HUNGRY ECOCITIES

A S+T+ARTS RESIDENCIES PROJECT

Hungry EcoCities
S+T+ARTS Residencies

Deliverable 2.1 – HEC virtual fab lab framework requirements

Version 1.0

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History of changes

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1 Abstract

This first deliverable or Work Package 2 outlines the requirements of **HEClab**, an innovative certification platform and opportunity scouting environment that will extend beyond the scope of the Hungry EcoCities project. This deliverable builds upon the matchmaking process described in Deliverable 1.3 and aims to formalize the process into a virtual fab lab.

The requirements have been identified by the project partners and serve as a starting point for the development of HEClab, which will be done as part of D2.2 (architecture) and D2.3 (integration).

HEClab will serve as a dynamic virtual fab lab within the agri-food domain to analyse and disseminate the outcomes of art-driven experiments and propagate the value of responsible innovation they embody. A key feature of HEClab will be its certification system, built upon state-of-the-art, art-driven frameworks, such as the PESETABS diffusion model. This model encompasses ranking, benchmark visualizations, and matchmaking services and will enable the scoring, comparison, and benchmarking of projects and experiment ideas, offering valuable insights into their performance across multiple dimensions. By leveraging HEClab's benchmark visualizations and comparisons, stakeholders including artists, scientists, and SMEs can gain a deeper understanding of project strengths and areas that require further improvements or collaborations. This facilitates informed decision-making and fosters meaningful connections.

The **ultimate objective of HEClab is to facilitate the development, diffusion and scaling of high-quality, sustainable, and responsible AI art-driven projects within the agri-food industry.**

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2 HEClab

2.1 Overview

HEClab will play a central role in the Hungry EcoCities project, aimed at enabling the agri-food industries to benefit from the coming together of AI / digital technology and the artistic expertise, all while considering ethical and responsible boundaries. This integration of art and technology aims to drive innovation, enhance sustainability, and address the social and environmental challenges faced by the agri-food sector. With a strong commitment to these ethical and responsible boundaries, HEClab will serve as a catalyst for transformative change.

To realize its mission, HEClab emphasizes the importance of collaboration and resource sharing among stakeholders in the agri-food value chain. By setting innovation goals, deploying modern ICT infrastructure, adopting a human-centred approach to design and development, and fostering collaboration, **HEClab strives to create a platform where novel ideas can flourish and transformative solutions can be diffused.**

The EU's proposed AI Act stimulates responsible use of AI. As a certification and scouting platform, HEClab provides a virtual place where innovators can share their innovative technologies and services, find test beds for experimentation, and publish valuable insights and lessons learned. **HEClab aims to digitize the art-driven technology valorisation process in the food domain initially**, stimulating collaboration between artists, scientists, technologists, growers, and agricultural specialists.

Building on the shoulders of S+TARTS and SmartAgriHubs brings the Hungry EcoCities consortium in a strong position to **share new knowledge, explore feasibility of new and improved technologies and catalyze support for take up.**

2.2 Objectives

The primary objective of HEClab is **to stimulate the development of novel products and services that align with a human-centred approach to innovation and sustainability goals.** By fostering dedicated art-industry collaboration in R&D projects, the HEClab enables the creation of transformative solutions that address social, business, and environmental challenges in the agri-food sector. We aim to **drive the uptake of digital technologies across the agricultural sector through art-driven experiments**. By integrating artistic perspectives, these experiments aim to explore innovative applications of AI technology that enhance social inclusivity, improve business practices, and contribute to sustainable agricultural practices. Through this process, the HEClab serves as a dynamic space where artists, scientists,

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and SME stakeholders can share innovative projects that explore the intersection of art, technology, and sustainable agri-food systems. **By facilitating the diffusion of experiments, the HEClab encourages the sharing of knowledge, experiences, and best practices among stakeholders.**

In line with its human-centred approach, the HEClab places a **strong emphasis on the design and development of digital technologies that explicitly acknowledge human values and needs**. By infusing art-driven innovation principles into the development process, the HEClab can highlight (elements of) digital technologies that are socially inclusive, environmentally friendly, and ethically responsible. This approach not only enhances user acceptance and trust in digital technologies but also paves the way for more sustainable and responsible innovation in the agri-food industry.

A final objective of HEClab involves conducting an impact analysis. This entails an evaluation encompassing various dimensions: problem assessment, an innovativeness check, a responsibility evaluation, and a readiness assessment.

To sum up: our objectives to **share new knowledge, explore feasibility of new and improved technologies and catalyze support for take up are**:

1) Sharing innovative insights: Facilitate the sharing of inventive ideas addressing agri-food challenges through art-inspired projects. Drive AI technology adoption via art-driven experiments for sustainable agriculture.

2) Human-Centered Design: Develop ethical and inclusive digital solutions merging art and technology.

3) Conduct an impact analysis, evaluating dimensions like problem significance, innovation level, negative externalities, and solution readiness. Ensure alignment with EU values and goals. This evaluation framework ensures transparency and accountability in the agri-food industry.

To realise these three objectives, the **HEClab capitalizes on the wealth of knowledge and lessons learned from both the 20 residency projects within Hungry EcoCities and results and practices accumulated over other industrial and EU projects, most notably S+T+ARTS projects.**

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2.3 Iterative approach

The Humanizing Technology Experiments (HTE) conducted by artists and a team from the consortium will generate the first use cases that can be used to design, deploy, and evaluate a first working proof-of-concept of the HEClab. The outcomes of these residency experiments will be made accessible through HEClab and made available for testing during the Paths to Progress Experiments (PPE) conducted by artist and SME duos that work in collaboration with a team from the consortium. We will take into account the outcomes, successes, and challenges encountered during these experiments and integrate them in an iterative methodology. By leveraging these valuable insights, the HEClab aims to refine its processes, enhance its capabilities, and continuously improve its support for art-driven innovation in the agri-food domain.

HEClab will thus leverage the 20 residency experiments as use cases to iteratively design, deploy, and evaluate a certification system based on the PESETABS diffusion model.

The HEClab will need to include ranking, benchmark visualizations, and scouting/matching services to evaluate and compare projects within the agri-food domain. Through this certification system, stakeholders can gain insights into the performance of projects across different dimensions, such as policy, ecology, society, economy, technology, art, business, and science. By leveraging the certification system and benchmarking capabilities, stakeholders can identify areas of strength and areas that require improvement or further collaborations. This enables a more informed decision-making process and fosters a culture of continuous improvement within the agri-food industry.

2.4 Requirements

In order to serve as a certification and scouting platform, the HEClab needs to be a user-friendly digital environment that offers a wide range of features to support knowledge sharing within the agri-food industry. It should be designed to be accessible to stakeholders [1] with diverse backgrounds and expertise, promoting inclusivity and participation.

The implementation of the HEClab as an online certification and scouting platform is first most inspired by other EU funded projects, such as the Europeana project (see Figure 1) which provides cultural heritage enthusiasts, professionals, teachers, and researchers access to Europe's digital cultural heritage; and the ARRIVAL Platform (See Figure 2) which offers a complementary service designed to mobilise financial

[1] potential stakeholders: artists, SMEs and clusters/associations, tech suppliers, RTOs, EU institutions and digital innovation hubs, and the general public. See Deliverable 5.2 for a full description of all stakeholders.

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resources to accelerate the market access and scale up of “first of a kind” sustainable transport solutions.

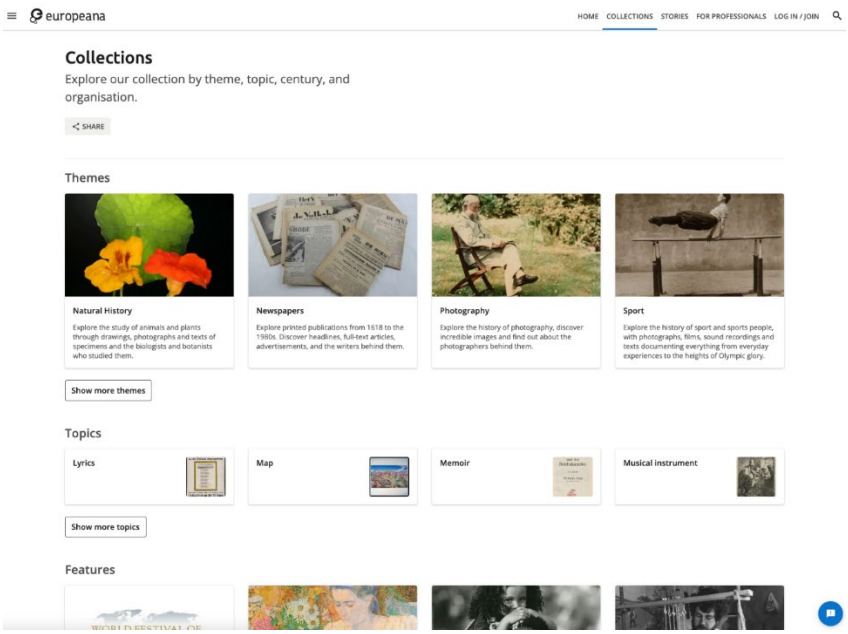

Fig 1: Homepage of the Europeana project website.

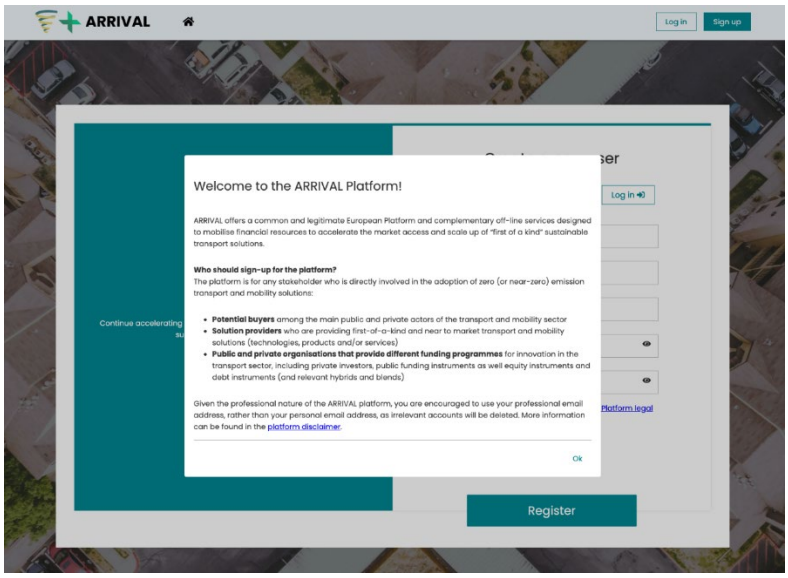

Figure 2: Welcome page of the ARRIVAL platform.

A second source of inspiration is the EU funded [ITEA3 Panacea Gaming Platform] project which released a certification system (see Figure 3) based on lessons learned during the project. KU Leuven was involved in this project and will transfer the learnings to feed the certification module in HEClab.

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Technology	Engagement	Research	Clinical	Accessibility
PRIVACY & SECURITY	Motivational design features	EVIDENCE	CLINICAL RISK ANALYSIS	AVAILABILITY
Data Confidentiality	information	Academic papers available		Cross-Platform Availability
Data Privacy	awareness and personal insights	clear target for interventions		Cross-Device Availability
Data Security	incentivization	outcome measures of near and far transer		Availability on Web
Data Storage	social interactions	outcome measure of neural change		Availability on App Stores
	trustworthiness and liking	longitudinal research		Alexa Rating / Google Page Rank
STABILITY & PERFORMANCE	ability	SCIENTIFIC RELIABILITY		Availability on App Stores (per country)
Page loading speed		Scientific check		
App running speed	Motivational design theories	Ethical approval		
	theory of reasoned action			
INTEROPERABILITY	theory of planned behavior			
# of Possible Integrations	self-determination theory			CONTENT
Platform interoperability	Information-motivation behavioral skills model			Readability
Service API Documentation	health belief model			Graphics Representation
	operant conditioning			Pricing
BUILD	goal-setting theory			
Native (Java, Swift)	social facilitation theory			
Hybrid (HTML5, CSS)	elaboration-likelihood model			USABILITY
	trans-theoretical model			bythe app's Target Audience
PERMISSIONS	perceptual control theory			10 Usability Heuristics for User Interface
Contacts				
Make a call				ASSISTIVE TECHNOLOGIES
				Hearing Impairment Support
AUDIO				Visual Impairment Support
Does not play when screen is locked				
Does not play over another app				
Resumes when the app returns to foregr.				
VISUAL QUALITY				
Responsiveness of the Interface				
Landscape/Portrait support				
Transition speed between display orient.				
Distortion, Blurring, Pixellation				
Automatable: Criterion that we can assess by automation. (E.g. A software can check an app's ranking on Google PlayStore and give a score)				
Non-automatable: Criterion that needs to be assessed via human intervention (E.g. An expert may need to scientifically check the reliability of content)				
The criterion written in black means that we need to check whether we can automate it or not. Or we can ask this information from the app developer/owner				
Source engagement: https://www.lensesofmotivationaldesign.com/				

Figure 3: certification model used in the ITEA3 Panacea Gaming Platform.

Combining these two ideas, the **HEClab can be seen as the main knowledge transfer mechanism of the project**, much like a virtual fab lab including highest impact showcases to portray the application potential of the digital technologies in the food and agriculture sector through visionary artistic experiments. Innovators will be able to share their innovative technologies and services, offer or find test beds for experimentation, and exchange valuable insights and lessons learned in the domain of agri-food.

The HEClab will initially be built and fed with AI building blocks based on industrial and academic expertise from consortium partners KU Leuven, BRNO University of Technology, MENDEL University, EatThis, In4Art and the external experts within the knowledge hubs.

The HEClab will therefore offer stakeholders throughout Europe (and beyond) a platform to browse through the applications that are most relevant for them. The consortium of Hungry EcoCities will take specific attention to create the digital HEClab in a way that it helps companies interested in the uptake of the applications to do so.

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The **key feature of the HEClab will be its certification model and resulting visual representations**. As art-driven innovation is at the core of the Hungry EcoCities project, we will build upon the recent PESETABS whitepaper which covers eight dimensions for the Hungry EcoCities project: policy, ecology, society, economy, technology, art, business, and science (see Figure 4). These will select the directions.

To ensure that the certified projects contribute effectively and responsibly, the initial certification will also entail an impact analysis. This analysis encompasses several dimensions, evaluating both the significance and feasibility of proposed solutions:

- Problem assessment: The impact analysis will delve into the problem's magnitude and relevance. It will assess how substantial the issue is, its pertinence within the agri-food industry, and the potential consequences of not addressing it. This evaluation will ascertain the stakes involved and the potential benefits of solving the problem.
- Innovativeness check: The analysis will also scrutinize the level of innovation exhibited by the proposed outcome. It will consider whether the solution offers a combinational or radical novelty in terms of ideas, approaches, or technologies. The assessment will span various scopes, including its impact on the company, the sector, Europe, and the global landscape.
- Responsibility evaluation: A significant aspect of the impact analysis is the assessment of potential negative externalities. This involves identifying any possible adverse effects that the proposed solution might generate and gauging their significance in the context of EU values and goals, including the consequences of AI development and deployment. This evaluation ensures that the solution aligns with ethical and responsible innovation practices.
- Readiness assessment: The readiness of the solution to address the identified problem or be effectively deployed within the industry will be carefully examined. This analysis will assess the degree to which the solution is prepared to tackle the problem and contribute to meaningful outcomes.

By conducting this impact analysis, the HEClab aims to ensure that certified projects not only exhibit innovation and feasibility but also adhere to ethical considerations and have a meaningful impact on the agri-food industry and society as a whole.

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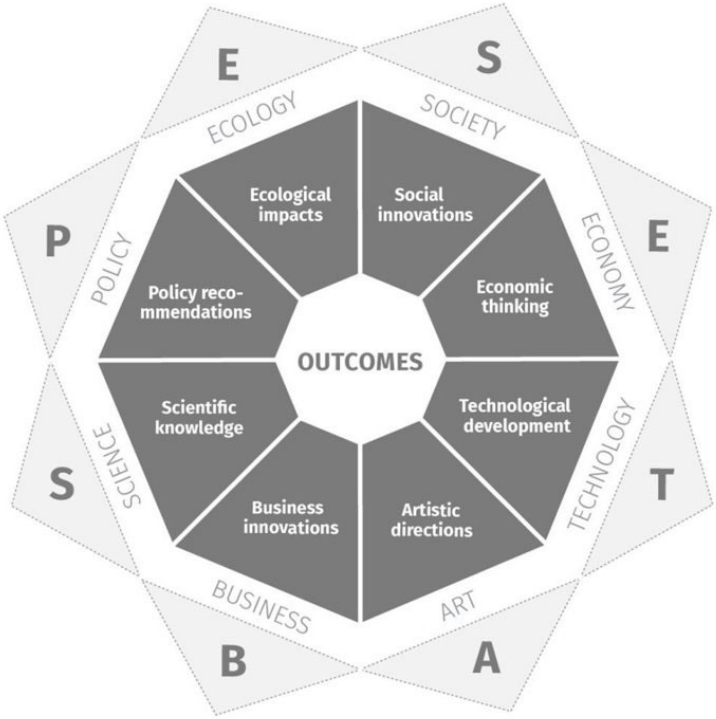

Figure 4: visual representation of the PESETABS diffusion model

Primary requirements of the HEClab are:

1. **User profiles and project spaces:** Each user (artists or SME representatives) can create a personalized profile on the HEClab platform, showcasing their portfolio, skills, expertise, and project interests (e.g., Figure 5). Users can also create dedicated project spaces where they can document and share their ongoing initiatives, progress, and outcomes. These project spaces support potential stakeholders to shareproject milestones.
   KPI: HEClab should contain all 20 residency projects after project end. After 2 years after the project, the HEClab should list at least 40 user profiles and 80 project spaces.

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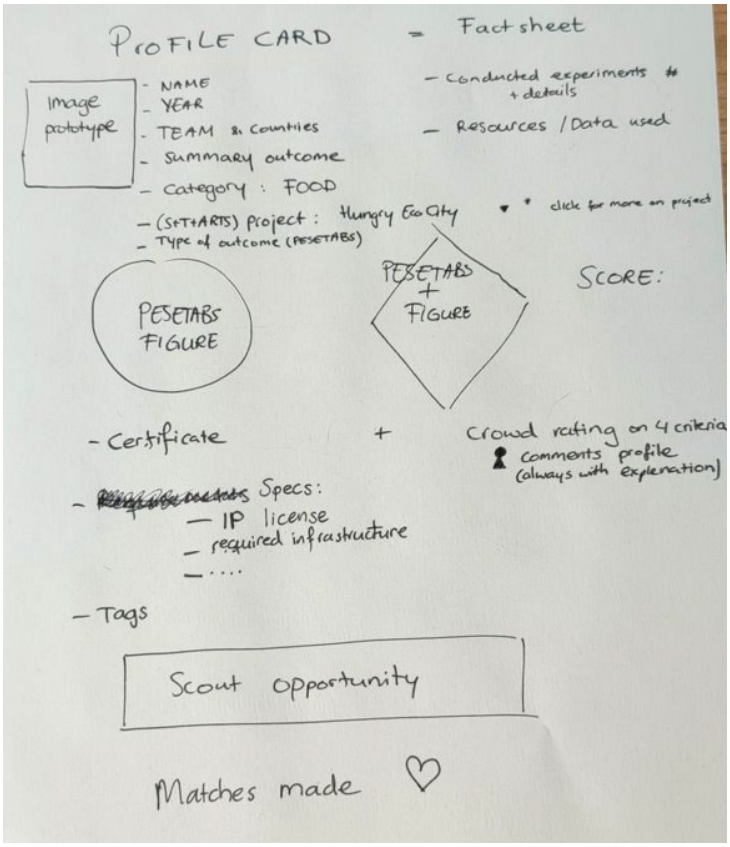

Fig 5: profile card sketches.

2. **Resource library:** The HEClab platform features a resource library that offers a vast collection of educational materials, research papers, case studies, and best practices related to art-driven innovation, sustainable agriculture, and responsible technology development. Each residency project will have to list their used resources to populate the initial resource library. Users can access these resources to deepen their understanding, expand their knowledge, and stay informed about the latest trends and advancements in the field. HEClab should incorporate logging functionality to measure the extent to which users utilize the resource library, indicating the level of engagement and interest in the available materials.
   KPI: We aim for a utilization rate of at least 80% of all resources shared on HEClab. A higher utilization rate suggests that users find value in the resources provided, actively seeking knowledge and staying updated on the latest trends and advancements in art-driven innovation, sustainable agriculture, and responsible technology development.

3. **Scouting Services:** The HEClab platform includes scouting services that enable stakeholders with similar interests and complementary expertise to find each other. It stimulates the formation of interdisciplinary teams, enabling users

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to collaborate on projects that require diverse skill sets or diverse access to resources. Artists can benefit from exposure to successful projects and gain inspiration for their own work. Additionally, as illustrated in Figure 6, recommendations can be provided to stakeholders regarding potential collaborations, relevant resources, and emerging trends in the field, promoting informed decision-making and fostering a vibrant and dynamic ecosystem.

KPI: the matchmaking process for the Paths to Progress Experiments (PPE) should be organized within a first proof-of-concept. Lessons learned will be integrated into a new iteration.

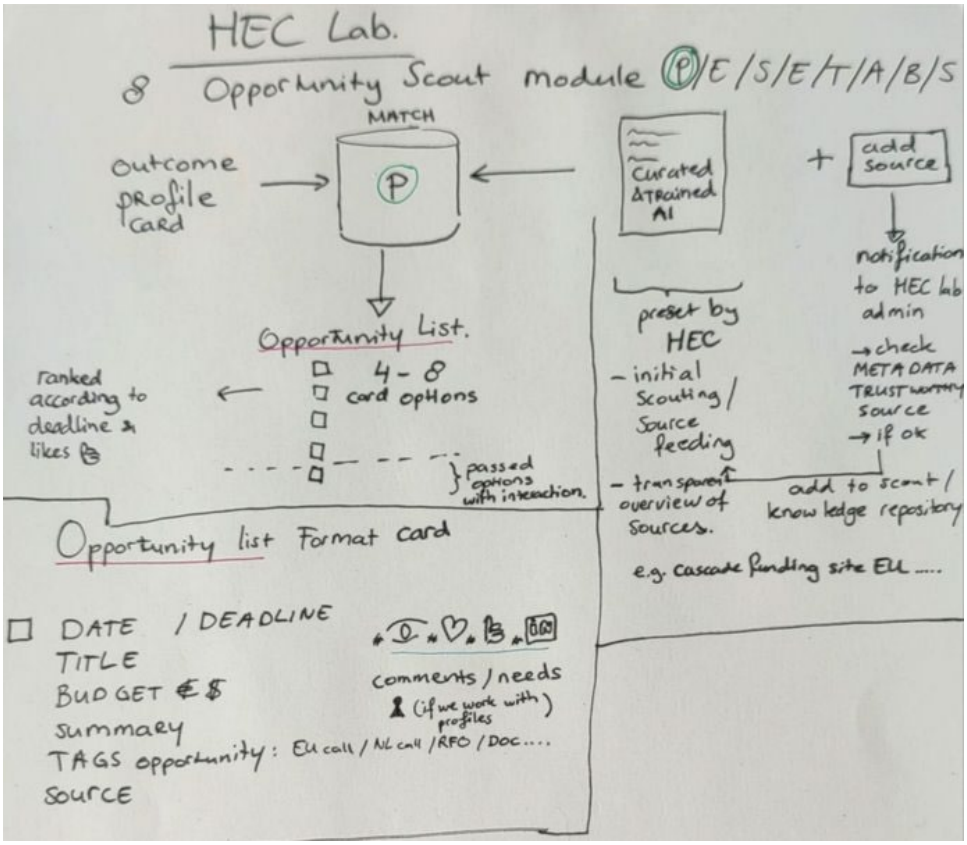

Figure 6: initial sketch of the HEClab's scouting services.

4. **Training and Support:** The HEClab platform offers training programs, workshops, and webinars to empower users with the necessary skills and knowledge to leverage technology. Additionally, webinars tailored to the needs of artists, farmers, AI experts, design studios, politicians, and other stakeholders will be available through HEClab.

   KPI: metrics such as the number of users who participated in training programs or attended webinars, the frequency of support inquiries, the average response time of the core team, or the resolution rate of user issues. We aim to organize at least 3 webinars per year.

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By implementing these features and functionalities, the HEClab platform provides a robust and inclusive digital infrastructure for art-driven innovation, collaboration, and knowledge sharing. It **empowers stakeholders to explore new possibilities, drive sustainable change, and contribute to the transformation of the agri-food industry.**

2.5 Iterative certification approach

As mentioned earlier, HEC residence project outcomes hosted via the HEClab will be certified according to the PESETABS framework. The PESETABS framework follows a three-stage process to analyze the underlying focus of art-driven experimental projects [2]. Firstly, the analysis begins by examining the project from two perspectives: systemic and thematic. The systemic analysis delves into the project's domain, including its context, relationships, and dynamics. On the other hand, the thematic analysis focuses on the project's theme, message, and purpose. Secondly, the experiment itself is evaluated to uncover any surprising outcomes it may have yielded. Lastly, the spill-over potential of the project is identified by exploring the eight directions outlined in the PESETABS diffusion model and aligning them with the project's ambitions.

For example, a project cantered around healthy nutrition may have spill-over potential in policy, society, and science, while an art-driven experiment in pesticide reduction may have spill-over potential in society, business, and technology. The final step involves creating an action plan to capture the value generated by the art-driven experiment.

To ensure transparency in this three-staged certification procedure and to facilitate the diffusion of certified projects into agrifood markets, the HEClab will need to meet the following requirements:

1. **Transparent Certification Process:** Implement a transparent certification process that clearly outlines the criteria, evaluation methods, and benchmarks used to assess projects. This process should be accessible to all stakeholders, providing visibility into the certification procedure and ensuring that it is fair, consistent, and aligned with the values and goals of the Hungry EcoCities project. Transparency will enhance trust and confidence in the certification system, fostering wider adoption and recognition of certified projects.
2. **Certification Benefits:** Communicate the benefits of certification to stakeholders in the agri-food sector. Highlight how certification can enhance the credibility of projects that align with the human-centred approach, sustainability goals, and ethical principles promoted by the Hungry EcoCities project. Certified projects can gain visibility and recognition as innovative, socially responsible,

[2] https://www.in4art.eu/wp-content/uploads/2023/05/Pesetabs-in4art-whitepaper-january-2023.pdf

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and environmentally friendly solutions, attracting potential partners, investors, and visitors.

3. **Market Diffusion Support:** Establish mechanisms and partnerships to support the diffusion of certified projects into agrifood markets. This can involve collaborations with industry associations, distribution networks and events, and other relevant stakeholders in the agri-food sector. The Hungry EcoCities consortium can leverage its network and partnerships to connect “certified” projects with potential collaborators and gain exposure to target audiences. This market diffusion support will contribute to the success and impact of certified projects, accelerating their adoption and integration into the agri-food industry.
4. **Certification Visibility:** Develop a dedicated section or platform within the HEClab that showcases certified projects, their achievements, and their impacts. This platform can include project profiles (e.g., Figure 5), success stories, and metrics that demonstrate the value and relevance of certified projects in addressing all eight dimensions. By providing a central hub for certified projects, the HEClab increases their visibility, making it easier for potential collaborators, investors, and customers to discover and engage with these innovative solutions.
5. **Certification Feedback Loop:** Establish a feedback loop between certified projects and the HEClab to gather insights, lessons learned, and success stories. This feedback loop can help refine and improve the certification process, identify areas of strength and improvement, and capture the real-world impacts and challenges faced by certified projects in agrifood markets. This continuous learning and improvement process will ensure that the certification system remains relevant, responsive, and adaptable to the evolving needs of stakeholders and the agri-food industry. The 20 residency project will therefore serve as first use cases.

By integrating transparency in the certification procedure and emphasizing the benefits of certification for diffusion, the HEClab can effectively promote certified projects and drive their visibility in the agri-food domain. This approach will strengthen the visibility, credibility, and viability of innovative, art-driven solutions that align with the human-centered approach, sustainability goals, and ethical principles fostered by the Hungry EcoCities project.

In summary, the HEClab serves as a supporting digital platform within the Hungry EcoCities project, facilitating the convergence of AI technology and artistic expertise in the agri-food industry. Through its emphasis on collaboration, knowledge-sharing, and the digitization of the art-driven technology valorisation process, the HEClab aims to stimulate innovation, increase trust in digital technologies, and drive sustainable development in the agri-food sector. By fostering cross-sectoral engagement,

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interdisciplinary collaboration, and art thinking, the HEClab is poised to revolutionize the agri-food landscape and create a brighter future for all stakeholders involved.

2.5 HEClab after HEC project

The Hungry EcoCities consortium has close collaborations with other EU funded projects. For example, KU Leuven is involved in the Europeana project, which allows us to leverage lessons learned in other domains. In4Art is a practitioner of art-driven innovation and embeds the PESETABS analysis in its practices in all other projects, both EU funded as privately initiated. This will allow us to create the HEClab and ensure it continuity after the project.

3 Reflection and Lessons learned.

During our research to develop the framework requirements for HEClab we came across many existing or expired versions of digital platforms aimed to diffuse and provoke collaboration amongst entities in any kind of way. It struck us that many of these platforms are little used and little maintained/updated after an initial starting. This led to the reflection on our end to think of how HEClab could overcome these issues.

We believe we can overcome this by 1) developing a strong certification module for art-driven experimentation producers to certify their outcome and report to them opportunities for development, 2) developing a second module for solution seekers or problem owners interested in solving complex problems in the food industry, to analyse their need and scout for solution opportunities among the art-driven innovation certified outcomes, and 3) matching innovative solutions with problem owners on the basis of opportunities for collaboration and co-development.

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Annex to Deliverable 2.1: initial listing of possible elements for the HEC lab web application.

1. User Interface and User Experience

Design Consistency

- Employ a uniform color scheme, typography, and iconography throughout the website.
- Ensure intuitive navigation menus.

Design of the menu bar:

Homepage Link

- A clickable logo or "Home" text at the top left corner typically returns users to the main page.

About

- **Lab Overview**: Introduction to the fab lab, its mission, and objectives.
- **Team**: Brief profiles of the researchers, scientists, and staff.
- **History**: The evolution and milestones of the lab.

Projects

- **Ongoing**: List of current projects with brief overviews.
- **Completed**: Archive of past projects with results and conclusions.
- **Upcoming**: A preview of future projects or research topics.

Databases and Tools

- **External Links**: Direct links or brief intros to connected databases like NCBI, KEGG, etc.
- **In-house Tools**: Any unique tools or software developed within the lab.
- **Tutorials**: Guides on how to use the lab's tools or access databases.

Agricultural Challenges

- **By Stress Factor**: Dropdown or sub-menu for challenges like drought, contamination, etc.
  - Each stress factor could further lead to crop-specific information, e.g., drought -> maize.
- **By Crop**: Directly choose the crop and then see the challenges associated with it.
- **Interactive Modules**: Access to the interactive features like the maize leaf under stress.

Research and Publications

- **Latest Papers**: The most recent publications from the lab.
- **Collaborations**: Research done in collaboration with other institutions or labs.
- **Open Access Resources**: Any freely available research material or findings.

Education and Outreach

- **Webinars and Workshops**: Schedule and archives.
- **Interactive Learning**: Any e-learning modules or courses provided by the lab.
- **Resources for Teachers**: Materials tailored for educational purposes.

Virtual Lab Tour

- An interactive or video-based tour of the physical lab, providing users with a sense of the lab environment.

AI Collaboration

- **AI Assisted Search**: Redirect to the feature where users can use AI to sift through research papers or data.
- **AI Insights**: Predictions or insights generated by AI models based on lab data.

Contact and Support

- **Contact Form**: For general queries.
- **FAQ**: Address common questions and issues.

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- **Technical Support**: For issues related to virtual machines, databases, etc.

News and Updates

- Regular updates on the lab's achievements, events, and other noteworthy happenings.

Search Bar

- Ideally placed at the top right or centrally for users to quickly find specific content.

13. User Account (if applicable)

- **Login/Logout**: For users who have accounts, perhaps to save progress in e-learning modules or to save favorite papers.
- **Profile**: Manage personal details, preferences, and saved content.

Footer

- **Legal**: Privacy policy, terms of use, and cookie policy.
- **Social Media Icons**: Direct links to the lab's social media profiles.
- **Sitemap**: An overview of the site's structure.
- **Newsletter Signup**: For users who want regular updates via email.

Accessibility

- Design layouts suitable for desktop, tablet, and mobile devices.
- Utilize alt-text for images and screen reader-friendly designs.

Interactive 3D Models

- Implement WebGL or Three.js frameworks for rendering interactive 3D models.
- Allow users to rotate, zoom, and interact with the 3D visualizations.

User Dashboard

- Personalized landing page showcasing user's past activity, recommendations, and saved articles.
- Progress tracker for any interactive courses or tutorials.

2. Possible Functional Requirements

Dynamic Selection

- Dropdowns or graphical selectors for choosing stress factors and crops.
- Immediate visual feedback upon selection.

Virtual Machine Integration

- Seamless transition from the website interface to the virtual machine environment.
- Real-time data streaming and display capabilities.

Database Link-outs

- Dynamic links to external databases that open in a new tab or provide in-site pop-up information.

AI-Assisted Search

- Predictive search capabilities.
- Keyword highlighting and context-driven search results.

3. Database requirements (to be developed)

Data Management

- Employ SQL or NoSQL databases depending on data type and access patterns.
- Implement data caching for frequently accessed information.

Updates and Syncing

- Automated scripts to fetch updates from linked databases.
- Timestamps to indicate last updated information.

User Data Protection

- Encrypt personal data.

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- Anonymize user analytics data.

4: Collaboration and Linking Features

Project Showcase

- Dynamic gallery or carousel format.
- Brief project descriptions with options to delve deeper.

Scientific Annotation

- In-line citations for easy reference.
- Hover tooltips providing short descriptions of linked articles.

Feedback System

- Commenting capabilities with moderation features.
- Upvote/downvote system for community-driven content prioritization.

5. Analytics and Measurement Integration

Virtual Simulations

- Interactive graphs and charts showing real-time data.
- Option to download or share specific data points.

Analytical Tools

- Drop-down menus or selectors for various analytical techniques.
- Tutorials or guides on how each tool works.

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Possible content specific chapters in the HEC lab (not complete)

Spectrophotometry

Overview

- A brief introduction about what spectrophotometry is and its applications.

Interactive Tutorials

- Animation or video-guided tutorials on how spectrophotometry works and how to interpret results.

Sample Data

- Example spectrophotometric data to help users understand typical results.

Troubleshooting Guide

- Common issues faced during spectrophotometry and solutions.

Microscopy

Overview

- Introduction to the different types of microscopy (e.g., electron, light, fluorescence) and their applications.

Image Gallery

- A curated gallery of microscope images. Users can zoom in, with descriptions explaining the image.

Interactive Tutorials

- Guided demonstrations on how to use different microscopes and how to process and interpret microscopic images.

Annotation Tool

- Users can annotate or highlight regions of interest on sample images and share or save their annotations.

High-Performance Liquid Chromatography (HPLC)

Overview

- Introduction to HPLC and its role in separating mixtures.

Interactive Module

- An interactive module allowing users to simulate an HPLC run and see how different conditions impact results.

Sample Chromatograms

- Archive of chromatograms to demonstrate typical results and anomalies.

Troubleshooting Guide

- Common issues in HPLC runs and their solutions.

Polymerase Chain Reaction (PCR)

Overview

- Introduction to PCR and its role in amplifying DNA.

Interactive Tutorials

- Step-by-step guides on setting up PCR reactions, including calculations, primer design, and cycling conditions.

Result Interpretation

- Sample gel images of PCR results and explanations.

Troubleshooting Guide

- Solutions to common PCR problems, such as non-specific amplification or no amplification.

Quantitative PCR (qPCR)

Overview

- Introduction to the principles of qPCR and its applications.

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Interactive Tutorials

- Demonstrations on setting up qPCR reactions, including primer and probe design, and data interpretation.

Sample Data

- Sample qPCR curves, melt curves, and how to interpret them.

Troubleshooting Guide

- Common qPCR issues, like primer-dimers or inefficient amplification, and solutions.

<u>Atomic Absorption Spectroscopy (AAS)</u>

Overview

- Introduction to AAS and its role in analyzing and quantifying the presence of metals.

Interactive Tutorials

- Step-by-step guide on preparing samples for AAS, understanding the equipment, and interpreting results.

Sample Spectra

- Archive of AAS spectra for different metals at varying concentrations.

Troubleshooting Guide

- Solutions to common AAS issues like matrix interference or instrumental errors.

Each of these methods will also have:

- ***User Guides**: Manuals or guides for users who want a deep dive into the methodology and best practices.*
- ***FAQs**: A dedicated section addressing commonly asked questions related to the method.*
- ***Related Publications**: Links or references to seminal and recent publications related to each analytical tool.*

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AI related topics for the HEC lab configuration (not complete)

6. AI-Assisted Features

Recommendation System

- Machine learning models to predict and suggest relevant content.
- Feedback loop allowing users to rate the relevancy of suggestions.

AI-Curated Content

- AI algorithms scanning global research databases for the most recent and relevant publications.
- Summaries or digests of top articles.

AI-Driven Analysis in Metabolomics and Transcriptomics

Data Integration and Harmonization

- **Multi-omics Integration**: Merge transcriptomics and metabolomics data for comprehensive analysis.
- **Database Linkage**: Connect to external databases to fetch additional gene or metabolite information.

Predictive Modeling

- **Biomarker Discovery**: Use AI to identify potential biomarkers from large datasets.
- **Pathway Analysis**: Predict pathways affected based on the gene expression and metabolite data.

Visualization Tools

- **Heatmaps**: For differential gene/metabolite expression.
- **Interactive Pathway Maps**: Visualize affected pathways and drill down to specific genes or metabolites.

Comparative Analysis

- **Species Comparison**: Understand how different species respond at the transcriptomic and metabolomic levels.
- **Condition Comparison**: Compare responses under different stress factors or treatments.

Anomaly Detection

- **Outliers Identification**: Spot unusual patterns or data points in the datasets.
- **Noise Reduction**: AI-driven algorithms to reduce background noise in the data.

AI-Menu - Content

Dynamic Content Recommendations

- **User Profile Analysis**: Provide content recommendations based on user's past reading habits and search queries.
- **Trending Topics**: Use AI to identify hot topics in the research community and bring relevant papers to the forefront.

Advanced Search Capabilities

- **Semantic Search**: Go beyond keywords; understand the context of user queries to fetch more relevant results.
- **Graph-based Search**: Explore connections between papers, authors, institutions, and topics in a visual manner.

AI-Generated Summaries

- **Adaptive Summarization**: Generate summaries based on user preference – short abstracts or detailed overviews.
- **Visual Abstracts**: Convert textual findings into visual abstracts using AI, aiding in faster comprehension.

Linkage to Experimental Data

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- **Relevance Scoring**: Score papers based on their relevance to the experimental data present in the fab lab database.
- **Contextual Annotations**: Annotate experimental data with related research findings, providing a richer context for interpretation.

Periodic Digests

- **AI-Generated Newsletters**: Curate weekly or monthly newsletters based on the most important findings or trending research areas.
- **Personalized Alerts**: Notify users of breakthroughs or significant publications in their areas of interest.

Collaboration Recommendations

- **Researcher Matchmaking**: Based on AI analysis of publications and interests, suggest potential collaborators.
- **Conference/Event Suggestions**: Recommend conferences or events that align with the user's research interests.

HEClab backbone topics (not complete)

7. Security and Privacy

Connection Security

- SSL certificates to ensure HTTPS connections.
- Regular security patch updates.

Data Protection Compliance

- Clear cookie consent banners.
- Easily accessible privacy policy and terms of service.

8. Educational and Outreach Section

Learning Portal

- Categorized educational content.
- Interactive quizzes and assessments.

Webinars and Workshops

- Calendar integration for upcoming events.
- Archival of past sessions with search capabilities.

9. Integration and Compatibility

API Development

- RESTful or GraphQL APIs for third-party integrations.
- Thorough API documentation.

Browser Compatibility

- Testing on various browsers to ensure website functions optimally.
- Regular updates to stay compatible with the latest browser versions.

10. Maintenance and Support

System Backups

- Regularly scheduled backups of the entire system.
- Off-site storage for backup redundancy.

User Support

- Dedicated FAQ section.
- Ticket-based support system or chatbots for instant help

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Resources section topics (not complete)

Agritechnologies and Organizations Database

Agritechnologies

Overview

- Introduction to the latest technologies impacting agriculture and their significance.

Technologies List

- Breakdown of technologies like GMO, CRISPR, Microalgae cultivation, etc.
    - Each technology could have its subsection with descriptions, applications, advantages, and challenges.

Interactive Timeline

- An interactive timeline showcasing the evolution of agritechnologies over the years.

Companies and Institutions

Directory

- An alphabetical list or search bar to explore companies and institutions.

Featured Profiles

- Detailed profiles of leading companies and institutions in agritechnology. This could include their history, significant contributions, technologies they're known for, etc.

Collaboration Opportunities

- List of companies and institutions open for research collaborations, internships, or partnerships.

Regulatory and Organizational Databases

Overview

- Brief on the significance of regulatory bodies and organizations in guiding and shaping agriscience.

FDA and Similar Organizations within EU

- Information on the FDA's role in food safety, biotechnology, etc. Links to their database and latest guidelines.
- Similar organizations from other regions/countries could also be covered.

Environment and Agriculture

- Data and guidelines from organizations focusing on sustainable agriculture, environmental impacts of farming practices, etc.

Horticulture and Food Technology

- Organizations focusing on plant cultivation, gardening, and innovative food processing and safety technologies.

GMO and Biotechnology

- Regulatory bodies overseeing GMO crops, their approvals, safety guidelines, and other biotechnological advancements.

Microalgae and Bioproducts

- Organizations and databases centered around microalgae cultivation, its applications, and derived bioproducts.

Remote Sensing in Agriculture

- Information on the utilization of drones, satellites, and other remote sensing technologies in agriculture. Links to organizations or initiatives that provide satellite data or insights for agricultural applications.

Resources and Publications

Reports and Whitepapers

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- Access to reports or whitepapers published by these organizations.

Interactive Webinars

- Schedule and archive of webinars or workshops conducted by these organizations.

Collaboration Reports

- Showcase of collaborative projects, their findings, and impact on agritechnologies.

Global Perspectives

Regional Spotlight

- Highlight the agritechnological advancements in different regions or countries.

Case Studies

- Real-world implementations of agritechnologies and their impact.

Each section should have:

- ***Search Functionality**: A robust search bar that allows users to quickly find technologies, companies, or organizational data.*
- ***Feedback and Suggestions**: Allow users to provide feedback or suggest new entries or updates to the database.*
- ***Updates and Alerts**: Notify users of any new additions or significant updates in the database.*

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