Design issues in Human-centered AI for Marginalized People

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Abstract. Designing for migrants and asylum seekers requires the involvement of the whole society to improve the integration of citizens coming from countries with different cultures, religions, and life patterns. The design and development of AI companions for a personalized access to services is the horizon chosen to support and improve the inclusion of migrants and refugees both for the effectiveness of the services provided by public administration and local organizations, and for the quality of life of migrants and refugees. AI-based services are at the heart of the Digital Companion for migrants and asylum seekers designed to support more effective communication between public administrations and migrants. The human-centered, iterative, participative and critical design approach proved to be valuable to address the heterogeneous needs of the end-users as well as of the local service providers. Concrete issues in defining, testing, and refining the AI are discussed in view of provoking an impact on the whole society and towards a scenario of full development and upscaling.

Keywords: Interaction Design, Artificial Intelligence, Social Integration, Migrants.

1.   Introduction

The design of AI-based companions for migrants' public service experience calls into question the social function of design, especially the design that contributes to social development, a production of objects that can act on relationships within society. As reported by Moretti [1] *products and objects that open debates, guide reflections, counter dominant narratives, support counter-narratives, challenge the status quo* might be ascribed to the paradigm of Socio-design, not only centered on the design of objects, but to that of social interactions.

Socio-design is especially relevant if we consider that the migratory flows towards Europe has been increasing because of social and economic instability and pushes with the need to find solutions to improve the integration of citizens coming from countries with different cultures, religions, and life patterns [2].

REBUILD aims to design and develop a Digital Companion that will support migrants and refugees in Europe in accessing existing services. The Digital Companion represents the result of the user-centred and participatory design approach adopted in REBUILD with the aim of addressing in an integrated and consistent manner the needs of real target users, the ethical and intercultural dimensions and to monitor and validate the socio-economic impact of the proposed solution. The design process was structured according to the integration of multiple design perspectives and the following conceptual frameworks:

 - user-centred, according to the needs, limitations and capabilities of the target users,
 - activity-centred, according to the characteristics of human activity,
 - person-centred, in accordance with the experience of the person in his or her life context.

An AI-based chatbot service is at the heart of the Digital Companion, which will support more effective communication between public administrations and migrants.

Moreover, the various reception structures not only find communication with migrants critical but often ignore even the level of education, professional skills, and state of health of the immigrants they interact with. Knowing more about migrants' life is necessary to start an effective process of real integration.

The research described in this paper wants to be part of a transition from the paradigm of user-centered design, to an activity-centered systems design approach the Activity-Centered Systems Approach [3], described by Donald Norman as one of the fundamental principles of Human-Centered Design, to arrive at the person-centered design, in which the reflective dimension on one's condition of life finds all the space it deserves within the experiences that the person makes.

The person cannot be parcelled out without destroying him and dispersing his identity, as is done, has already been done, for the user, who, precisely because of the re-

*ductive vision that gave rise to it, has become in design a lump of unrecognizable frag-
ments, without identity and, as the very first Paolo Legrenzi would say, "without dignity
of form". [4]*

The technological ambition is to use artificial intelligence-based solutions (user pro-
filing, skills/needs matching, chatbots) for the development of a usable, accessible, and
intelligent ecosystem for both target groups; while the methodological challenge is to
adopt a participatory design approach, involving both target groups from the very early
stages of the project, taking into account users 'needs, limitations and expectations, as
well as perceived gaps, cultural differences and ethical issues.

2. Participatory Design for a Human-centered approach to AI

The inspiration behind the implementation of REBUILD AI-based solutions relates to
the project objective of reconstructing the migrant's life in the country of destination.
The reconstruction of one's own life and that of one's relatives implies for the migrant
a restart and a responsibility taking for one's action, a taking on of the rights and duties
that life in the host country implies. In order to accomplish this vision, REBUILD fol-
lows a user-centered and participatory design approach, aiming to respond to the real
needs of the target users, including ethical and intercultural dimensions in the design,
monitoring and assessment of the social and market impacts of the proposed solution.
Both target groups (immigrants/refugees and local service providers) participated and
are still part of an ongoing design process focused on 3 pilot countries: Italy, Spain, and
Greece, the gateways to Europe for the central Mediterranean route.

This methodological approach aims to manage the technological innovation at the
heart of the project with a bottom-up and UX-driven process, constantly informing the
design and technological development through continuous design iterations and inter-
actions with the real project beneficiaries. The aim is to produce a technology that re-
spects users and responds to their real needs, thus becoming a truly accepted and useful
tool for migrants, and effective in the digital transformation of services offered at the
local level.

In particular, the research and design methodology developed in the project inte-
grates methods and techniques from a wide range of disciplines, from ethnography and
applied psychology to social sciences, user-centered design, and collaborative design.
The research methodology started with service provision processes 'analysis, and field
research, to bring user knowledge to the Scenario-based design, REBUILD service co-
design and interaction design concept.

In the early stages of the project were based on the definition of questionnaires for
analyzing needs, expectations, and gaps perceived by migrants; Focus groups, involv-
ing migrants and refugees as participants, to understand the relevant cultural factors to
be necessarily taken into account when designing the service/application; and desk
analysis of pilot countries first and second migrant reception processes and services,
aimed at defining the user experience of both migrants and reception service providers,
and consequently the design concept of REBUILD technologies.

The participation and involvement of migrants and refugees, as well as public administrations, associations, and NGOs working on integration and migrant support was a key component of the methodological approach from the very beginning of the activities. The knowledge base of the project has been built based on scientific literature; analysis of NGOs / voluntary organizations / local service providers websites to identify service proposition and delivery to migrants and refugees; and joint analysis carried out by a multidisciplinary working group involving researchers, technology experts and operators, who are themselves refugees (including UNINETTUNO students, beneficiaries of the initiative "University for Refugees - Education without Borders") working in the field of reception and cultural mediation, providing an essential contribution to the design of the research.

Field data, collected in the first part of the research, were used as input for scenario-based design [5][6]. The use of scenarios made it possible both to organize and consolidate the data collected through the initial research activities and to assess and validate the envisaged solutions from a technical point of view. In this way, scenarios functioned and are also functioning as a participatory design tool throughout the entire design process.

In REBUILD we propose a scenario-based approach to service design, as a concrete means of providing a perspective on the problem and the resulting solution, through a flexible description in terms of representation of actions, events, or situations. Scenarios can be used to explain the hypothetical user journey and usage of a service, investigating possible performances, opportunities, weaknesses and strengths before actual implementation.

Importantly, by using the scenarios, we supported the development of the intelligent chatbot system and the design of the services with a clear perspective of the future use of the intended solution.

The co-creation methodology defined in the REBUILD project used "service scenarios" to construct a space for user tasks, with the aim of guiding different technical specifications from the context of intelligent chatbot development. In our co-design workshops with migrants and service providers, we built envisioning scenarios, which are a tool for imagining the system to come, a first way to make ideas tangible and explore the possibilities of supporting these ideas [7]. The envisioning scenarios allowed us to establish some of the narrative elements that are forming the basis for the design solutions. Scenarios have facilitated user involvement because they have provided a shared vocabulary, "a common language that everyone can understand, regardless of their background, they create common ground so that a discussion can take place between the various stakeholders on current and future use" [8].

Visual narratives were drawn from the interactions between the story plot, its characters, and their environment. The development of the narrative was achieved through a fluid exploration of the characters in their environment, with dialogue added as the characters came to life. Both the two main factors of a narrative, plot, and story, were conceived based on user research: plot as the presentation of narrative events and story as the relationship and connection of these events [9].

3.   User Research for Human-Centred AI

The AI design described in this paper draws inspiration from the results of the research activities and co-creation of the design solutions defined in the REBUILD co-design especially in relation to the attractiveness and expectations of effectiveness and value of the services and the role of the chatbot.

Findings from the REBUILD Co-Creation Workshops [10] have been elaborated into main design keynotes that report the opportunities for interaction, service and content design to be developed for the intelligent Chatbot. It is important to remark that the data produced during the Co-Creative Workshops is qualitative and is used in this article to draw conclusions related to the soft qualities of interaction: it is meant to inform and inspire both the design team and the LSP to evoke empathy for the involved stakeholders and end-users.

3.1.   Migrants' integration and exclusion counteracting

The integration of migrants and refugees is based on the knowledge of duties and rights of migrants and refugees, as well as the knowledge of the language of the host country. Learning the language of the host country is the first step in the integration process: inadequate knowledge of the language leads to restrictions on access to information, the use of services, the expression of needs and the ability to relate to the social context and feel part of the local community. Furthermore, knowledge of the language is the basic requirement for access to services and for access to training and employment opportunities.

Language knowledge and competence, support to knowledge of rights and duties, integrated access to services and support to counselling for migrant and refugee citizens constitute the reference perspective for the design of the chatbot. The need for migrants to know their rights and duties also represents an opportunity to learn about the laws of the host country. As time goes by, migrants and refugees need to become increasingly aware of their rights and social and civil rules. In addition, the activation of counselling programmes aims to promote the well-being and quality of life of the person through a strengthening of their resources and a greater awareness of their potential.

In relation to integration, REBUILD also wants to consider migrants and refugees who find themselves in situations of existential hardship and questions the forms and methods through which they will be able to use the app, and whether they may be at risk of marginalization, such as victims of human trafficking and people who are not part of the reception services. The project aims to structure communication campaigns to promote and disseminate the chatbot, also through the involvement of subjects outside the consortium but active in providing the service to migrants, e.g. telephone operators.

3.2.   Literacy

The integration of migrants and refugees in European cities and the labour market will be addressed in REBUILD with a holistic approach to literacy, which is the basis for autonomy, self-realization and occupational integration. Supporting all-round literacy

involves bringing together the linguistic, cultural and technological components in a single path.

Linguistic literacy. The regulations for the granting of long-term residence permits in many European countries require certification of language proficiency and this requirement determines that language services are the most in demand. Migrants learn the language in educational or host organisations and also in a variety of contexts and methods, in addition to formal classes: e.g. through involvement in group activities (theatre, sports, etc.), listening to music in the language or using digital tools such as Google Translator. In particular, it emerges that language learning is easier by listening and watching educational contents than by reading written documents and texts. REBUILD aims to explore the roots of the language learning experience and to support and encourage motivation to learn.

Cultural literacy. Linguistic literacy is inseparably linked to cultural literacy. From the Workshops emerges the need to define a simplified language, made of visual codes and based on visual grammar, made of pictograms, graphic animations and videos. The ease in understanding visual representations is closely linked to the individual's ability to acquire and manipulate concepts shared with the rest of the community. The Workshops showed how migrants may not share the same knowledge and understanding of concepts that are common in Western societies (e.g. the model of work activity, the concept of curriculum vitae, etc.), nor possess the same mental models of process / procedures as the host country.

Technological literacy. Technological literacy is a challenge and an opportunity to be experienced in the project by enhancing the awareness of the features and potential of the devices; the understanding of services and software tools and education in technology adoption behaviours to achieve personal goals.

3.3.   Intelligent Chatbot

The REBUILD intelligent chatbot provides intelligent information support to users through diversified interaction strategies: from natural language processing to purely visual language. The identity of the chatbot is coherent and consistent in the different user experience scenarios, with the proposition of integrated and interdependent services. Above all, the chatbot will support migrants and refugees in acquiring knowledge of the services provided on the territory (health services, population registers, school system for minors and education courses for adults, but also places of cultural interest, social events, etc.).

These aspects represent the strategic link for the regaining of autonomy and the reconstruction of the person's experience. Therefore, starting from the need to inform, guide and accompany migrants, REBUILD focuses on the design of new digital services to connect, strengthen and enhance existing services.

3.4.   Mentoring and Counselling

The interaction with the chatbot aims to support the structuring of mentoring and counselling strategies both among peers and by experts. Peer mentoring represents an opportunity to enhance the competence of the most experienced peers to support everyone. Counselling is instead supported with the goal to promote lifelong learning processes in the academic context and to certify and recognize skills acquired in formal and informal contexts, transforming them into training credits that can be spent in the academic career. This service is particularly integrated in the processes of recognition and certification of cultural and professional qualifications acquired in the countries of origin, supporting a broad vision of taking into account the needs, expectations and life objectives of the migrant.

In the next chapter we present how the results of the user research have been elaborated into service blueprints and how they lead to AI-based solutions.

4.   AI Service Blueprint Validation

What are the REBUILD services? How can you have access to the REBUILD services? How are the REBUILD services structured on an emotional, informative and functional level? How are the REBUILD services validated towards user requirements? Those are among the questions that the service design and testing activity will answer.

By elaborating on REBUILD use cases 'the service blueprints have been developed in order to provide a visualization of the process that a person goes through to accomplish her/his goal. In its most basic form, service blueprints include journey mapping that starts by compiling a series of user actions into a timeline. Next, the timeline is fleshed out with user thoughts and emotions in order to create a narrative. This narrative is condensed and polished, ultimately leading to a service architecture from a user perspective. In REBUILD, testing the inner and emotional experience of the end-users have been plotted as a single line across the journey phases, in order to highlight signaling the emotional "ups" and "downs" of the experience.

Similar to user-journey maps, service blueprints are instrumental in complex scenarios spanning many service-related offerings [11]. In REBUILD the experience maps and service blueprints have been developed in parallel with App UI design finalization and technical implementation. Service logics and structure, user interface and user interactions, and operational functionalities, have been conceived as interwoven processes which mutually benefit one from the other. Service blueprints allowed project designers and developers to reduce redundancies, improve the user experience, better the quality of services or converge siloed processes by providing a comprehensive understanding of the interactions and the underlying resources and processes. In particular service blueprints show: user actions, frontstage actions, actions, backstage actions and processes.

The validation of service blueprints with service stakeholders exposed the big picture to LSP, offering a map of dependencies and opportunities for its optimization. For example, information gathered early on in the user's journey could possibly be repurposed later on backstage. In particular the pilot study and migrants users 'responsible have been involved in a design validation process which was centered on:

- discussion and finalization of experience maps;

- discussion and revision of REBUILD APP and LSP Dashboard interactions;

- finalization of the microinteraction with the service, also providing the textual description to introduce the Scenarios, and the needed informational resources (like locations, documents, etc.);

- finalization of REBUILD AI conversation tree logics.

In the following paragraph the Job Seeking service blueprint is presented as an example of the REBUILD scenarios:
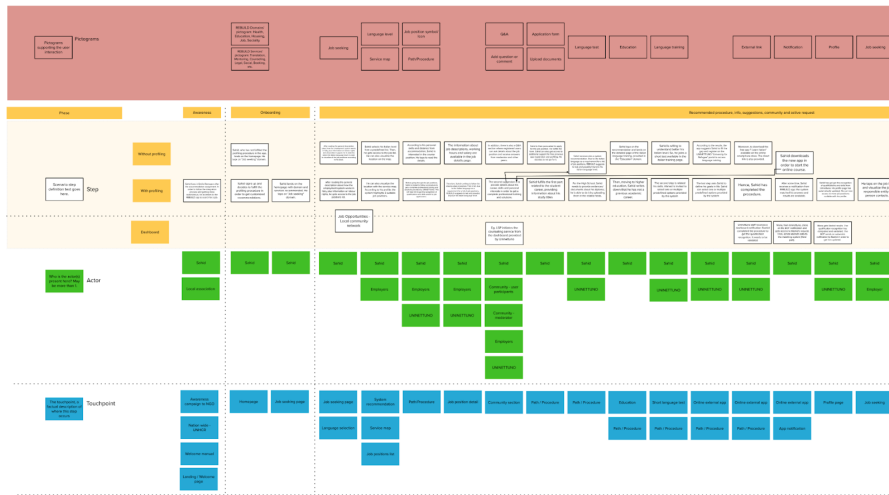

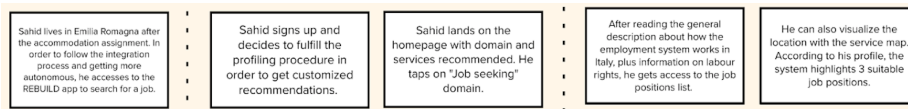**Fig. 1.** Job Seeking Service Blueprint.

Fig. 2. Details of Job Seeking Service Blueprint user journeys.

The Job Seeking service blueprint validation allowed to discuss already known user requirements (UR) and to elicit novel ones like the following ones:

UR: As a user I want to be able to use the Rebuild App for job seeking in an easy and understable way.

UR: As a user, I want to browse through the REBUILD App in the language of my preference and be able to understand its functionalities.

UR: As a user, I want to easily access certifications, language and equivalent title recognition.

UR: As a user, I want to overcome the difficulties in language learning and understanding as a cause of access to education service dropout.

UR: Lack of simple, basic information for refugees / migrants: Basic information about where to find a shelter, or to find medical support, are not easy to find.

UR: As a LSP professional, I want to see provision of a list of LSPs (association, training centre or providers) that organize education or training programs in the residence territory.

UR: Need to let the users be able to choose and organize on their own their education or training programme: this is affirmed because a lot of people interviewed (also who are welcomed in the reception system) would like to finish/complete their study path or pursue a training course.

UR: Need to get a language school mapping, formal or informal, managed by institution or civil society. The same goes for IT classes, the capacity to use a computer is lower than the smartphone and tablet one (overall for people living in Italy and Spain), but is fundamental for job skills.

The user research, service blueprint and interface interaction iterative approach had three positive effects in REBUILD:

(1) valorization of user research results, with migrants delighted to understand and develop the service as personal and LSPs time and effort paid in gathering relevant information;

(2) development of service logics as consequence of user research, and fine-tuning of user requirements thanks to service blueprint validation;

(3) no risk of inconsistent data when the scenarios are iteratively discussed and fine-tuned according to different lens of analysis, meaning user actions, system interactions, technology implementation, organizational procedures.

levels of headings.

5.   AI implementation on migrants and refugees' needs

As shown in the previous paragraph, guiding and supporting the user in accessing services and achieving their goals is one of the primary objectives of the Digital Companion: ease of reading and understanding the possibilities of interaction, orientation and guidance for relevant actions in accessing services are the enabling conditions for the empowerment, development of self-efficacy and empowerment of migrants and refugees.

The first interaction with the Digital Companion is of particular importance in structuring a guidance-oriented user experience. The first approach with a virtual assistant can affect the whole conversation and represents a fundamental step. The first interaction can be made by having the bot present itself and show off its functionality, using components and solutions, e.g., video-tutorials, short carousel Use Cases, and interface navigation and usage tips that present the purpose and identity of the Companion and the actions that can be taken. This aspect of the project is also linked to

the design of the conversation between man and machine and, in particular, to the ability of the chatbot to understand natural language. This ability is far from being taken for granted, since human expressions are often denoted by slang, dialects, and catchphrases, complicating comprehension.

Thus, literacy, language barriers and awareness of available services resulted to be the main design issues to be addressed in the research.

5.1. Migrants and refugees' literacy

Supporting migrants and refugees with limited or any literacy skills has been a relevant and particularly complex need emerging from the pilots; since human-computer inter-action, and specifically human-mobile technologies interaction, has a strong textual component, addressing literacy issues represented the main technological challenge for REBUILD solution design. The approach proposed in the codesign session and further elaborated through the project lifetime was based on a conversation system (two-way communication), based on pictograms.

REBUILD defined a conversation system through a chatbot enabling the user to in-teract through a dialogue system based on pictograms: users can "build" their question or request to REBUILD chatbot selecting pictograms from three main categories: 1) domains, the main categories of social and support services provided at local level by public administrations and private organizations, grouped in relevant areas such as health, legal, education, etc.; 2) services, representing actions or specific needs related to the selected domain, such as a request for an appointment, the information about geographical localization of an office, the request of a meeting with a cultural mediator, etc.; and 3) possible further specifications related to the "request" built using the first two categories of pictograms. Pictograms are provided according to the Software as a Service paradigm: each module of REBUILD can use pictograms independently from other modules, in any time, in a secure manner.

Fig. 3. Use of pictograms in the Digital Companion home screen (left) and in the ongoing procedures (right).

A second solution defined in the design and development process of REBUILD, addressing again the literacy issue, focused on enabling oral communication through the app, overcoming the textual barrier. The AI-based match-making system integrated in REBUILD and the linked task-solver component allow a user to opt for formulating their request through a video message. Local service providers, on the other hand, register themselves providing information about the categories of services provided ("Domains"), the geographical area, and the language capacities of their operators. The video posted by a migrant formulating their request through the video-communication system is therefore addressed to the local service provider (LSP) in the migrant's geographical area able to provide the requested service, and able to support the migrant through an operator capable of speaking the migrant's language. Audio/video exchanges among migrants and cultural operators from LSPs are managed as micro-services [12], separating each service that builds up the audio/video exchange system in small services with specific functionalities. In the user-operator interaction mediated by REBUILD audio/video exchange system (user record and send a video, REBUILD application allocates this file to the proper LSP in the territory through REBUILD dashboard, verifies the language spoken by the user, communicates this to the operator, that

can assign this video-request to the volunteers in their organization matching the language skill needed to address the request) all the information exchange among different REBUILD modules are done through secure channels and in compliance with GDPR regulations. A potential evolution will be the automatic detection of the languages spoken by the users, in order to reduce the response times.

5.2.   Language barriers

Beyond literacy, languages represent a critical barrier in the case of recently arrived migrants, since they can be fully literate but unable to read or speak the language of the new host country. REBUILD proposed two main solutions addressing this challenge.

REBUILD's CMS was developed in 9 languages covering both the languages of the pilots 'regions (Italian, Catalan, Greek), the main EU languages spoken by migrants ' arriving through the migration routes covered by the project (English, French, Spanish) and the main native languages of these migrants (Arabic, Farsi, Kurmanji). REBUILD application was then integrated with AI-based machine translation components, based eTranslation[1] [13] and Connecting Europe Facility[2] (CEF) Building Block, provided by the European Community. This allows to automatically translate all the texts, both those related to the application and those provided through the Dashboard by LSPs, allowing migrants to read the service descriptions in the chosen language.

A second aspect in the platform design and development was focused on the chatbot engine, and based on the knowledge and insights gathered through the initial research and the co-design workshops. In order to keep the conversations 'structures highly under control, REBUILD decided to define rule-based chatbots. This solution keeps the various implemented languages aligned in terms of vocabulary, sentences 'structure and conversation trees, overcoming the current shortcomings of chatbots based entirely on NLP technologies. Rule-based conversation system allows therefore the migrants to access a controlled conversation, in which migrants are supported in the inputs and answers from the chatbots are controlled and verified ex ante to maximize precision and clarity in the information provided.

5.3.   Awareness of available services

Interviews, surveys, co-design workshops and all the research interactions involving migrants, refugees and operators highlighted migrants 'lack of knowledge about the available services, at local level, addressing migrants and refugees, especially as they recently arrived in the new host country. This is more critical for vulnerable people and people excluded from the reception/welcoming circuits. Furthermore, service providers also highlighted their need to better understand and know which actors and services are available in their same region and territory, potentially enabling synergies and complementarity among different actors. These gaps in information and knowledge generate both missed opportunities (migrants and refugees in need of a specific service cannot

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[1]   https://ec.europa.eu/cefdigital/wiki/display/CEFDIGITAL/eTranslation

[2]   https://ec.europa.eu/inea/en/connecting-europe-facility

access it) and service provision failures (for example, migrants applying for a job but missing a language certification not knowing there is an organization providing language courses).

REBUILD used most of its AI-based components to address this challenge; user profiling helped in understanding user needs and to valorize their backgrounds; local service providers 'services catalogues powered the match-making system, finding matches among users 'needs and services provided in the same region; the recommendation system, finally, proposes to the user the services available for the needed domain and need, in the user's region, also integrating a "proactive" component of the application [14] enabling REBUILD to propose services, places, events that potentially are relevant for the specific user of the application. REBUILD recommender system is based on a Hybrid filtering (Knowledge Graph [15], Autoencoders, Restricted Boltzmann machines [16], Deep Neural Networks), improving both user profiling and the analysis of similar contents/services available in REBUILD platform, refining the suggestion proposed to the users (for example, suggesting education-related services to users who declared to have children in school age, or actively supporting the job searching in a continuous process highlighting new opportunities based on the user's background and CV). This capacity, finally, enabled also cross-domain interactions: if a user is searching for a job but is missing some relevant requirement (a language certification, or a vocational training certificate), REBUILD will suggest the educational service able to achieve the needed requirement, crossing Job and Education domains; the same will happen if a user is trying to obtain a certificate for accessing national health system services (Health domain) but is missing a document (Legal domain), thus enabling also the Local Service Providers mutual synergies and complementarity that was a perceived need in the analysis phase.

6.   Assessing the impacts for maximising them

Coherently with the participatory, user-centered approach followed in the design and development of the REBUILD socio-technical solution, also the analysis of the social, economic, technological and political impacts of REBUILD will be an instrument for hearing the voices of migrants/refugees and service providers.

The impact assessment activity will accompany the upcoming testing phase in order to understand to what extent REBUILD is able to foster a more effective inclusion of migrants and refugees in the hosting communities and, at the same time, can help local service providers and public administrations in increasing the effectiveness of their service provision. It will do so by gathering users 'feedback through online surveys (in some cases embedded in the REBUILD App and dashboard), online and face to face interviews and focus groups. These methods will be accompanied by the secondary data analysis of the analytics emerging by the usage of the REBUILD socio-technical tool.

The REBUILD impact assessment framework has a quali-quantitative nature; it has been developed and validated by REBUILD partners and, as we will see in the next

paragraphs, it considers all the topics and issues mentioned in the previous sections. Such a framework is based on state-of-the-art methods of impact assessment and is based on a framework developed and validated in previous European projects [17][18][19]. The dimensions considered are rooted in migration and innovation literature and are aligned with REBUILD's expected outputs.

When considering the potential benefits of REBUILD for migrants and refugees, the framework considers several dimensions among which impacts on education and human capital (including the above mentioned issue of language learning), impact on citizenship and social capital [20], impact on employment, impact on trust in institutions and impact on digital literacy.

In analysing the value added of REBUILD for service providers other dimensions will be considered such as impact on efficiency, increase in collaboration among local actors, impact on the quality of local policies thanks to the availability of better quality data on migrants and impact on service digitalisation.

Finally, also the impact on the whole society will be considered building a scenario of full development and upscaling of REBUILD. In such a scenario, a community that is better able to include migrants and refugees, that have better integrated local services and that take advantages of the potentialities of services digitalisation can become a community with higher quality of life for all, but also a community that save considerable resources that are now allocated to welfare, health and justice costs generated by the non-integration of migrants.

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