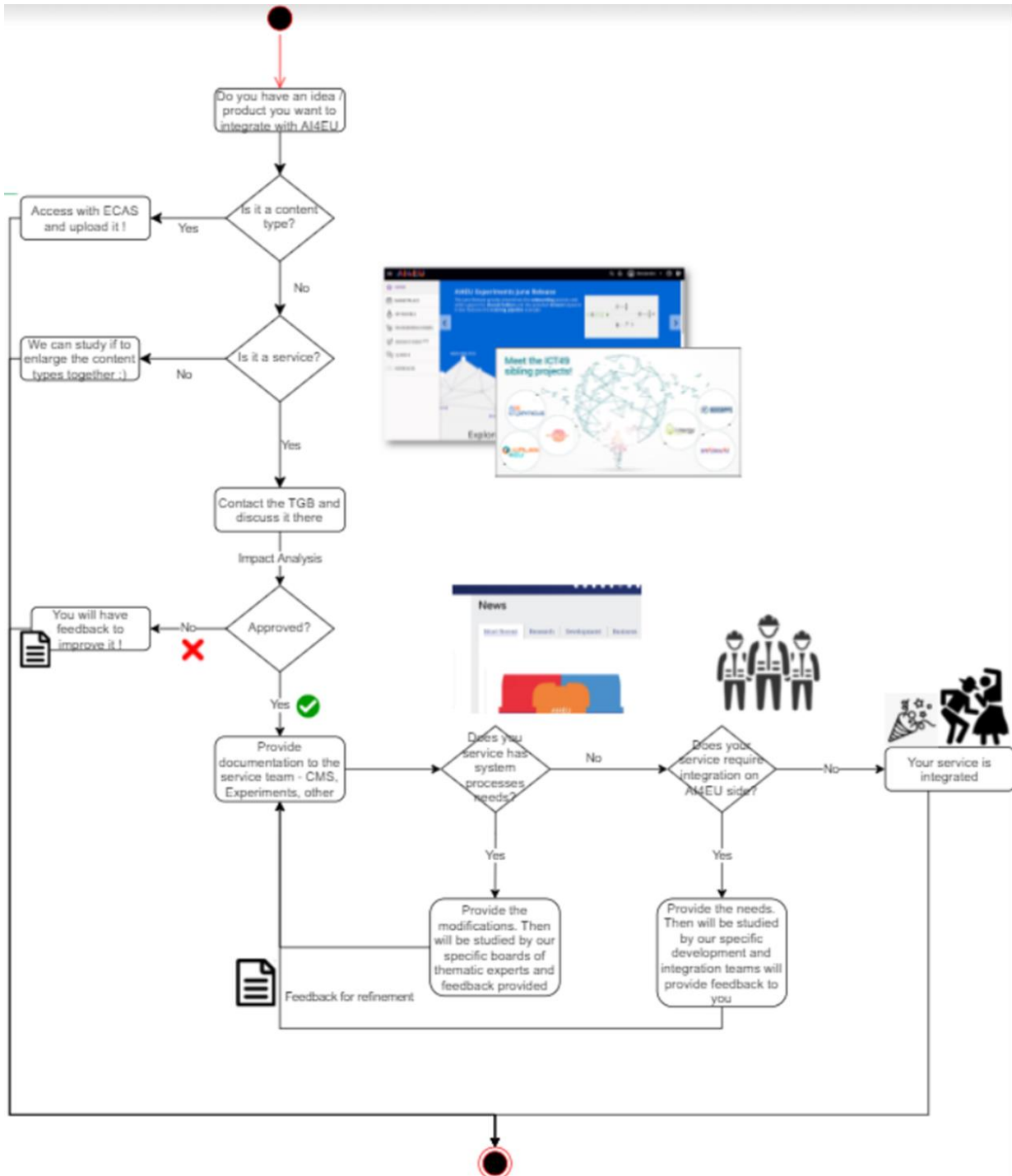


Figure 12 AI4EU integration workflow

6.4.2. Main Principles of Interoperability with AI4EU Platform

Technically, the interoperability to implement between StairwAI and AI4EU platform is made by the StairwAI Chatbot (dialog system applications) that requests directly the elements provided by the Advanced Search Engine.



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Figure 13 shows the interoperability between StairwAI and AI4EU platform through the StairwAI Chatbot implemented in the StairwAI WP4.

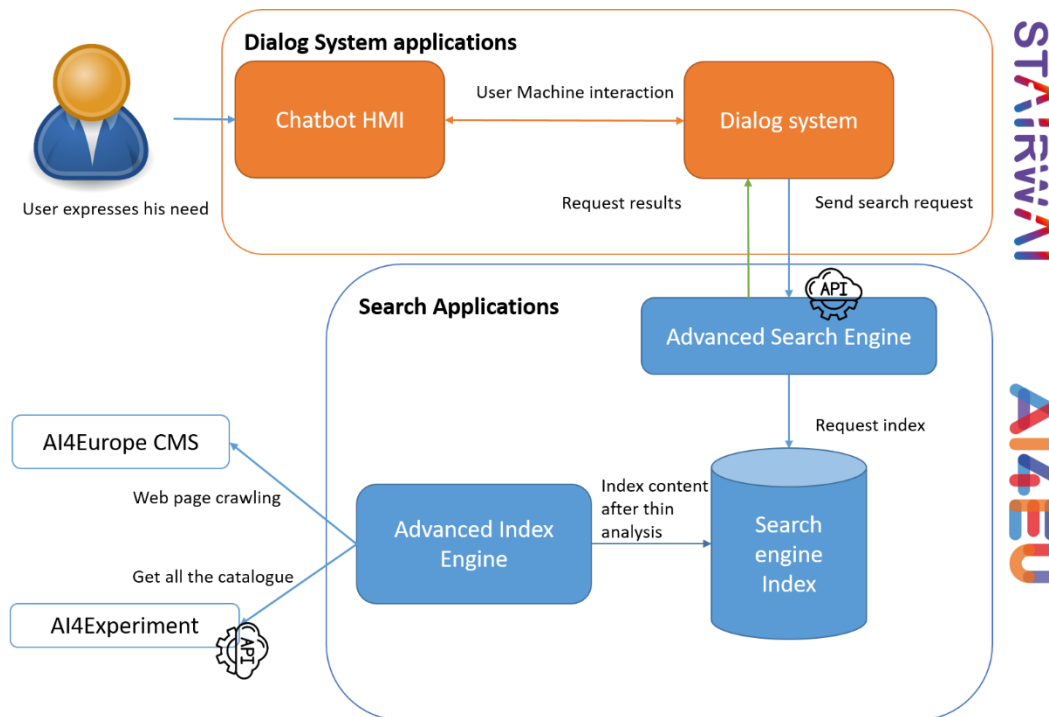


Figure 13 Interoperability principles between StairwAI and AI4EU platform

Details regarding the interoperability between the StairwAI Chatbot and the Advanced Search Engine are available in the WP4 deliverable “StairwAI Chatbot MVP”²².

How the dialog system (chatbot) is interconnected with the Advanced Search Engine?

The user expresses his needs to the Chatbot: dialog system from an HMI. The dialog system extracts the intent of the user to build structured request compliant with the advanced search engine API. This request is analysed by the search engine and the latter returns the results. This result is reformulated by the dialog system to answer the user.

How the Advanced Search Engine is interconnected with AI4EU Experiments?

Advanced Search Engine uses the REST API provided by Acumos. This API allows users to access the descriptions of the resources. The Search Engine browses all the resources from the catalogue and indexes it in a structured manner and stores it in the index.

²² Deliverable 4.1 StairwAI Chatbot MVP

<https://liveunibo.sharepoint.com/:w:/r/sites/StairwAIproject/Shared%20Documents/WP4%20-%20Multi-lingual%20interaction%20with%20the%20platform/Deliverables/D4.1%20StairwAI%20Chatbot%20MVP/Deliverable%204.1.docx?d=w978757491b6d4d5b845b688621148caf&csf=1&web=1&e=CZTwlx>



The Advanced Search features allow searching into the catalogue of Acumos by using free text and/or structured requests gathered from the dialog system (Chatbot). The index maps the data model of the AI resources catalogue (AI4EU Experiments module).

From the dialog system to the Search Engine:

- The dialog system formulates a structured requests by analysing the intent of the user.
- The structured request is then sent to the Search Engine via an API.

Catalogue indexing procedure:

- The REST API provided by Acumos allows to get all documents associated and describing the AI resources catalogue ²³.
- The AI resources are described in JSON format i.e. it uses a key/value structure. Advanced search engine is adapted to this kind of data and allows to index all key/value pairs.

AI resources searching from the advanced search engine i.e. searching through the advanced search engine is performed in two ways:

1. request is a free text: in this case the whole index is requested after a thin analysis of the request
2. request is structured (by DSL elastic format): in this case the search is similar to a request on a relational database.

Detailed technical information on AI4EU experiments is available here in the AI4EU Github ²⁴

How the Advanced Search Engine is interconnected with the AI4EU CMS?

The indexing application of the Search Engine

- downloads the pages from the CMS, make a documentary analysis (tokenization, lemmatisation, named entities recognition, syntactic analysis, automatic knowledge graph generation, keyword extraction, automatic summary, sentiment analysis and unsupervised document classification)
- and stores this analyse into an Elastic Search index.

The dialog system (Chatbot) formulates a structured requests by analysing the intent of the user (the same as the one sent to the AI4EU Experiments).

The structured requests are then sent to the Search Engine via an API.

The Search Engine queries the index and retrieves the documents from the CMS pages related to the user request.

Technically, the retrieve documents are a JSON object containing the analysed documents that can be displayed by the Dialog System. The CMS can be requested using a filter based on AI Community, Ethic, Education etc.

How to interconnect StairwAI with the user identification system?

²³ <https://docs.acumos.org/en/elpis/submodules/federation/docs/developer-guide.html>

²⁴ [tutorials/Deliverable AI4EU D3.3 Platfrom Manual.pdf at master · ai4eu/tutorials · GitHub](#)



On AI4EU platform side, the users are authenticated using of the API “ECAS” exposed by European Commission, this API provides SSO features. StairwAI applications and services uses same authentication methods than AI4EU platform which deliver sufficient information for applications.

The user description profile at AI4EU platform level contains only user id, name and email for both CMS and AI4EU experiments authentication.

EU SSO ECAS Solution description

ECAS is the EU Login is the European Commission's user authentication service. It allows authorized users to access a wide range of Commission web services, using a single email address and password.

EU Login is available for any EU Institution and Agencies that want to securely authenticate users. The Client application must be able to perform a web-based authentication flow and may not collect user credentials itself (EU Login credentials may only be entered on the EU Login screen), it must also support one of the client protocols offered by EU Login.

EU Login ECAS²⁵ and its SSO Documentation²⁶ for the integration need are available in the Europa service.

These documents give:

- detailed description of the services and components offered by EU Login,
- detailed technical documentation on the implementation of EU Login for a system,
- extensive information wiki, available with guidance, sample code, client implementation.

EU Login offers an Acceptance Environment and a mock-up Server, available for free and allows to get a feeling on how EU Login works, to see if it is feasible to integrate with the technology StairwAI will use, what user data you will get back after authentication, etc. EU Login is free to use. There are no procurement fees and no setup costs. The EU Login Team will ensure maintenance, support and management of the solution.

6.4.3. AI4EU Conceptual Data Model and Ontology

Technical information on AI4EU conceptual data model and ontology is public and available on GitHub^[OBJ].

The way and the why StairwAI will exploit the AI4EU conceptual data model and ontology is through a semantic alignment with StairwAI's Conceptual Semantic Model, defined in WP3.

Task T3.2 is organizing an AI Ontology Working group. The group is currently working and targets the following objectives:

- Avoid replication of work across projects on ontologies.
- Seek for a “common ontology” (if possible) to support the future AI-on-demand platform and other related projects (ICT48, ICT-49 and beyond).
- Make knowledge discoverable across platforms.
- Incorporate trustworthy AI topics related to Knowledge Classification.

Deliverable D3.2 “Design of the knowledge representation in the StairwAI AI Asset Management System – version 2” provides further details on the connection between StairwAI and AI4EU conceptual models.

²⁵ <https://ecas.ec.europa.eu/cas/login>

²⁶ <https://citnet.tech.ec.europa.eu/CITnet/confluence/display/IAM/ECAS+for+Developers>



7. Conclusions

StairwAI service based on a few major components from the AI4EU architecture and service providers which StairwAI will get from open calls later. Novel parts of the StairwAI are horizontal matchmaking and vertical matchmaking, which makes resource deployment easier for low tech SMEs.

The idea of these matchmaking components is to use AI to find user requirements and constraints, and also suitable resource provider. Multilanguage NLP techniques will be used to create advanced user engagement and enable convenient access.

This document presents requirements for StairwAI platform but also for interoperability with AI4EU.

Major classes of requirements are functional requirements and non-functional requirements on all essential components of the StairwAI platform architecture. These parts describe technologies, functionalities, non-technical requirements which fulfil users' requirements and set basis on upcoming service levels.

AI4EU interoperability is essential part of the whole platform architecture because users are accessing services and other resources of the StairwAI through AI4EU platform and its authentication mechanisms. Possible future features of the StairwAI platform are new classes of resources, deeper connection with open science resources and upcoming European Open Science Cloud services and resources. All these new features will be discussed in the future.



Annex 1: Questionnaire Outline

In the following the outline of the questionnaire described in section 5, exploited to collect data for the horizontal matchmaking service (training phase).

Section 1: General Information

This section asks for information about the respondent company, plus a few pieces of personal information about the respondent themselves. This section will also include GDPR notices and confirmation requests, not appearing in this list.

- First Name
- Last Name
- Years of experience in Information and Communication Technologies
- Country
- Sector of Operation (public/private/non-profit/academia)
- Industrial sector (According to the International Labour organisation)
- Size of your organisation (in approximate number of employees)
- How many years have the company been operative?
- Company's service (Production services, HR, development of solutions, etc)
- Company URL (optional)

Section 2: Use Case Description

This section contains questions concerning the considered industrial use case. With a few exceptions, these are all free-form questions that the respondent will address by filling a textbox.

- Application of use case - real or hypothetical
- Use Case Context (The physical or digital system that may benefit/benefited from the use of AI)
- Use Case Motivation (How the problem arises -- or has arisen -- in the company business, what makes it challenging)
- Data Availability/Provisioning (Which data are -- or were -- available, what needs to be still collected)
- Use Case Objective (What the AI system is supposed to do/did and which benefits you plan to get/you got)
- Additional requirements (Any property of the AI system that are not immediately tied to its function, but are still needed for the application -- e.g. fairness, explainability, energy or power efficiency, latency)
- Have AI components being already employed for the use case? (Yes/No/Maybe)

Section 3: Description of the AI Solution

This section contains questions concerning the AI solutions employed to address the use case (when available). All questions are mostly in checklist form and refer rather closely to the AI Watch ontology for the description of AI topics.

- Approximate date with use case was implemented or launched
- Topics covered on reasoning



- Topics covered on planning and optimization
- Topics covered on learning
- Topics covered on communication
- Topics covered on perception (computer vision)
- Topics covered on perception (audio processing)
- Topics covered on integration and interaction (Multi-agent systems)
- Topics covered on integration and interaction (Robotics and automation)
- Topics covered on integration and interaction (connected and automated vehicles)
- Topics covered on AI Services (These correspond to "analytics perform" in the AI_watch taxonomy)
- Topics covered on AI ethics
- Topics covered on philosophy of AI



Annex 2: Standards for Hardware and Software Requirements

There are several standards related to hardware and software which combined will provide resources to be used by the matchmaker.

To ensure replicability of the performed tests and implementations of the StairwAI project, standards or de-facto standards will be adopted as much as possible.

The following tables summarize them in various domains.

Silicon Layer:

Type	Name of Body (hyperlinked URL)
CPUs/GPUs	x86_64
	ARM
	NVIDIA
	AMD
	RISC-V
Organizations	RISC-V Foundation

Operating Systems:

Type	Name of Body (hyperlinked URL)
Operating Systems	Linux
	Microsoft Windows
Organizations	Linux Foundation
	Linaro
Standards / Examples	ISO/IEC 23360-x:2006 (LSB)

Virtualization:

Type	Name of Body (hyperlinked URL)
Technologies	Linux Containers
	VM
Organization	OCI



	OCP
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Management:

Type	Name of Body (hyperlinked URL)
Technologies	Kubernetes
	Docker Swarm
Organization	Apache
SDO	ETSI

Type	Name of Body (hyperlinked URL)
Tools and Framework	TensorFlow
	OpenNN
	Caffe
	Keras
	PyTorch

