HUNGRY ECOCITIES

A S+T+ARTS RESIDENCIES PROJECT

Hungry EcoCities
S+T+ARTS Residencies

Deliverable 2.2 – HEC virtual fab lab framework architecture

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1. Abstract

The HEClab is an online platform designed to promote the adoption of digital technologies for eco-friendly innovation in the food sector. It is currently under development as part of the Hungry EcoCities project, with plans for ongoing enhancement post-project.

In the realm of innovation, significant attention is often paid to the initial and final phases of development, such as ideation, exploration, experimentation, business development, application, and market introduction. However, a critical yet frequently neglected segment of the development process is the intermediary phase, which includes demonstrating in appropriate settings, validating in operational contexts, and finalizing the system for practical use and duplication. The HEClab aims to address this gap by concentrating on levels 5 and 6 of the Technology Readiness Level (TRL) scale, which involve facilitating these intermediary steps.

The HEClab will serve as a digital platform that enables the identification of connections between proof-of-concept models generated from art-inspired experimental projects and suitable operational settings for demonstrating and validating these innovative solutions.

Set to debut in the 2024 call for artists and end-users, HEClab is on track for steady growth, aspiring to be a key asset in the field of art-inspired innovation, particularly in fostering sustainable advancements within the food industry.

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2. HEC virtual fab lab framework

2.1. Introduction and timeline

The HEClab aims to become a web-based tool to stimulate uptake of digital technology opportunities for sustainable innovation in food. It's first versions will be built as part of the project Hungry EcoCities, with the intent to continue developing after the project ends.

In innovation processes, a lot of emphasis is given to the early stages of development (ergo; ideation, exploration and experimentation) and the later stages of development (ergo; business development, application and marketization). An often overlooked but essential part of the development funnel is what lies in between: demonstrating in relevant environments, validation in operational environments and thereby completing the system, making it ready for use and replication. Facilitating these steps, on the Technology Readiness Level (TRL) scale levels 5 and 6, is the focus of the HEClab.

The HEClab will be a digital tool which allows for finding matches between proof-of-concept prototypes coming out of art-driven experimentation projects, and relevant operational environments to demonstrate and validate the solutions. In addition, creating windows of opportunity for demonstration and validation through funding opportunities, a database of collaborators, and a knowledge repository will make the HEClab a useful tool for those interested in art-driven experiments and looking for solutions to contribute to a more responsible and sustainable food system.

The HEClab will first be used during the second open call for artists + end users in 2024 and will be gradually expanding its services and operations thereafter.

To start the development of the HEClab, the following first steps have been identified:

Step 1 - Creating the base modules of the HEClab
Timing: March 2024
Step 2 - Filling the 'prototypes' module with the outcomes of the HTE Experiments
Timing: June 2024
Step 3 – Testing the 'knowledge repository' module with the sources gathered during the HTEs
Timing: June 2024
Step 4 – Testing the 'matchmaking' module through the personalised dashboards with the dummy opportunities to test tagging
Timing: July 2024

After this step, we run the first test of the working of the HEClab, which should be able to:

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Produce recommended matches between prototypes (from step 3) and relevant environments (from collaborators database of end-users responding to the Open Call II opportunity) with suggested knowledge sources and additional collaborators, presented in a personal user dashboard.

The test of the working of the HEClab should be possible in **July 2024**

By establishing a robust and versatile platform infrastructure, the HEClab lays the groundwork for a matchmaking ecosystem that bridges the gap between theoretical innovation and practical application, driving forward the mission of sustainable development in the food industry.

2.2. Creating the Base Modules of the HEClab:

The initial phase of developing the HEClab, a cornerstone of the Hungry EcoCities project, focuses on the construction of its foundational infrastructure. Scheduled for completion by March 2024, this phase is critical for establishing the platform's core functionalities. These include the Profile, Knowledge, Prototype, and Opportunities databases, alongside the User's Personal Matching Dashboard and the platform's Landing/Login page. Each module is designed to cater to the diverse needs of the platform's users, ranging from end-users and prototype owners (artists) to opportunity scouts.

Profile Database

The Profile Database acts as the backbone of the HEClab, facilitating interaction among various user types. It encompasses the creation of detailed profiles for:

1. **End-Users:** These users provide relevant environments for testing prototypes, bridging the gap between innovation and practical application.
2. **Developers/Makers/Artists:** Referred to as the 'owners' of prototype cards, they are the innovators who bring tangible forms to theoretical ideas.
3. **Viewers:** Users who navigate the platform to explore, scout, or search for information, prototypes, or opportunities without actively contributing content.

Upon completing their profiles, users gain access to a personalized dashboard, tailored to their interests and contributions to the platform, to start the matching process for opportunity scouting. This dashboard serves as a gateway to the resources, opportunities, and connections available within the HEClab ecosystem.

The design of the Profile Database prioritizes privacy and selective visibility. Profiles are not publicly accessible, ensuring that sensitive information remains confined to only

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to validated HEClab matches. The platform may incorporate a feature allowing users to search within the database, subject to privacy constraints and the necessity of maintaining a secure environment. Alternatively, the system might restrict users to viewing only those matches and connections that the platform's algorithms identify as relevant to their interests and needs.

Knowledge, Prototype, and Opportunities Databases

Alongside the Profile Database, the Knowledge Database will store a wealth of information gathered during the Hungry EcoCities project and beyond, serving as a repository for research, insights, and best practices. It will show the resources on which the prototype made their claims. The Prototype Database will catalogue the innovations developed by the platform's creators (artists), providing a showcase for their work and a resource for end-users seeking solutions. The Opportunities Database will list potential applications and environments where these prototypes can be tested and implemented, connecting creators with real-world testing environments.

User Matchmaking Dashboard and Landing/Login Page

The User Dashboard is the centrepiece of the user experience, offering a consolidated view of matches, opportunities, and content relevant to each user's profile and interests. It will enable efficient navigation and interaction within the HEClab ecosystem.

The Landing/Login Page serves as the gateway to the HEClab, welcoming users with an intuitive and informative interface that guides them through the process of creating a profile or accessing their dashboard. This page sets the tone for the user experience, emphasizing the platform's commitment to innovation, collaboration, and sustainable development in the food sector.

2.3. Knowledge Database

The Knowledge Database within the HEClab platform serves as a pivotal resource, encapsulating a wealth of information derived from the pioneering "Humanizing Technology Experiments" conducted in the Hungry EcoCities project. This repository is meticulously designed to accommodate a diverse array of knowledge forms, including academic literature, popular articles, multimedia sources such as images and

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videos, and other pertinent information that underpins the development and application of prototypes within the platform.

Composition and Content

The database's content consisting of insights and findings from the nine humanizing technology experiments, each contributing to a deeper understanding of sustainable innovation's practical and theoretical aspects. The inclusion of written sources ensures a solid academic and practical knowledge base, while images and video sources offer visual and interactive dimensions to the learning and exploration experience within the HEClab.

By demonstrating the grounding of each prototype in empirical research, practical experimentation, and peer-reviewed knowledge, the database significantly contributes to building trust and acceptance among the platform's users. We want to validate if seeing the direct connections between prototypes and their foundational knowledge helps users appreciate the prototypes' validity and reliability.

We expect that the linkage between knowledge sources, prototypes, and collaborators fosters a collaborative environment where users can easily identify potential partners, mentors, or resources relevant to their interests or projects. This interconnectedness encourages cross-disciplinary collaboration and innovation, enriching the ecosystem within the HEClab.

Interactivity and Searchability

A key feature of the HEClab is its interactive search functionality, which allows users to navigate the repository with ease and efficiency. The database is structured to support search queries based on tags, keywords, and correlations between different knowledge sources. This interactive element ensures that users can quickly find relevant information, draw connections between different pieces of knowledge, and explore the database's depth without feeling overwhelmed by its vastness.

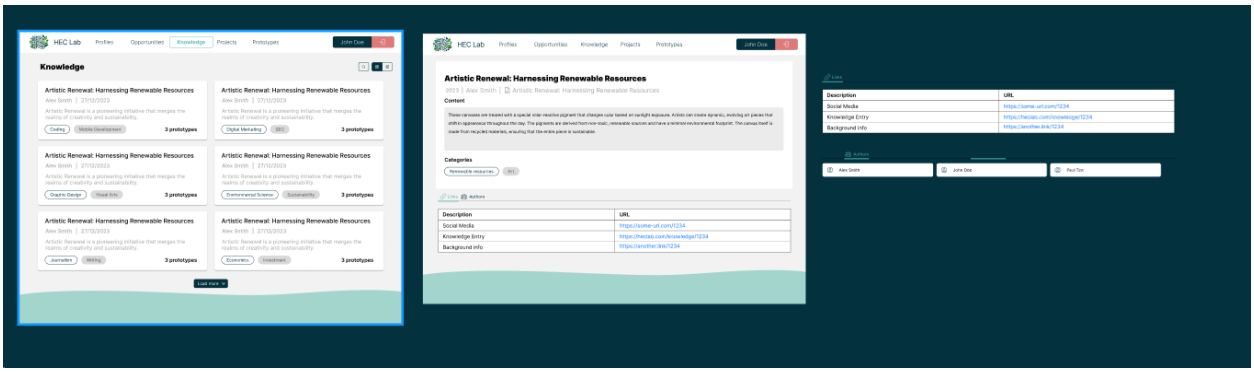

Figure 1: Visualization of how the working of the knowledge repository is foreseen

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The keywords and tags come in several categories – we will experiment with free tags and those that initially be predefined in a list. Possibly additional categories will emerge:

1. technology tags (e.g., AI, blockchain, VR)
2. theme related tags (e.g. biodiversity, health, energy)
3. classification tags (e.g. publication, best practice, recent development, code)

Tags of categories (1) and (2) are intended to connect to cards in the database and facilitate the matchmaking. Tags of category (3) are intended to categorize the knowledge database and make it searchable in an interactive way.

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2.4. Prototype Cards: Catalysing Sustainable Innovation in the HEClab

In the realm of sustainable food innovation, the HEClab serves as a dynamic platform where the outcomes of cutting-edge experiments are transformed into tangible assets for real-world application. Each experiment conducted within the project, totalling 19 across the span of 2024 and 2025 (9 in total ongoing and 10 in 2024/2025), yields one or more outcomes that demonstrate the practical utility of digital technology solutions in addressing sustainability challenges in the food sector. These outcomes are meticulously converted into outcome or demonstrator cards, which are pivotal in enabling end users to gauge the relevance and potential benefits of these innovations for their specific needs.

Entry and Analysis of Prototypes

1. **Form Submission:** The journey of a prototype into the HEClab begins with a detailed submission form. Innovators are required to encapsulate the essence of their prototypes or components, including their functionality, sustainability impact, and the specific challenges they aim to address. This form is designed to capture a comprehensive overview of the prototype, ensuring that all relevant information is considered in the evaluation process.
2. **Dimensional Analysis:** Upon submission, each form undergoes a thorough analysis across multiple dimensions. Initially conducted manually by experts, this process evaluates the prototype's innovation, sustainability potential, technological viability, and applicability to real-world challenges. In the future, this analysis might be augmented or replaced by automated systems to enhance efficiency and scalability.

Certification and Creation of Prototype Cards

1. **Sustainable Innovation Certification:** Prototypes that meet the stringent criteria set forth by the HEClab are awarded a certificate of sustainable innovation potential. This certification is not just a recognition of the prototype's merit but also serves as a gateway for its entry into the HEClab's ecosystem.
2. **Prototype Cards:** The certificate is effectively transformed into a prototype card, which encapsulates all critical information about the prototype in an accessible and engaging format. These cards include concise written descriptions, images, and video demonstrations that collectively provide a clear understanding of the prototype's functionality, application, and sustainability impact.

Accessibility and Integration

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1. **HEClab Database:** Once created, the prototype cards become an integral part of the HEClab's database. They are categorized and stored in a dedicated section, making it easy for users to browse, search, and discover innovative solutions that align with their interests or challenges.
2. **Searchability and Connections:** The prototype cards are meticulously linked to the HEClab's Knowledge Repository, ensuring that users can explore the theoretical foundations, research, and experiments underpinning each prototype. Furthermore, each card is associated with specific owners or collaborators, enhancing the platform's collaborative potential. The integration of matching tags facilitates the discovery of relevant opportunities, allowing users to find prototypes that align closely with their specific needs or challenges.

The prototype cards within the HEClab represent a bridge between theoretical innovation and practical application in the sustainable food sector. By providing a structured, accessible, and informative gateway to the outcomes of the experiments, these cards empower end users to explore, validate, and potentially adopt digital technology solutions that address their unique sustainability challenges. The HEClab's approach to cataloguing and presenting these innovations not only fosters a culture of collaboration and knowledge sharing but also accelerates the adoption of sustainable practices in the food industry, paving the way for a more responsible and sustainable future.

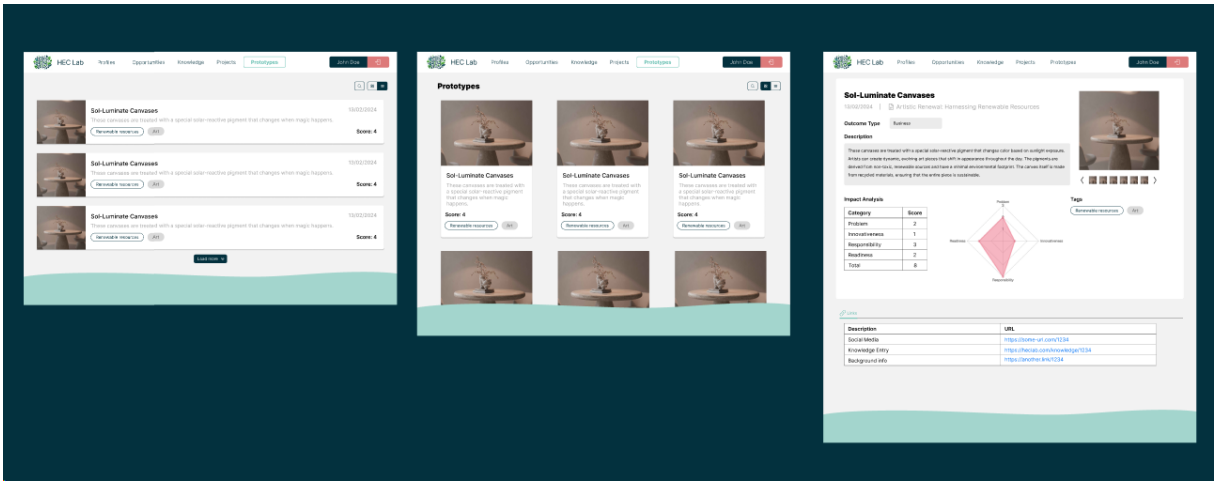

Figure 2: Visualization of the working on the outcome "prototype" card section.

2.5. Opportunities Database: Fostering Collaborative Innovation in the HEClab

The Opportunities Database is a pivotal component of the HEClab, designed to consolidate and present a wide array of opportunities ranging from funding and assignments to calls and tenders. This database is fuelled by the Scouting Module, an intake form that allows for the detailed submission of various opportunities by different

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stakeholders including end users, public funders, private funders, and through cascade funding mechanisms.

Matchmaking Module and Opportunity Cards

1. **Intake Form Structure:** The Opportunity Module is meticulously designed to capture all necessary details pertaining to an opportunity, ensuring that submissions are comprehensive and informative. This structured approach facilitates the effective matching of opportunities with the needs and capabilities of the HEClab's diverse user base.

Testing and Evolution of the Opportunities Database

1. **Initial Testing with Open Call II:** The first significant test of the Opportunities Database's functionality and impact will be conducted using the HEClab's own Open Call II. This initial opportunity will serve as a pilot, allowing for the evaluation and refinement of the database and the Scouting Module, ensuring their effectiveness in connecting developers, end-users, and knowledge creators with relevant opportunities.
2. **Integration of AI for Enhanced Discovery:** In its subsequent phase, particularly during the PPE (Path-to-Progress) stage, the HEClab plans to explore the integration of AI technologies to automate and enhance the discovery of opportunities. This AI-driven approach will focus on identifying relevant inputs from public funders and cascade funding sources based on predefined tags, enhancing the efficiency and breadth of the scouting process.
3. **User Engagement and Feedback:** Opportunities identified through AI or community contributions will be subject to user scoring, based on their relevance and the users' interest in participation. This feedback mechanism will not only refine the relevance of presented opportunities but also foster a user-centric evolution of the database, aligning it more closely with the community's needs and interests.

The Opportunities Database, powered by the collaborative efforts of the HEClab community and augmented by AI technologies, stands as a cornerstone for catalysing sustainable innovation in the Hungry EcoCities project. By creating a centralized repository of diverse opportunities and employing a community-driven approach to its expansion and refinement, the HEClab ensures that its users—whether they are developers, end-users, or knowledge creators—have access to a broad spectrum of possibilities for collaboration, funding, and growth. This strategic component of the HEClab not only facilitates the matching of needs with solutions but also embodies the platform's commitment to fostering an ecosystem of innovation, collaboration, and sustainable development.

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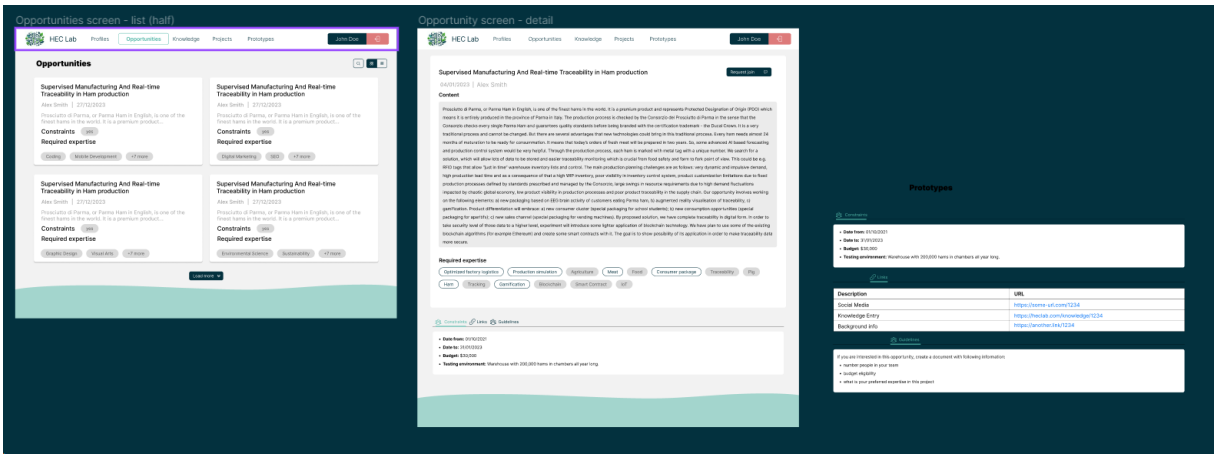

Figure 3: Demonstration of the opportunities environment.

2.6. User dashboard

Each section is designed to give users a personalized experience, ensuring that the information displayed is tailored to their specific needs and interests, facilitating a more efficient and targeted interaction with the platform. The dashboard appears to serve as a central hub for the user, from which they can navigate to different areas of the HEClab ecosystem.

The layout presents a clear and structured approach to user interaction, featuring several key sections:

1. **Name / Profile:** This is the area where the user's name and profile information are displayed, which can include their role, contact information, and any other relevant personal or organizational details.
2. **My Matches:** This section shows the user's matches based on the platform's algorithms or search parameters—connecting them to potential collaborators, opportunities, or resources.
3. **My Opportunities:** Here, users can find opportunities such as calls for projects, funding, or any relevant tenders that have been matched to their profile or that they have expressed interest in.
4. **My Project Cards:** This part of the dashboard displays a collection of the user's active-, pending-, or completed project cards, each representing a different initiative or prototype they are working on or following.

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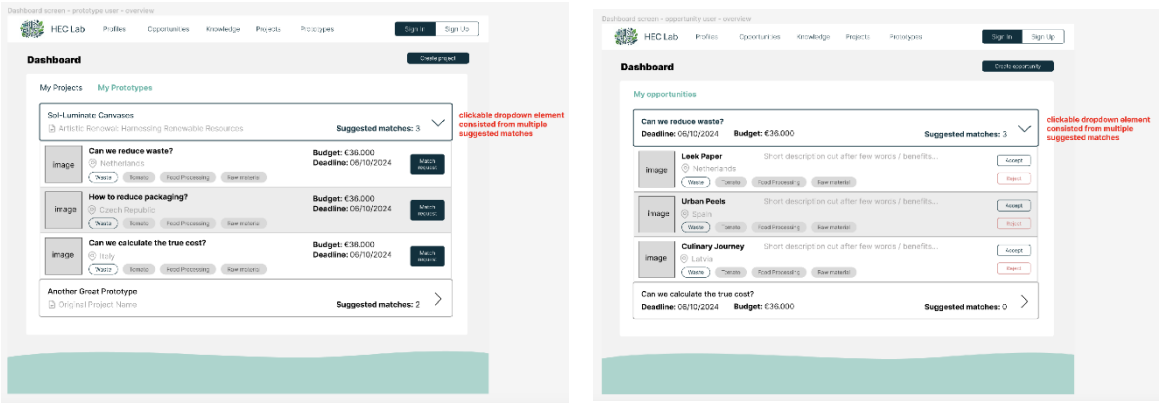
5. **My Knowledge Feed:** This feed will provide users with a stream of relevant articles, papers, news, and updates related to their field of interest or current projects.



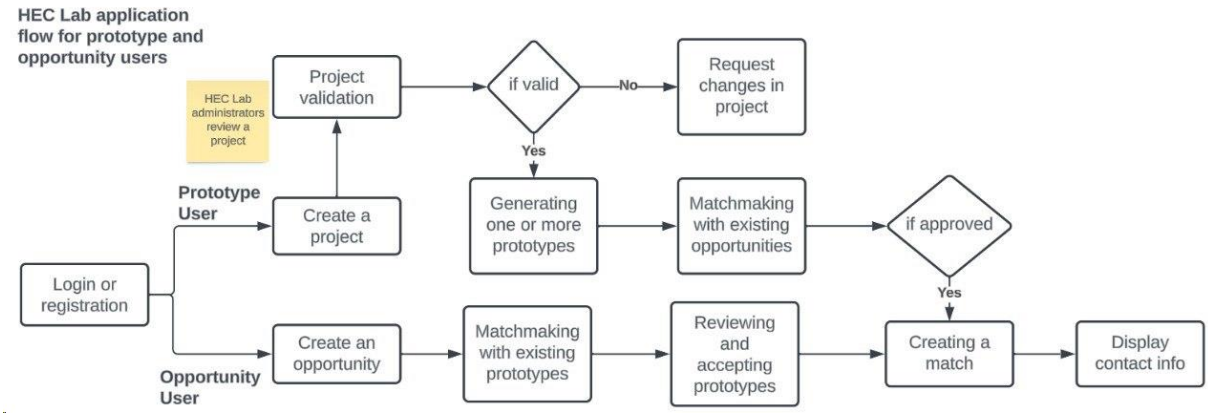


Figure 4 Outline of the user matching dashboard and application flow.

2.7. Landing Page and Login Page: Gateway to the HEClab

The design and functionality of the landing and login pages serve as the initial touchpoints for users interacting with the HEClab platform.

Design and Accessibility

1. **Front-End Design:** The landing page is meticulously designed to reflect the HEClab's commitment to sustainable innovation in food, integrating visual elements and themes that resonate with the platform's focus areas. The design prioritizes user-friendliness, ensuring that new visitors can easily navigate through the page to understand the platform's purpose, offerings, and how to engage with it.

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2. **Initial Login Requirement:** In the platform's early stages, access to content is gated behind a login requirement. This approach ensures a secure environment for users to share, explore, and collaborate on sensitive and proprietary information. The login page is designed for simplicity and ease, facilitating quick access for registered users while also offering clear guidance for new users on how to join the HEClab community.

Phased Content Accessibility

As the platform evolves, the strategy regarding content accessibility will also adapt. Plans are in place to gradually make certain sections of the HEClab content available without the need for login, broadening the reach of the platform and inviting wider engagement from the global community interested in sustainable food innovation. This phased approach to content accessibility will be carefully managed to maintain the platform's integrity and the privacy of its users.

The HEClab platform is conceived as an interactive, interconnected ecosystem designed to foster collaboration and innovation within the sustainable food sector. At its core, the platform is structured around a matchmaking dashboard and three central databases: the Knowledge Database, Opportunities Database, and Project and Prototype Database. Each database is tailored to facilitate specific functions within the platform, creating a seamless and integrated user experience.

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Figure 5 Flowchart diagram of the HEClab architecture.

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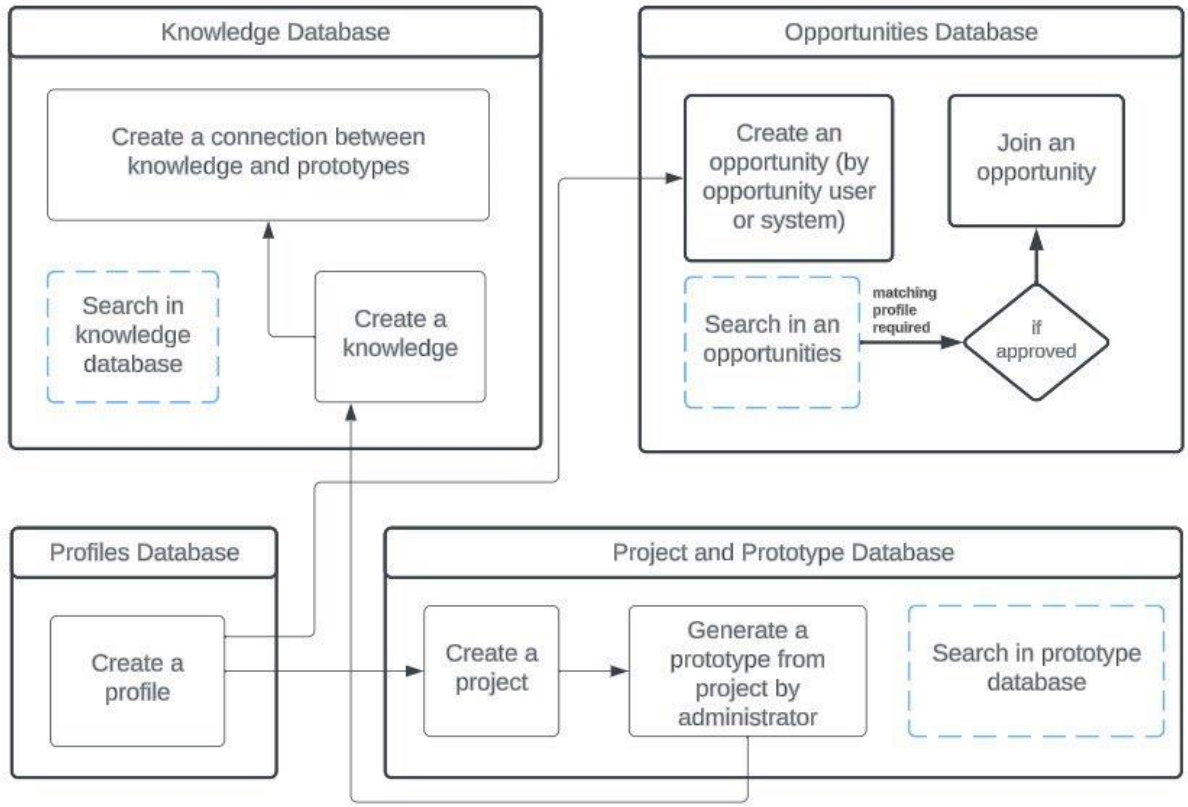

Figure 6 Flowchart diagram of the HEClab.

2.8. Matchmaking of the Prototype and Opportunity Cards

The matchmaking among opportunity cards and prototype cards will be based on two concepts reflecting the content defined by the card author's descriptions provided:

1) User-defined tags (that can be partially suggested by the user interface form);
2) Card description similarity values computed by state-of-the-art LLM-based (large language models) deep learning measures.

we propose a phased approach to developing the matchmaking system within the HEClab platform. Initially, we will implement a straightforward matching mechanism that utilizes tags provided by the authors of the prototype and opportunity cards. This rudimentary system will serve as a foundational feature, enabling basic matchmaking capabilities to facilitate early demonstrations and gather user feedback.

Building upon this foundation, we plan to introduce more sophisticated matching functionalities as outlined in this section. These advanced features will leverage text extraction techniques and complex matching algorithms, to refine and improve the relevance of matches between prototypes and opportunities. To achieve this, we will

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integrate an API developed for the HEClab, which specializes in advanced text analysis and matching algorithms. This API will enable the HEClab platform to analyze the content of prototype and opportunity cards in depth, extracting key concepts, themes, and requirements to facilitate more precise and meaningful connections between innovators and opportunities, allowing for a dynamic and intelligent matchmaking process that can adapt to the nuanced needs of users.

The matchmaking based on tags provided directly by the card authors, or automatically extracted from prototype/opportunity card descriptions, will be primarily based on simple Jaccard similarity coefficients (the size of the intersection between the set of tags of an opportunity card and a prototype card the divided by the size of the union of the same sample sets).

The applicability of this simple scoring scheme depends on the average number of tags and the consistency of the tags used across the opportunities and the prototypes. As the opportunity cards will be entered before the prototype cards in the case of the second HEC open call, we will experiment with suggesting the tags to the authors of the prototype cards based on the knowledge of the “required” tags used in the opportunity cards.

Unfortunately, the Jaccard index can lead to many matches having the same score, especially in the case of relatively small sets of tags. To deal with this issue and enable expanding the tags by information retrieval (IR) measures, the HEClab will also extend the matching methods towards standard query expansion repertoire of IR techniques. The prototype-opportunity pairs with (most) matching tags will be identified first. The rarity of tags will be valued by their inverse document frequency (IDF), and ranking will be ordered according to the largest amount of matched documents with the rarest occurrence (as measured by the IDF).

As the tag-based retrieval might produce short lists of results and the system can also be easily manipulated if the prototype card author wants to increase his or her chances to be among “the winners”, the HEClab will complement the above-mentioned matching schemes with a full-text search mechanism to find relevant matches. We will employ the full-text description fields to represent the cards (the combination of title + description fields) and derive the similarity score based on edge methods in the NLP field.

In preliminary experiments, we tried two approaches: The first one relies on a modern method for dense retrieval. In particular, we utilised the InstructOR model (https://huggingface.co/hkunlp/instructor-xl) – a dense retrieval model with instruction-specific retrieval. To represent documents, we used simple prompts (see below) followed by the document to be indexed.

OPPORTUNITY_INSTRUCTION = "Represent the opportunity description for retrieval: "
PROTO_INSTRUCTION = "Represent the prototype to find matching business opportunity for retrieval: "

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We split each opportunity/prototype into 300 token chunks, encoding each with the InstructOR model, and store them as an index. During ranking, we computed the similarity between vectors representing prototypes / documents via max-sim operation (following ColBERT method – https://arxiv.org/abs/2004.12832).

The second approach followed the traditional TF-IDF method – we represented each text field with sparse TF-IDF vectors (the IDF here is estimated from the text, not to be confused with the IDF of the tag-based matchmaking estimated from the frequency of tag usage across cards). The matching score is computed via the cosine similarity.

On the limited set the project collected, both methods retrieved relevant items, the preliminary evaluation seems to prefer the former approach. However, a proper assessment of relevance and comparison between the schemata can be done with more realistic sets of opportunity and prototype cards only.

In the future steps, we will also consider another approach – using the language model to extract possible opportunities from each prototype. Then, we could directly match the similarity between the opportunity which showed up, and the (short-text) list of potential opportunities automatically extracted from the lengthy prototype description. This might not only work better, but it could be more suitable for the use in the HEC project as the result would be more interpretable.

To characterize the methodology of the HEClab testing in general, we will evaluate usability on two levels exploring 1) whether matches occur and 2) if matches are deemed of interest.

For each prototype card, we expect 0-3 fits, for each opportunity card, we expect 5-20 prototypes that might fit. From the administrative point of view, it is critical to monitor the matching process and be immediately informed about the border cases. If no match for a newly entered card is found, this should be made explicit to the process administrators who can check whether this is really an exceptional case or whether the automatic match making mechanisms are not working properly.

The automatic mechanisms generate only “match candidates”. If an identified opportunity card is of interest, the prototype card owner should “validate” the interest in the particular opportunity. It will then appear in the dashboard of the opportunity card owner. Note that in the setting of this experiment, the prototype owner is not allowed to browse through all opportunities – only those which appear in the dashboard.

In the first set of experiments with the HEClab matching process, we will have a “waiting period” for the matching suggestions. The members of the HEC consortium being administrators of the HEClab platform will first see how well the matchmaking works and whether they should tinker with the tags on the opportunity / prototype card to support the matching. They could experiment different options and parameters of the process before its results will be visible to the prototype card / opportunity card

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owners. Thus, the administrators will have the option to see the “dummy” matching dashboard on the opportunity and prototype card levels.

The administrators will also have a dashboard with statistics in the administrator portal, visualizing, among others:

- the ratio of suggested matches / validated matches for prototype card / opportunity fit;
- the percentage of matching tags (accuracy of the match);
- most used tags;
- the percentage of prototypes matched to opportunity.

The timing for the matchmaking experiments is summarized below:

Test 1:

February 2024: Matching module interface + API integration. Note that the PESETABS certification module does not need to be in place for this initial experiment; it will be validated in March and April.

March 2024: Finishing the first prototype for testing with “dummy data”, entering the initial set of opportunity and prototype cards.

May 2024: Adding HTEs.

June- August 2024: Creation of profiles and project cards by prototype owners in OC2.

September 2024: Creating 10 opportunity cards, validation prototype owner OC2- transfer project card into prototype card.

Testing the automated matching and manual support in tagging. HEC partners will be actively engaged in this activity.

October 2024: Matchmaking validation by prototype owner OC2.

Test 2 (start October 7, 2024)

The opportunity card validation of requested matches from OC2 as support info for the Jury selection/assessment. First validation outside of HEClab (parallel tracking) – after Selection: each opportunity owner will validate two prototype cards as matches.

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The opportunity card suggested prototypes matches: based on added prototypes from HTEs.

Elaborate the matching environment: suggested matches/requested matches/ selected matches/two-sided validated matches.

Based on learning and insights from test 1, we will make a timeline and testing objectives to make the HEClab robust and ready to test different sources for opportunity scouting and match opportunities for the outcomes of the PPE.

2.9. Enhancements and Community Building

With the HEClab becoming fully operational and tested for the first time by the end of 2024, focus will shift towards enhancing the platform's functionality and user experience, expanding its features, and nurturing a community of innovators, developers, and sustainability advocates.

1. **User Experience and Platform Working:** Continuous improvement in the platform's working and user experience will be prioritized, ensuring that the HEClab remains intuitive, engaging, and responsive to the needs of its diverse user base.
2. **Feature Expansion:** Identifying and integrating additional features will be crucial for keeping the platform at the forefront of innovation. This could include advanced matchmaking algorithms, opportunity scouting through connections with external overviews, expanded content and card profile types and the PESETABs module (Annex 2) . The integration of artificial intelligence and big data could significantly enhance the scouting process's efficiency. There is also a growing need to develop and integrate sustainability indicators for opportunities, ensuring alignment with the HEClab's mission.
3. **Community Building:** Efforts will be intensified to grow the HEClab community, fostering an environment of collaboration, knowledge exchange, and mutual support among users from various sectors and disciplines.

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3. Reflection and Lessons learned

In the realm of sustainable food innovation, the creation of the HEClab has necessitated an interdisciplinary approach, blending technology, art, and sustainability principles and the ambition to support the uptake and further development/ exploitation of TRL 4 -6 prototypes and outcomes. This engagement has been crucial in ensuring the module's content remains relevant and comprehensive and required the necessary decision in the architecture workflow: prototype cards, opportunity cards and match making environment. Therefore, we decided to make the HEClab matching module central in the second open call and use that as an opportunity to test the interface and possibilities of the system. By pursuing a phased development, following the process of the Humanizing Technology Experiments and Paths-to-Progress experiment in the project, we can have an iterative development and fine-tune upon actual needs and insights. With this, the HEClab is embedded in the core of the project and will also become the vehicle to present and exploit the results of the experiments.

The journey has imparted several key lessons. Achieving a balance between having a structured process for opportunity submission and vetting and maintaining the flexibility to adapt to new opportunities has been an essential act. The tagging process to facilitate matchmaking is integral in the architecture workflow of the HEClab. Designing for scalability has proven to be a wise foresight, allowing the scouting module to grow without the need for foundational changes. Additionally, establishing feedback loops will be instrumental for continuous improvement, with user input from the second open call being a cornerstone for refining the module's functionality.

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4. Partners Hungry EcoCities

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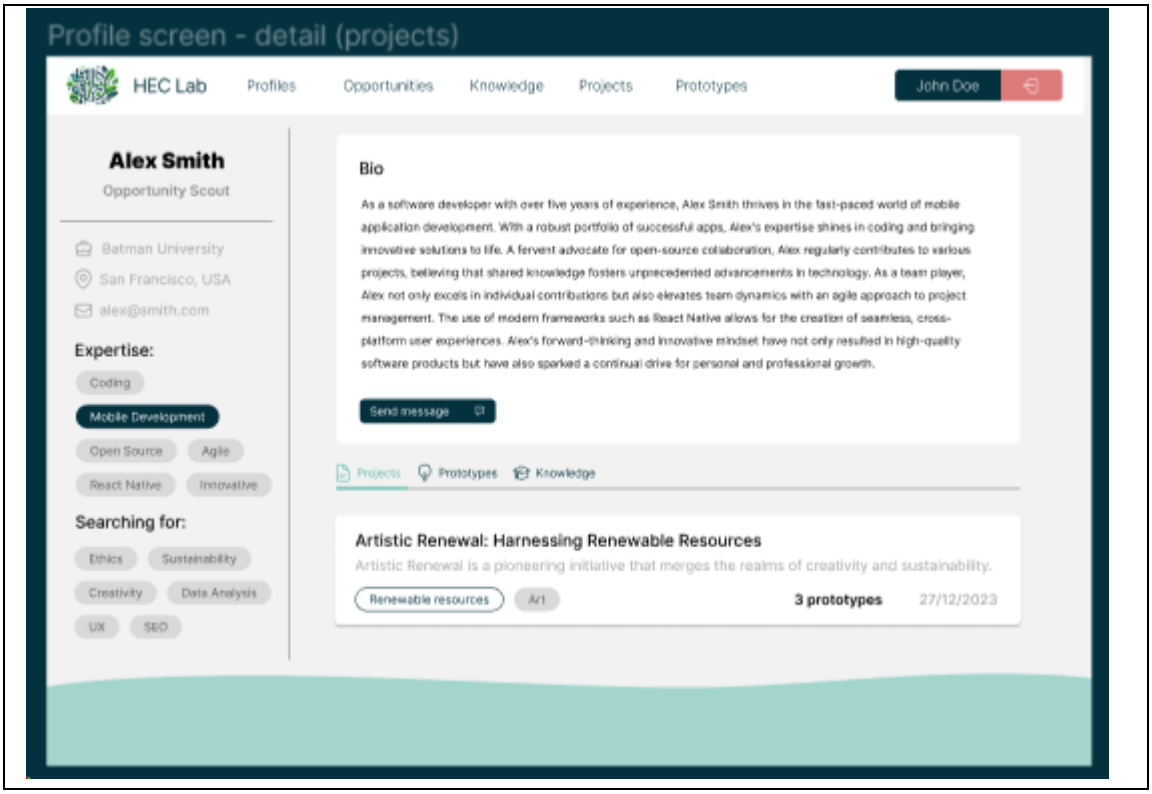
ANNEX 1: Example data: the possible journey of an art-driven prototype through platform.

PART 1 – ENTERING A NEW PROJECT (Example):

The art-driven experimentation project *Repairing with Lichen* (real S+T+ARTS residency project from 2022) enters the HEClab in search of collaborators and opportunities for further development of the innovative components which have come out of the project. This is how it could work:

1/ a "profile" should be compiled. Based on the type of profile, you get access to a next phase. In this case, the "prototype owner" profile gives access to submit a project for outcome analysis.



2/ the owner of the project, in this case either the artist or one of the involved partners, starts the process by filling an project entry form on the platform (Prototype database step a)

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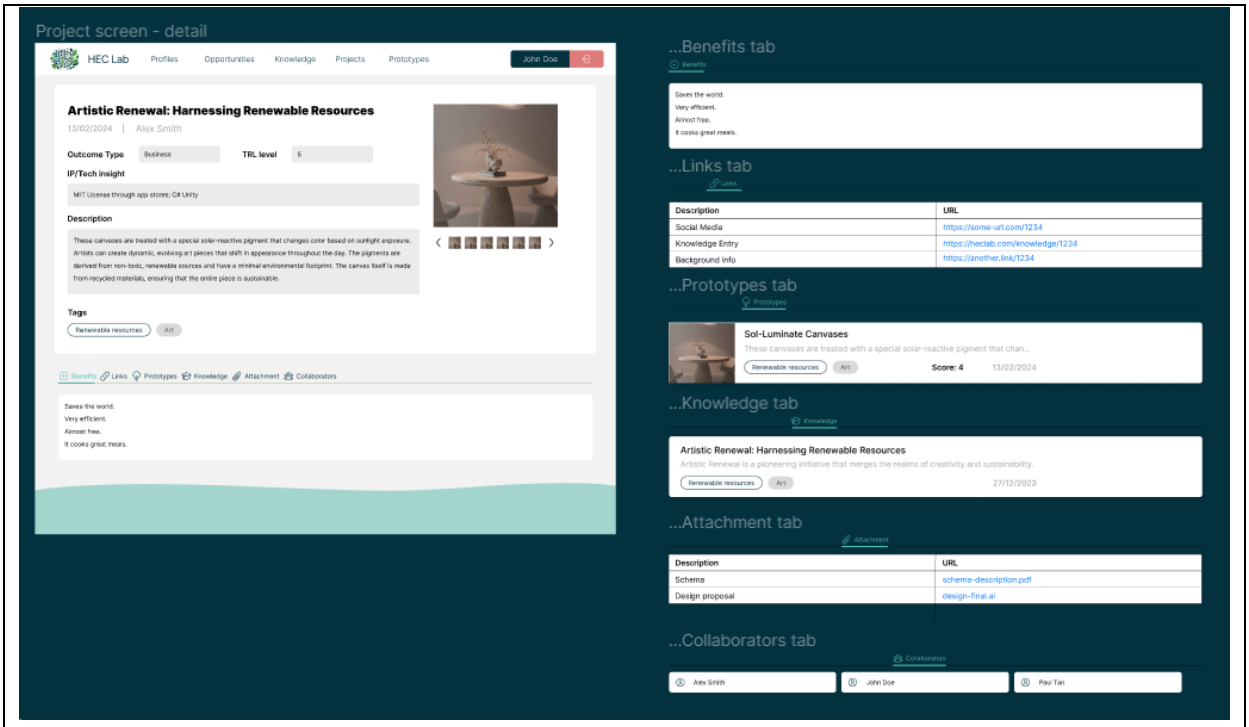

3/ the submitted form gets send to the HEClab administrator (in the test phase the Hungry EcoCities consortium partners) for analysis.

➔ *Analysis will happen manually at first, possibly automated in a later stage as it is based on a preset of criteria coming from the art-driven innovation methodology*

The criteria on which it should be scored are:
> problem
> innovativeness
> responsibility
> readiness (+ TRL level assigned)
+ tags….

The analysis can also add additional tags/ suggest recommend tags to improve the interlinkage between the different topics and outcome cards/ knowledge repository.

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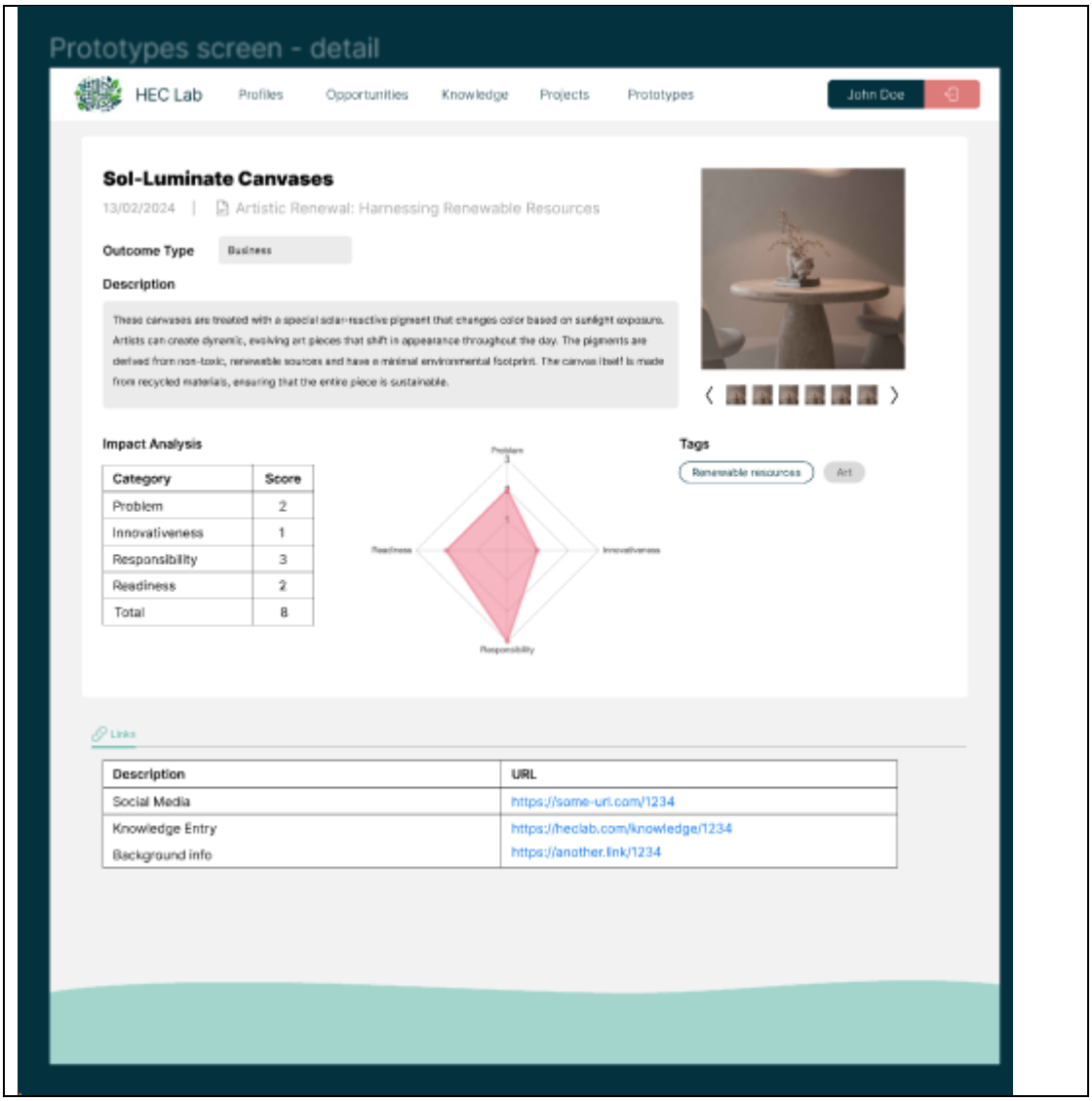

4/ after analysis, the project is converted into one or more art-driven innovation card(s) with a certificate of sustainable innovation potential. Cards consist of text, images and either embedded or linked video content.

➔ *There will be a card for every outcome with innovation potential, this can be multiple per project entry. In the case of Repairing with Lichen, 4 outcomes with potential have been identified, so 4 cards will be generated in the database. The cards contain specific information and a set of tags to connect them to other parts of the platform.*

Card 1: Prototype growth tiles
Card 2: Lichen time horizon
Card 3: Least natural site model
Card 4: Inside Lichen VR

5/ the prototype cards enter the prototype database and the connected owners of the card (after registering on the platform) will see the cards enter their personalised dashboard under ‘my contributions’. Per prototype card, they can request Matching opportunities.

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ANNEX 2: PESETABS Integration

The HEClab, as a crucible for innovation and sustainability in the food industry, has embraced the PESETABS framework as a method for certifying the outcomes of HEC residence projects. This rigorous framework ensures that art-driven experimental projects contribute meaningfully to the ecosystem, fostering connections that extend beyond conventional boundaries.

The PESETABS framework operationalizes a three-tiered analytical process, meticulously designed to evaluate and certify the outcomes of experimental projects.

Stage One: Systemic and Thematic Analysis

In the first stage, projects undergo a dual-faceted examination:

- Systemic Analysis: This delves into the project's domain—its context, relationships, and dynamics—offering a comprehensive understanding of its place within the wider system. It considers the intricate interplay between various elements of the project, ensuring that its connectivity and potential impact on the ecosystem are thoroughly understood.
- Thematic Analysis: Focusing on the project's thematic essence, this analysis uncovers the core message, intent, and purpose behind the innovation. It scrutinizes the creative vision and the narrative that the project seeks to convey, aligning it with broader societal and ecological themes.

Stage Two: Evaluation of Experimental Outcomes

The second stage of the PESETABS process involves a deep dive into the experimental outcomes of the project. It aims to uncover any unexpected results or serendipitous discoveries that may have arisen during the execution of the project. This stage is critical for identifying innovative breakthroughs and transformative solutions that could have a far-reaching impact.

Stage Three: Spill-Over Potential Identification

In the final stage, the framework assesses the project's diffusion potential by mapping its outcomes against the eight directional outcomes of the PESETABS model:

- Ecological Impacts: Projects are assessed for their environmental contributions, such as resource efficiency or biodiversity enhancement.
- Social Innovations: The capacity of the project to influence social change or address social challenges is evaluated.

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- Economic Thinking: The potential economic benefits or shifts in economic paradigms are considered.
- Technological Development: Innovations in technology and their integration into existing systems are explored.
- Policy Recommendations: The project's ability to inform or shape policy directives is analysed.
- Scientific Knowledge**:** Contributions to the scientific community or advancements in understanding are highlighted.
- Business Innovations**:** The project's impact on business models, practices, or entrepreneurship is assessed.
- Artistic Directions: The cultural or artistic significance of the project and its influence on creative industries are considered.

Matchmaking and PESETABS

The PESETABS framework is not only a tool for analysis but also a means for matchmaking within the HEClab. By aligning project outcomes with the eight directional outcomes, the framework aids in identifying synergies between projects and potential collaborators, funders, or users. This alignment ensures that each project relates to stakeholders who have shared interests, goals, or who may benefit from the project's outcomes.

Projects that resonate with ecological impacts, for instance, can be matched with environmental organizations or sustainability-focused startups. Similarly, projects with strong policy recommendations might find their match with governmental bodies or think tanks.

In essence, the PESETABS framework serves as a guiding matrix for the HEClab, enriching the platform's matchmaking capabilities by ensuring that project outcomes are not only certified for their innovation potential but are also strategically aligned with the eight directional outcomes to maximize their diffusion and impact. Through this structured approach, the HEClab ensures that the fruits of creativity and experimentation in the HEC residence projects find their rightful place, enabling a thriving ecosystem of sustainable innovation.

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