

## ReSilence

Retune the Soundscape of future cities through art and science collaboration

HORIZON- 101070278

### D7.1

# Dissemination and communication strategy

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#### Abstract

This deliverable comprises the design and setup of the project website as well as the start.eu

content management, which will provide up-to-date information on intermediate and final project results. This deliverable will also present the initial dissemination plan of the project and the creation of the project's communication material (project presentation, communication kit), which will be used as part of other dissemination activities. It will also contain a detailed market analysis of the domains of interest for ReSilence and it will provide the plan for the exploitation of the ReSilence outcomes after the end of the project.

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## History

Version	Date	Reason	Revised by
V0.1	20/12/2023	ToC creation	Anastasios Tellios, Kalliopi Valsamidou
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## Executive Summary

Deliverable D7.1 presents the identity of the ReSilence project, including the project's website, social media, etc. Additionally, it describes the dissemination activities foreseen by ReSilence. It elaborates on the basic dissemination principles and strategies focusing on events and conferences. The dissemination plan describes in detail scientific and commercial events targeted for participation, as well as scientific journals for article publication. The deliverable also provides an initial market analysis of the domains of interest of ReSilence, two different SWOT analyses one related to the stakeholders and one to the ReSilence modules. Additionally, exploitable results of ReSilence and targeted stakeholders to provide an initial exploitation plan and a roadmap to the exploitation for the upcoming months are also presented.

## **Abbreviations and Acronyms**

<b>AI</b>	Artificial intelligence
<b>AR</b>	Augmented Reality
<b>BMC</b>	Business Model Canvas
<b>EEG</b>	Electroencephalography
<b>EU</b>	European Union
<b>FR</b>	Fundamental Research
<b>IoT</b>	Internet of Things
<b>NLP</b>	Natural Language Processing
<b>OC</b>	Open Call
<b>SH</b>	Stakeholder
<b>SME</b>	Small medium business
<b>UG</b>	User Group
<b>VR</b>	Virtual Reality

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## 1. INTRODUCTION

Art and creativity are important pillars of our society. Therefore, it is imperative that artists and creatives are brought into as many industries as possible with new technologies to create spaces and designs for the upcoming environments in society.

S+T+ARTS ReSilence supports the development of art-driven technologies for designing the soundscape of future cities through the collaboration of artists, architects, urban designers, scientists, engineers, and researchers. ReSilence through two Open Calls (OC) has selected 15 artists and Artists and SME pairs and will support Art-Driven with a specific budget allocated for this purpose for each one of ReSilence's selected challenges. Artists in ReSilence have access to state-of-the-art technologies developed within the project to explore the borders between sound and silence in a changing world by producing sound awareness in urban spaces. ReSilence partners and artists from the Open Calls have engaged in several dissemination and communication activities so far and those activities are expected to significantly increase since the second Open Call artists have been selected in November 2023 (M15).

Additionally, to define the potential for exploitation of ReSilence, this deliverable initially presents the methodology to identify the stakeholders and methods for the analysis of these stakeholders. Following that we perform two SWOT analysis of the ReSilence stakeholders and ReSilence modules. This helps in overviewing the different factors that affect the market we are targeting and how it can affect the exploitation of ReSilence. Then we present the current landscape in terms of current tools and trends. This deliverable also describes the different exploitable results of ReSilence and their subsequent market analysis in order to identify how each result can be exploited separately. Finally, the deliverable reviews the various exploitation models that can be used in the future to identify the best possible exploitation strategy for ReSilence.

## 2. DISSEMINATION MATERIAL

### 2.1 Dissemination strategies

There is a wide variety of dissemination methods. Appropriate knowledge and skills are necessary to select the right one(s) to get the message across to the target audience and achieve the goals set out by the dissemination strategy.

A further aspect that should be considered is the necessary continuous adjustment and development of the dissemination plan. This is due to the on-going nature of a research and innovation project like ReSilence. The project team has to be aware of these changes occurring during the implementation of the project, while at the same time the project team should adjust them to the reaction from the public and the impact of the dissemination activities.

Hence, in settling a dissemination strategy, the project team will take the following questions into consideration:

**Project objectives:** What is the main objective of the project? What are the sub-goals of the project? What are the expected results? How will they serve the needs of the target beneficiaries related to the objectives of the project?

**Target audience:** For which target audience should a specific result and/or the overall result of the project be disseminated? What is the significance of that result(s) for that target group? Are the target beneficiaries likely to realise the significance or do they need specific assistance to understand the benefits for them?

**Dissemination goals:** What are the objectives and goals of the dissemination effort? What impact is the dissemination plan aimed at and what is it actually producing?

**Medium:** What are the most effective channels and tools to reach target audiences? Which methods fit best to their level of awareness and understanding? Which resources are necessary? How can the use of different tools effectively be combined?

**Execution:** When should the dissemination activities be implemented (e.g. at which points during the study and afterwards)? Who will be responsible for dissemination activities? Will the potential users be involved into the discussion of the results, and will their feedback be used to improve the applicability of the final results?

### 2.2 Website

A cross-disciplinary between arts and science research project like ReSilence to achieve an important impact has to establish good connections with interested researchers, artists and user communities. This is important for exchanging information, keeping up to date with the latest developments and disseminating the results and artworks. Nowadays, this can be greatly achieved through digital communication channels, such social media but also through a website.

The website has the advantage of being able to present information to a diverse group of people at the same time and on demand. It can not only provide basic information that is static e.g., the project's description and its envisioned outcomes, but also deliver reoccurring and constantly changing pieces of information such as progress reports, exhibitions, artists

residencies, artworks, latest achievements, or news reports produced during the project's lifetime. The purpose of the section is to describe the ReSilence website providing an abstract presentation along with insights of the ReSilence website. The ReSilence website will be pivotal to the project's communication activities.

### 2.2.1 Objectives

The project website serves as one of the main communications and dissemination means. The website has been designed to provide the project's overview and status update and point out the project's highlights. It focuses greatly on its homepage to the Open Calls and on more details about the ReSilence project. The focus lies on the website's main/landing page where the goals of the project are briefly but elaborately described. Furthermore, the user can find there a collection of project's highlights, such as latest news, recently published reports, etc. providing a quick insight into project's status. The website offers each partner's expertise description, along with the offered technologies and facilities within the project, as well as links to partners' websites, a very useful aspect of the website for users but also Artists and SMEs.

The website also includes a dedicated section for all the selected artists from both Open Calls along with their project proposals and previous relevant work as well as links to the artists and SMEs websites. All publicly available results of the project (such as public deliverables, presentations, publications, and resources including code snippets and datasets developed in the project) will be made accessible on the website. The website includes contact details, to get in touch with the project's team. The website fulfils the needs of different target groups, such as artists, the creative industries, private and public companies, the research community, and the general audience in general, we envision the website as a dynamic platform that grows over time and meets the developed objectives.

The website uses a clear structure and common language to describe the project. This facilitates the presentation of information regarding the envisioned goals, the current state, as well as the ongoing activities of the ReSilence project. As a display of the website's structure, a part of the home page is illustrated in Figure 1.

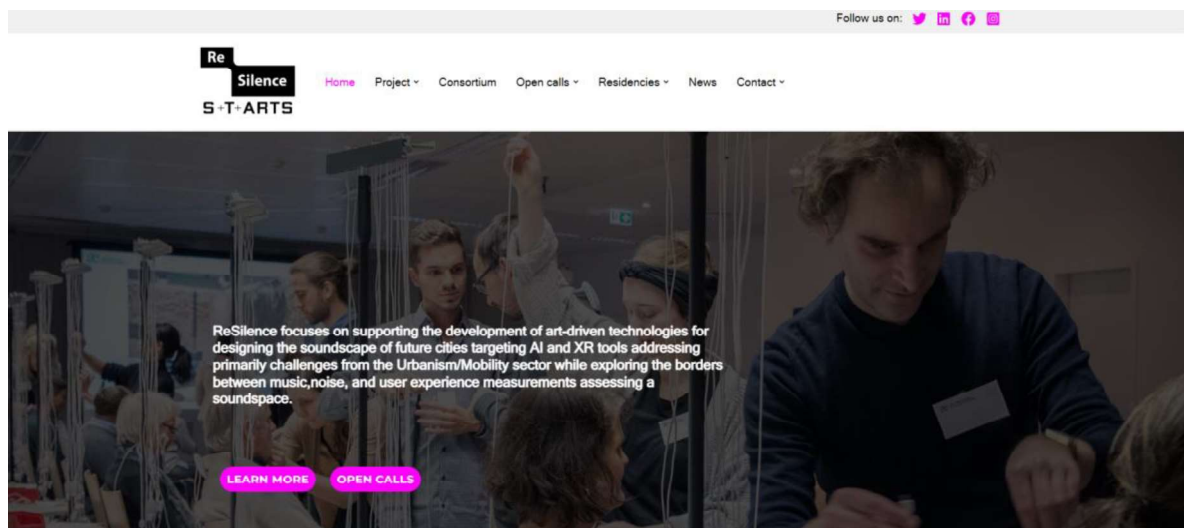


Figure 1: ReSilence home page

The ReSilence website will be maintained during the project lifetime and at least 2 years after the end of the project.

### 2.2.2 Structure of website

The website is subdivided into seven different parts that focus on different content. At the top of every page on the website the user is offered a well-structured header/menu bar leading to Web pages with more detailed information as shown in Figure 2. The categories (Home; Project; Consortium; Open Calls; Residencies; News; Contact) provide additional information about the project and its partners, it clearly showcases the presence of the Open Calls and artists and offers an overview of the project’s overall structure. It also provides an overview of the latest news and contact details to get in touch with the project’s team. Lastly on top left it provides links to all social media channels of ReSilence.

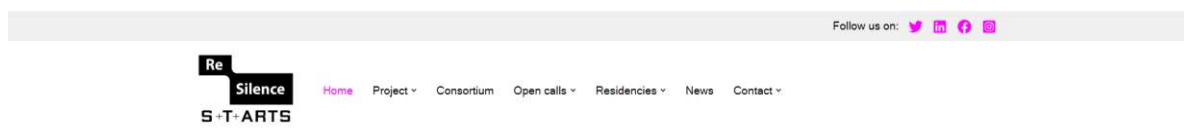


Figure 2: Header/Menu bar of ReSilence homepage

### Project submenu

By Clicking the “Project” tab (Figure 3) the user can read details about the S+T+ARTS initiative, the targets of the project in “Aims & Objectives” and can navigate to the facilities and technologies offered by ReSilence partners as well as the four pilot use cases of the project. In the “Use Cases” page, the use cases on which this project will focus are outlined, namely: 1. Musical Experience Design, 2. The New Silence (Sound and Mobility) 3. Sound of Urban Spaces and 4. Full-body sound experience.

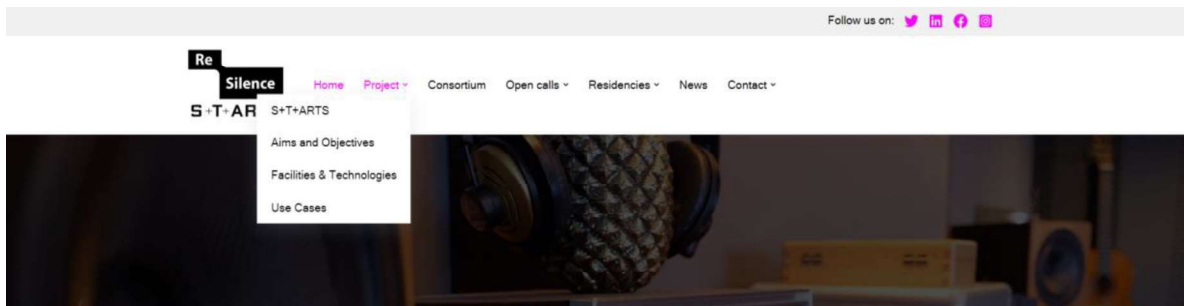


Figure 3: “Project” tab and its subentries

### Consortium web page

The consortium web page provides an overview of all the partners involved in ReSilence and their logos (Figure 4). Each one of the partners once clicked leads to a dedicated page for each partner along with links to their websites (Figure 5).



Figure 4: Consortium web page

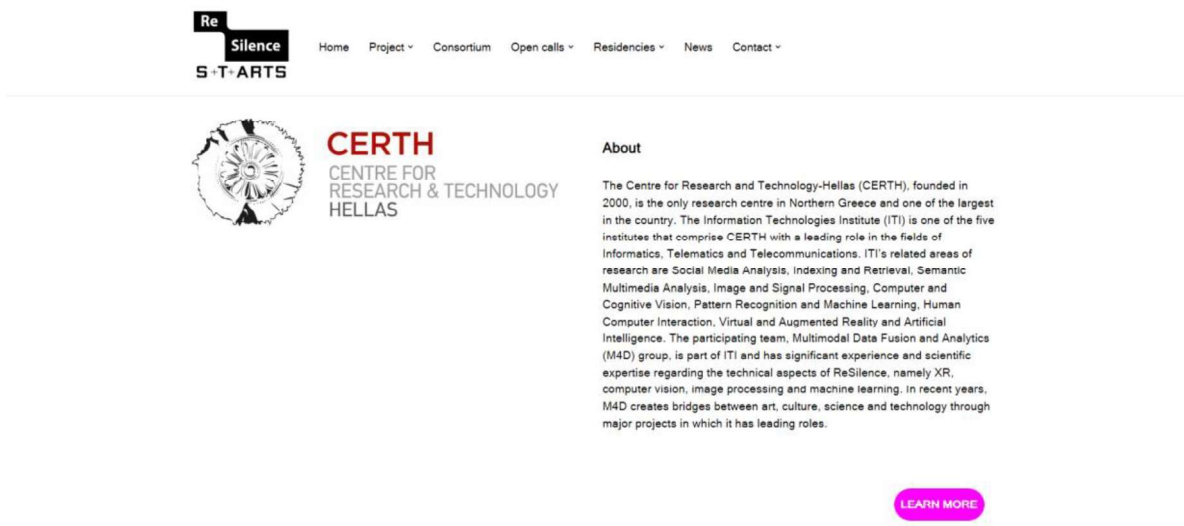


Figure 5: Partner dedicated web page

### Open Calls Submenu

The Open Call submenu contains information about the two Open Calls provided by ReSilence. These pages contain the FAQs and all necessary information needed for the artists interested in the Open Calls. Additionally, in this page an applicant was able to submit their proposal while the Open Calls were open (Figure 6). Aside from the application button on the Open Calls page during the duration Open Call calls a banner on top of the website clearly indicating the deadlines and application button for the applicant's convenience (Figure 7).

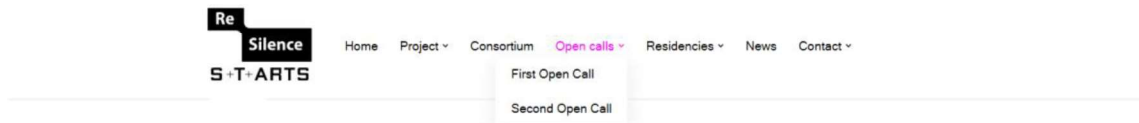


Figure 6: Open Call submenu and its entities

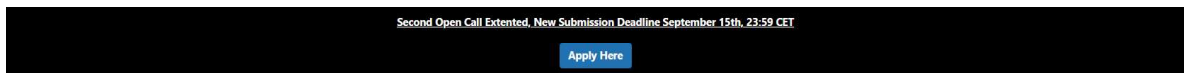


Figure 7: Open Call announcement banner

### Residencies submenu

In the residencies submenu a user can find all the artists and SMEs selected by both Open Calls along with information about their proposal and ideas on ReSilence's challenges as well as previous relevant work of each artist or collective and links to their websites (Figure 8).

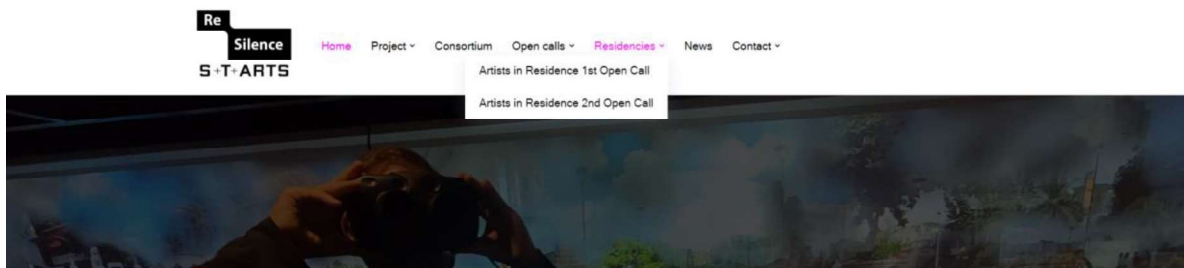


Figure 8: Residencies submenu and its entities

News web page

The “News” tab consists of a single Web page. Any update related to the project is added to this Web page. The intention of creating this Web page is to enable the users to keep track of the progress of the ReSilence project. A preview of every news post is provided with the option of being navigated to a Web page with more details on the respective news (Figure 9).

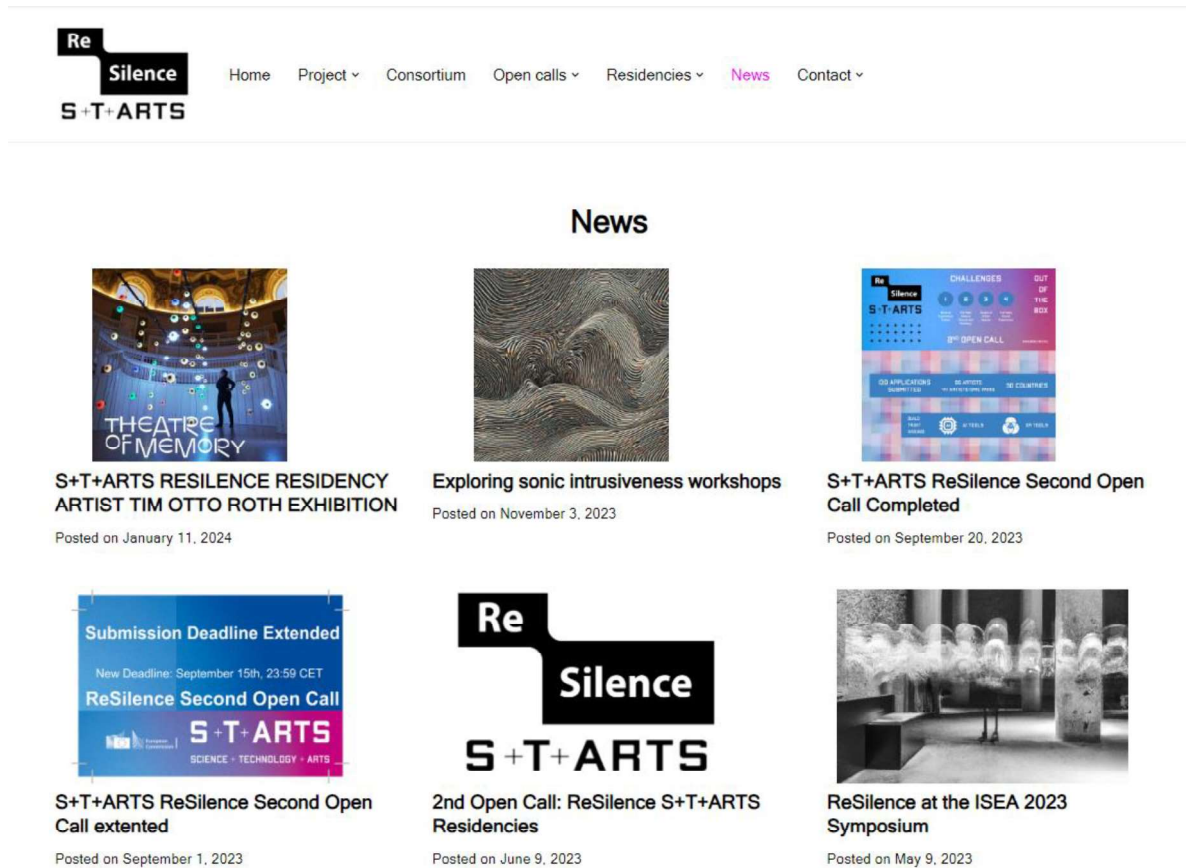


Figure 9: News Webpage

Contact

This Web page (Figure 10) provides the user with all the necessary contact information related to ReSilence. Furthermore, a web form is available as a supplementary means of communication using emails.

**Contact Information:**

Dr. Stefanos Vrochidis (Project Coordinator)  
 Email: stefanos@iti.gr  
 Phone: +30 2311 257754  
 Fax: +30 2310 474128

Dr. Sotiris Diplaris  
 Email: diplaris@iti.gr  
 Phone: +30 2311257778  
 Fax: +30 2310474128

**Address:**  
 Center for Research & Technology Hellas  
 Information Technologies Institute  
 6th km Charilaou - Thermi, 57001, Thessaloniki  
 P.O. Box: 60361  
 Greece

Your name  
 Your email  
 Subject  
 Your message (optional)

Please prove you are human by selecting the **key**.

Submit

Figure 10: Contact Webpage

### 2.3 ReSilence presence on the S+T+ARTS website

ReSilence has an active presence on the STARTS website and is constantly updating with news items the news feed of the web page (Figure 11). Additionally, ReSilence has a dedicated web page under the residencies submenu at starts eu home page (Figure 12). In the ReSilence webpage a brief description of the project is presented along with its main goals and objectives. Moreover, the pilot use case as well as all partners involved in the project along with links redirecting to their webpage are also offered (Figure 13). Lastly all Open Calls were also published on the starts eu website under the opportunities tab of the main home page menu, containing all necessary information about the project’s main challenges, FAQs and guides for applicants as well as application buttons and contact emails, similarly to the ReSilence website (Figure 14).

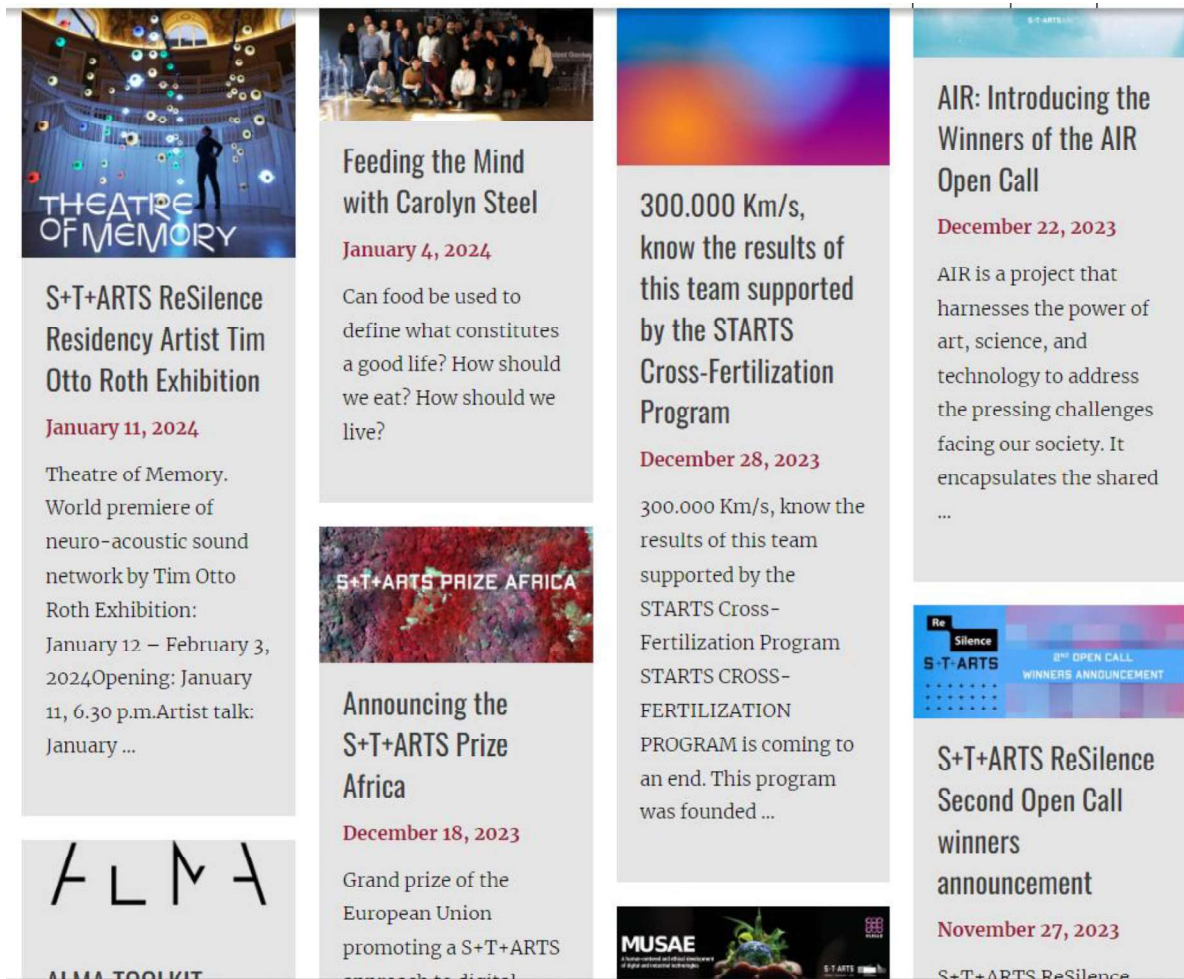


Figure 11: News items in the news webpage

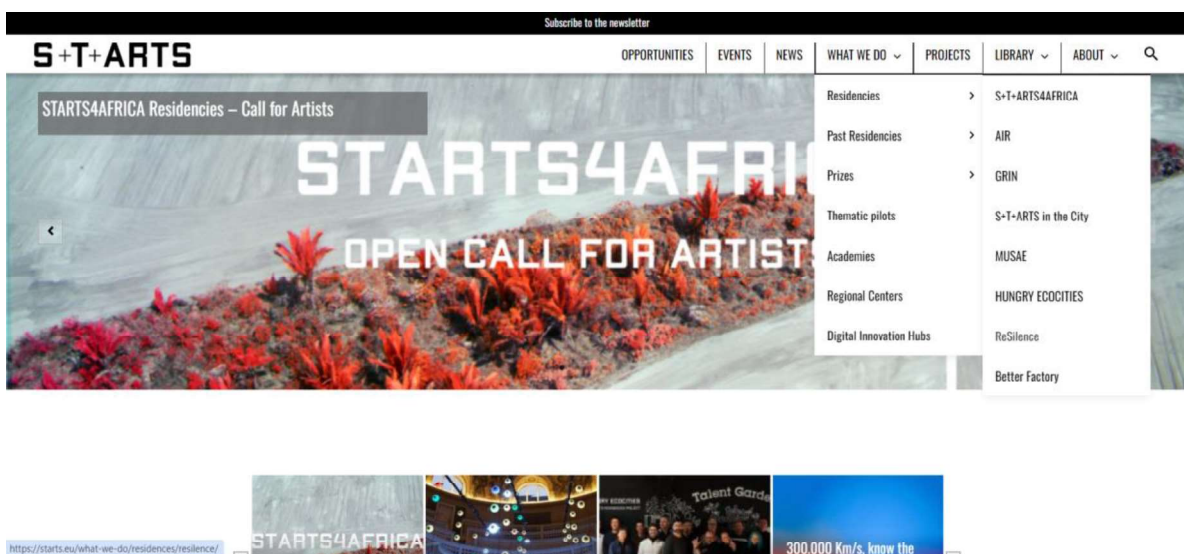


Figure 12: What we do submenu and its entities



## RESILIENCE

### Retune the Soundscape of future cities through art and science collaboration

A big challenge in the **Urbanism/Mobility** sector is not anymore to reduce what we call noise but to qualify the soundscape, to shape the vibrations of urban spaces, and to design the ambience of the city in a way that makes it enjoyable, secure, and familiar. We must consider acting on the **sound of the city** as a design issue applied to the most immersive “matter” in order to improve the quality of urban life.

*The main objective of the Resilience project is to support the development of art-driven technologies for designing the soundscape of future cities through the collaboration of artists, architects, urban designers, scientists, engineers and researchers.*

Resilience will use new technologies (**Artificial Intelligence and eXtended Reality**) to:

1. **Involve and collaborate with artists** in order to leverage multiple sources of inspiration, interdisciplinary collaboration, and build trust around AI & XR technologies.
2. **Explore the borders between noise and music** in a changing world by producing an **acoustic awareness** in urban spaces (not only reducing the intensity of noise, but also considering it as an energy producer and designing positive sounds, sounds we want to preserve and multiply)
3. **Create new types of sonic urban experiences** that expand possibilities for **accessibility, active participation/engagement, sustainability, and social inclusion**

One of the central motivations of Resilience is to address the importance of sound in urban design and experience. It aims at increasing citizens' awareness and participation in shaping the sounds of the future, which can enhance the wellbeing of citizens while also increasing economic activity and productivity. The real-world pilots of Resilience are going to be co-designed with the help of **S+T+ARTS residencies** and will demonstrate the expected impact of the proposed solution by focusing on specific societal problems related to cities and the music industry. Resilience organizes its activities around four pilot use cases:

- Musical Experience Design
- The New Silence (Sound and mobility)
- Sound of Urban Spaces
- Sound and social Inclusion

Resilience will support **Art-Driven Experiments (ADE)** through Open Calls with a specific budget allocated for this purpose. **Artists** in Resilience will have **access to AI and XR** technology in order to reflect on **novel uses** and their **impact on society**. They will also help in ensuring that the development process and system behavior of the technologies explicitly acknowledge human values and needs.

**Duration:** September 2022 – February 2025

**Consortium:** Centre for Research and Technology Hellas (GR), Aristotle University of Thessaloniki (GR), MaxPlanck Benayoun (FR), Max Planck Institute for Empirical Aesthetics (GER), Maastricht University (NL), Thessaloniki Concert Hall (GR), University of Genova (IT), University Pompeu Fabra (ES), WESOUND (GER)

**Management Contact Person:** Stefanos Vrochidis, [stefanos@iti.gr](mailto:stefanos@iti.gr)

MORE ABOUT [RESILIENCE](#)

## PARTNERS

### Centre for Research and Technology Hellas

The Centre for Research and Technology-Hellas (CERTH), founded in 2000, is the only research centre in Northern Greece and one of the largest in the country. The Information Technologies Institute (ITI) is one of the five institutes that comprise CERTH with a leading role in the fields of Informatics, Teleinformatics and Telecommunications. ITI's related areas of research are Social Media Analysis, Indexing and Retrieval, Semantic Multimedia Analysis, Image and Signal Processing, Computer and Cognitive Vision, Pattern Recognition and Machine Learning, Human Computer Interaction, Virtual and Augmented Reality and Artificial Intelligence. The participating team, Multimodal Data Fusion and Analytics (M4D) group, is part of ITI and has significant experience and scientific expertise regarding the technical aspects of Resilience, namely XR, computer vision, image processing and machine learning. In recent years, M4D creates bridges between art, culture, science and technology through major projects in which it has leading roles.

[Learn More](#)



### Aristotle University of Thessaloniki

Aristotelio Panepistimio Thessalonikis is established in Thessaloniki, at University Campus Administration Bureau, 54124, Greece, is the representative of the academic

Figure 13: ReSilence webpage on starts website



[BACK TO NEWS](#)

[BACK TO CLOSED CALLS](#)

### New Submission Deadline : September 15th 2023



Image: WIKI/NOZ

#### Open Call: ReSilence S+T+ARTS Residencies

ReSilence project aims to stimulate and support the development of art-driven technologies in the spirit of the broader S+T+ARTS initiative. The focus is on designing the soundscape of future cities through the collaboration of artists, architects, urban designers, scientists, engineers and researchers.

#### About ReSilence

As part of the S+T+ARTS program, Resilience in collaboration with artists is developing technologies to shape in novel ways our urban environments and soundscapes, re-positioning the role of silence and that of sound. To design the soundscape of future cities, Resilience project supports the development of art-driven technologies in the spirit of S+T+ARTS through the collaboration of artists, architects, urban designers, scientists, engineers and researchers.

#### About the residencies

Project proposals should focus on the challenges and opportunities sound and related media offers to urban futures to create awareness and stimulate public dialogue through exhibitions, communication initiatives and/or industry collaborations. Resilience offers 25,000 euro stipends to selected artists as well as 80,000 euro to SMEs (of which 30k must also go directly to an artist to aid production of related works).

Resilience envisages two different types of applications for the second open call:

a) An individual artist

b) SME/Artist pair

There are four different research challenges (RCHs) where artists can develop their ideas:

#### Musical experience design

Concerts are much more than just the music they feature. Technology brings new ways of enabling participation in concerts-on-line and remote. This enables the broadening and deepening of audience experience.

#### The New Silence (Sound and mobility)

Electric cars are introducing a new silence in the city. How can we design the interior/exterior car sound, as a combination of ambience and an audio interface in order to improve security and quality experience in mobility.

#### Sound of urban spaces

One aspect affecting the quality of urban life is sound. Analogous to visual city planning, a soundscape approach can be applied in order to analyse the form and sound of existing spaces, measure its quality and effects on citizens.

#### Full-Body Sound Experience

Traditionally we expect that sound is experienced through our ears. However, nowadays we have the ability to create tools and wearables that can support a full-body approach in experiencing music and sound.

#### When & How to apply?

Interested artists and SMEs will be able to submit their application at any time for the duration of the open call. Applicants should fill in the online forms in English.

[» More Open Call information](#)

[» Application \(Questionnaire / docs\)](#)

[» Guide for Applicants](#)

[» Frequently asked questions](#)

Individual artists and/or artists-SMEs will be able to answer the questions and upload the documents asked (budget, CV, links) in order to submit the proposal. The proposal should specify clearly (a) the type of application and a summary of the proposed work, (b) a description of the applicant's previous experience, (c) the motivation, ambition and relation to Resilience, (d) the expected duration of the residency and the budget.

Applications will be open from 9<sup>th</sup> of June to September 15<sup>th</sup> 2023

[Apply Here](#)

Please submit your applications exclusively via our [online application platform](#). The application must be written in English.

Submission Deadline Extended till September the 15th, 23:59 CET

#### Webinars

The consortium will organize webinars for future applicants to S+T+ARTS residencies. Consortium members and past residents will describe their experience and provide useful background information. There will be ample time for the questions. Artists can join these sessions online and get also an idea about the [technologies and facilities](#) that can be used to develop their idea.

If you have any questions do not hesitate to write us an email at: [resilience.eu@gmail.com](mailto:resilience.eu@gmail.com)

Figure 14: Second Open Call web page under opportunities on starts.eu website

## 2.4 Starts newsletter

Every month we feed the S+T+ARTS newsletter with content, if any. The newsletter aims at informing the interested public about ReSilence and overall, about S+T+ARTS projects, their progress, and new opportunities and to communicate ongoing activities and events.

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### S+T+ARTS news, events and open calls in December 🌟

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S+T+ARTS <starts.eu@gmail.com>  
Reply-To: starts.eu@gmail.com  
To: nefeli.valeria@gmail.com

6 December 2023 at 14:19

*We advise you to click on the pop-up window of your mailing platform to open this mail in your browser and enjoy the full layout.*



## NEWS



**S+T+ARTS RESIDENCIES  
RESILIENCE 2ND CALL  
WINNERS  
ANNOUNCEMENT**  
[+ MORE INFO](#)

The project received over **130 applications from 30 countries** in the 2nd open call. ReSilence selected **6 individual artists and 4 artists and SME pairs**. Residencies will start in January 2024 for a maximum duration of 18 months.

Figure 15: STARTS Newsletter example of the second Open Call

## 2.5 Social Media presence

Aside from the ReSilence website that is expected to work as a central point of attraction for everyone interested in the work of the consortium towards the project's objectives. ReSilence has an active presence on four social media platforms namely Facebook, Instagram, LinkedIn, and Twitter. The social media strategy of ReSilence is to inform the interested public about ReSilence and its progress and most importantly to attract new audiences interested in ReSilence objectives by communicating the ongoing activities and events. Additionally, it is of great interest to ReSilence to connect with communities of experts in the research field of ReSilence.

2.5.1 Facebook

ReSilence Facebook page has 66 followers and 51 total likes during the last 12 months of its existence.

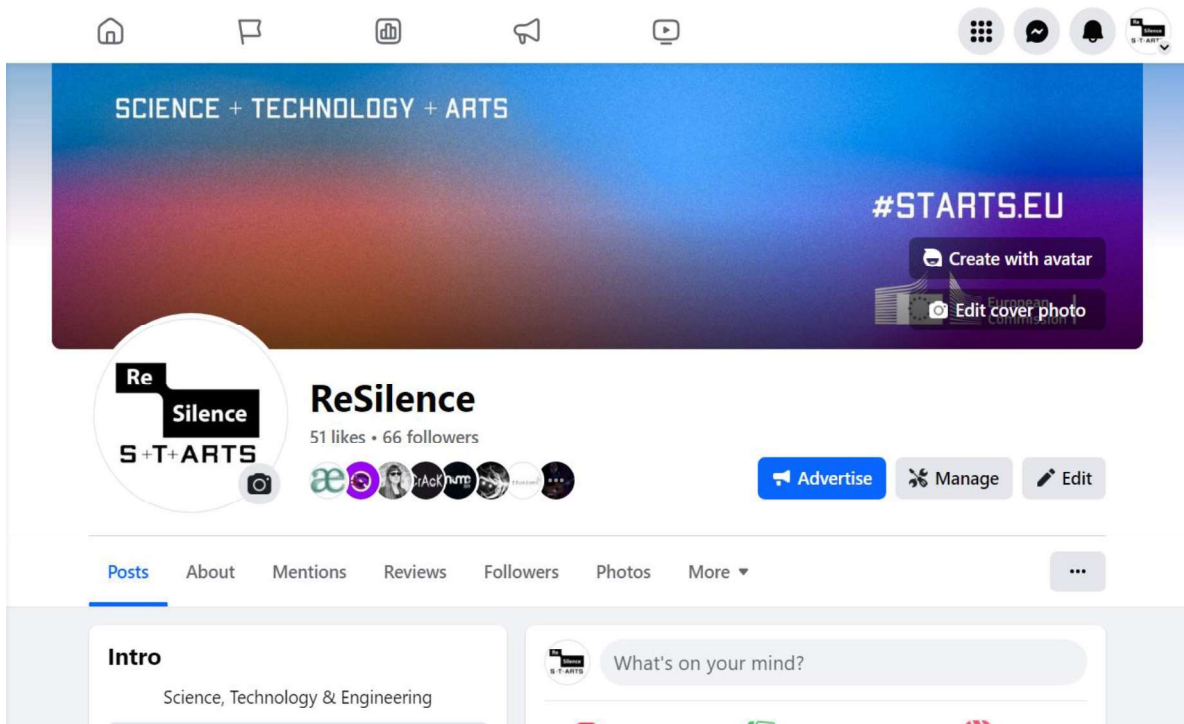


Figure 16: Second Open Call web page under opportunities on starts eu website



Figure 17: Cumulative Reach statistics since Facebook page’s start

### 2.5.2 Instagram

As part of its social media presence, ReSilence project has an Instagram account to allow for professional social interactions. The ReSilence’s profile has 246 total followers.

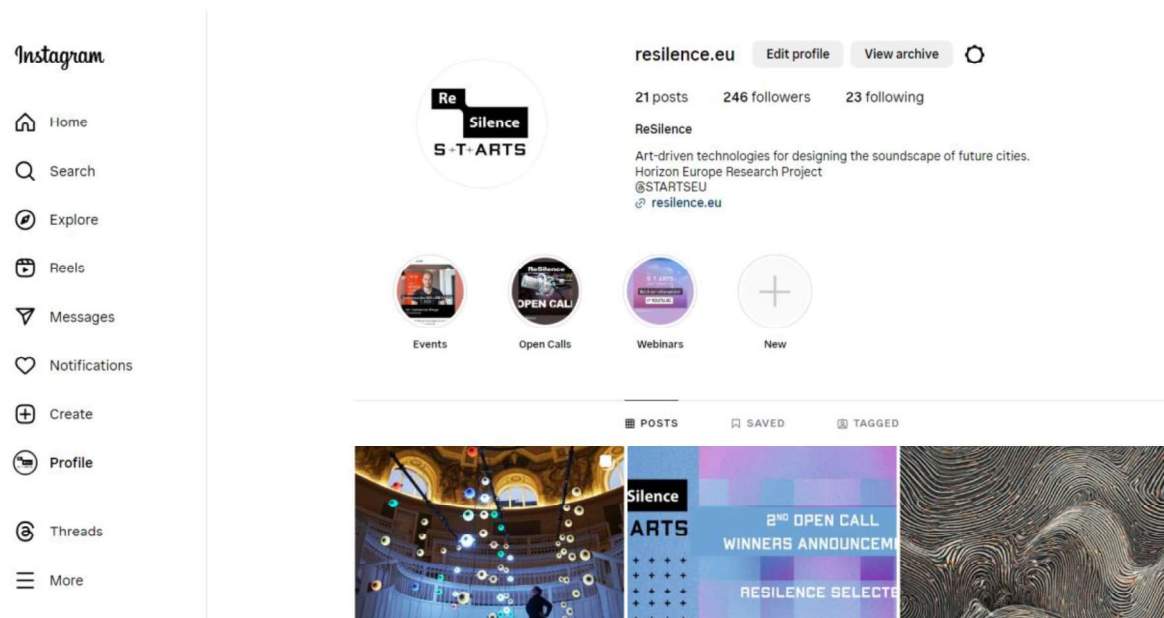


Figure 18: Instagram ReSilence profile page

### 2.5.3 LinkedIn

As part of its social media presence, ReSilence project has a LinkedIn account to allow for several social interactions with 50 connections and 6267 impressions in the last 12 months.

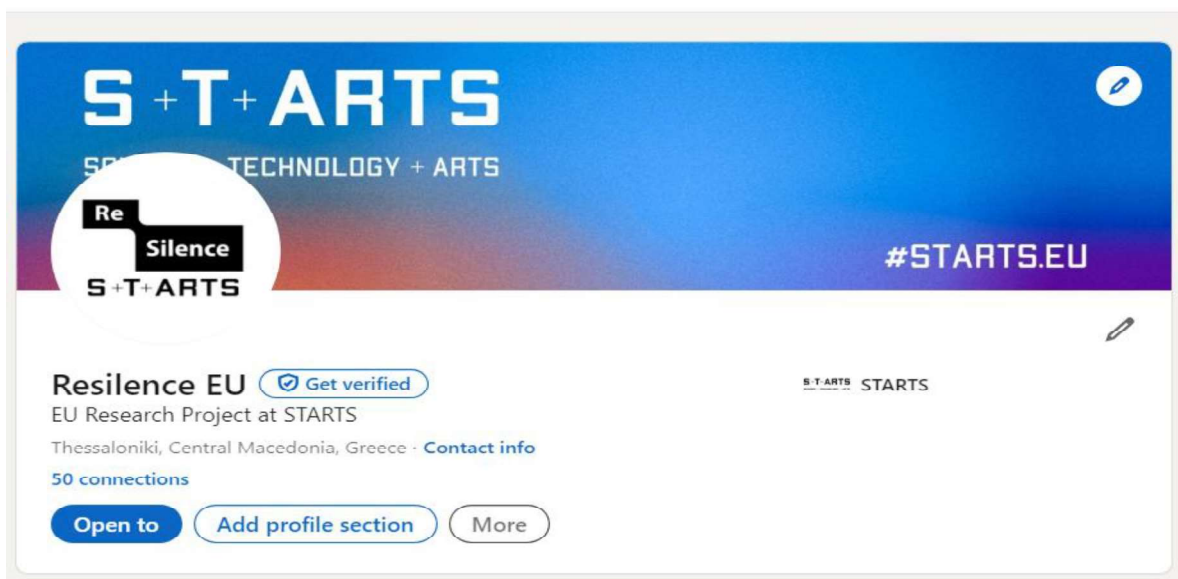


Figure 19: LinkedIn ReSilence profile page

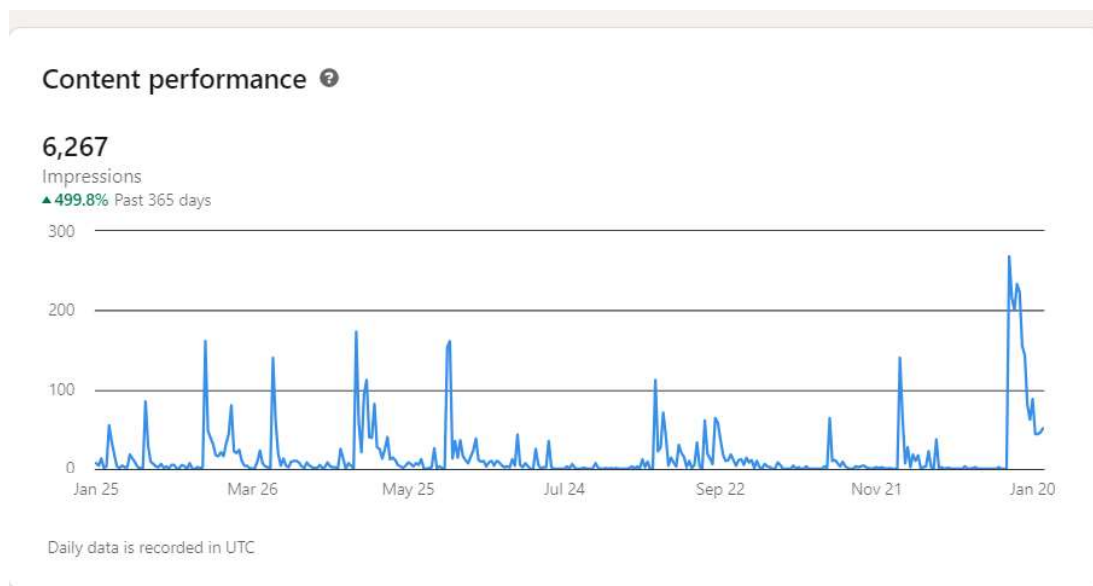


Figure 20: LinkedIn content performance of the last year

## 2.5.4 Twitter

ReSilence's presence on Twitter has 55 followers the last 12 months with a total engagement of 245 impressions for the last 3 months.

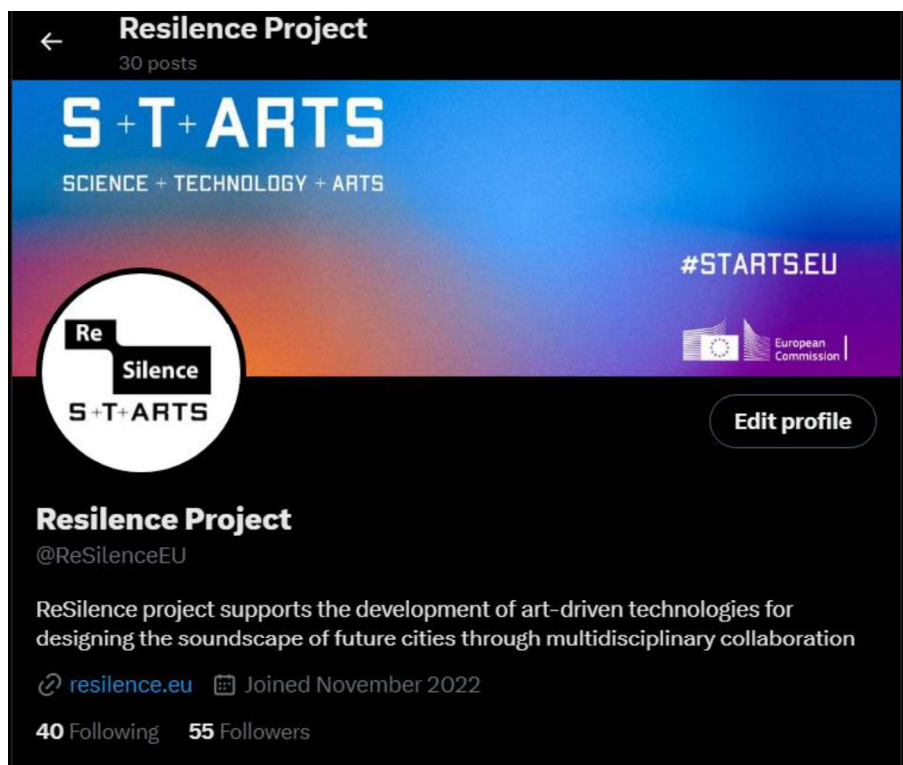


Figure 21: Twitter ReSilence profile page

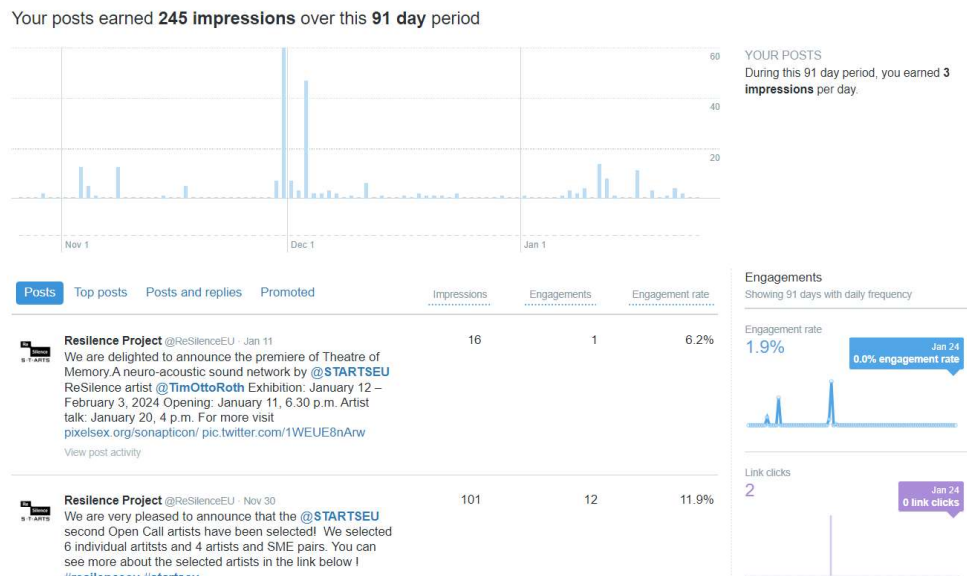


Figure 22: Twitter account analytics of the last 3 months

### 2.5.5 YouTube

ReSilence has no official YouTube channel but regardless of that, residency artist Andrea Cera is working on a five series informational videos related to his under the S+T+ARTS residency of ReSilence related to sound intrusiveness. So, two parts of the video series have been published on the artist's personal YouTube channel and will be disseminated on all ReSilence social media accounts and websites.

Published - not yet communicated.

- ReSilence - Exploring Intrusive Sounds - Intro (1/5)

<https://youtu.be/bOxpU6A8CpU>

In review before publication

- ReSilence - Exploring Intrusive Sounds - Auditory Roughness and Spectral Centroid (2/5)

<https://youtu.be/O9IbC4GJSP8>

### 3. DISSEMINATION EVENTS & ACTIVITIES

#### 3.1 Events, Conferences, Symposiums, Fairs

Date(s)	Activity	Title	Partner	Event	Location
31 Oct 2022	Festival	La natura multidisciplinare della forza lavoro culturale e creativa costituisce un valore aggiunto fondamentale per le aziende che combinano competenze nell'arte, nella scienza e nell'ingegneria, i cosiddetti "fusion skill"	Ralph Dum, Antonio Camurri, Beatrice De Gelder, Maria Grazia Mattei, Paolo Naldini, Maurizia Rebola	S+T+ARTS Talks in Genova / A regola d'arte Festival della Scienza, 2022	Palazzo Ducale, Sala del Minor Consiglio, Genoa, Italy
9-12 Mar 2023	Publication - Conference proceedings	A Pipeline for Extracting Abstract Dependency Templates for Data-to-Text Natural Language Generation	Mille, S., Ricci, J., Shvets, A. and Belz, A. (UPF)	7th International Conference on Dependency Linguistics	Depling, GURT/SyntaxFest 2023, Georgetown University, Washington D.C
9-10 May 2023	Festival	My car, my cocoon. How AI and data create more mobile quality of life.	Cornelius Ringe (WESOUND)	AUDI x OMR - Festival 2023	Hamburg, Germany
16-21 May 2023	Symposium	ReSilence: Retune the Soundscape of future cities through art and science collaboration	CERTH	ISEA2023	Forum des images, Paris, France
14 Jun 2023	Symposium	Voxelwise encoding models of body stimuli reveal a representational gradient from low-level visual features to postural features in occipitotemporal cortex	Giuseppe Marrazzo (MU)	How body relevance drives brain organisation	Maastricht, Netherlands
14 Jun 2023	Symposium	Connectivity of different occipital body areas and their roles in affective action perception	Baichen Li (MU)	How body relevance drives brain organisation	Maastricht, Netherlands
29-30 Jun 2023	Publication - Conference proceedings pp. 91-101	Key Environmental Lexicon Extraction Using Generative Transformer	Gotkova, T. and Shvets, A. (UPF)	2nd International Conference on Multilingual Digital	Lisbon, Portugal

				Terminology Today (MDTT 2023)	
16 Sep 2023	Fair	Overall ReSilence Project presentation	CERTH, AUTH, OMMTH	Thessaloniki International Fair	Thessaloniki, Greece
10-11 Oct 2023	Presentation	The primate social brain: Is it all in the mind?	Beatrice de Gelder (MU)	Symposium at the Accademia dei Lincei	Rome, Italy
2-3 Nov 2023	Online poster	An early ERP signature of self-whole-body perception	Juanzhi Lu (MU)	S4SN	Online
2-3 Nov 2023	Online poster	Minimal awareness shows emotion and gender specificity	Marta Poyo Solanas (MU)	S4SN	Online
3-4 Nov 2023	Workshop	3 workshops dedicated to familiarising the public with several timbral features which make a sound intrusive	Andrea Cera	Festival della Scienza Alto Vicentino (part of artist residency)	Schio, Italy
11-15 Nov 2023	Poster	Largely separate body and face networks in the macaque cortex revealed by a data-driven approach	Baichen Li (MU)	SfN 2023	Washington DC, USA
12 Jan-3 Feb 2024	public exhibition	Theatre of Memory	Tim Otto Roth	Exhibition (part of artist residency)	Auditorium of the Tieranatomisches Theater, Berlin, Germany
16-28 Feb 2024	exhibition and empirical study	Opening of “Theatre of Memory” by Tim Otto Roth	MPIEA	Theatre of Memory	Auditorium of the Tieranatomisches Theater, Berlin Germany
20 Feb 2024	Lecture recital for the general public	“How did you do that?”	MPIEA	Theatre of Memory	Auditorium of the Tieranatomisches Theater, Berlin, Germany

Table 1: Completed dissemination activities

## 3.2 Open Calls for artists

### 3.2.1 ReSilence Open Call Webinar

Dissemination of the first artist Open Call among artists and consortium partners was held online on 19th of January 2023. CERTH along with consortium partners organised a webinar with potentially interested artists from all over the world, presenting the ReSilence project objectives and technologies offered by each partner within the project. After the partners' presentations sessions ended the consortium accepted questions and discussed different scenarios of collaboration from an artistic perspective.

### 3.2.2 ReSilence Open Call webinar video

During the online webinar as discussed above in section 3.2.1 the session was recorded and with the addition of appealing imagery and attractive animations aimed to capture the audience's further attention. Its main information was what the ReSilence project objectives technologies present in ReSilence and how artists can be involved. Also, general information about the residency was offered regarding the budget, the duration, deadlines etc. The poster for the dissemination of the webinar was communicated on all social media platforms and the ReSilence website (Figure 23). The link to the video can be found below [https://www.youtube.com/watch?v=V7xpERk11LQ&ab\\_channel=ResilienceProject](https://www.youtube.com/watch?v=V7xpERk11LQ&ab_channel=ResilienceProject) and has accumulated a total 1600 views during the last 11 months since its uploading.

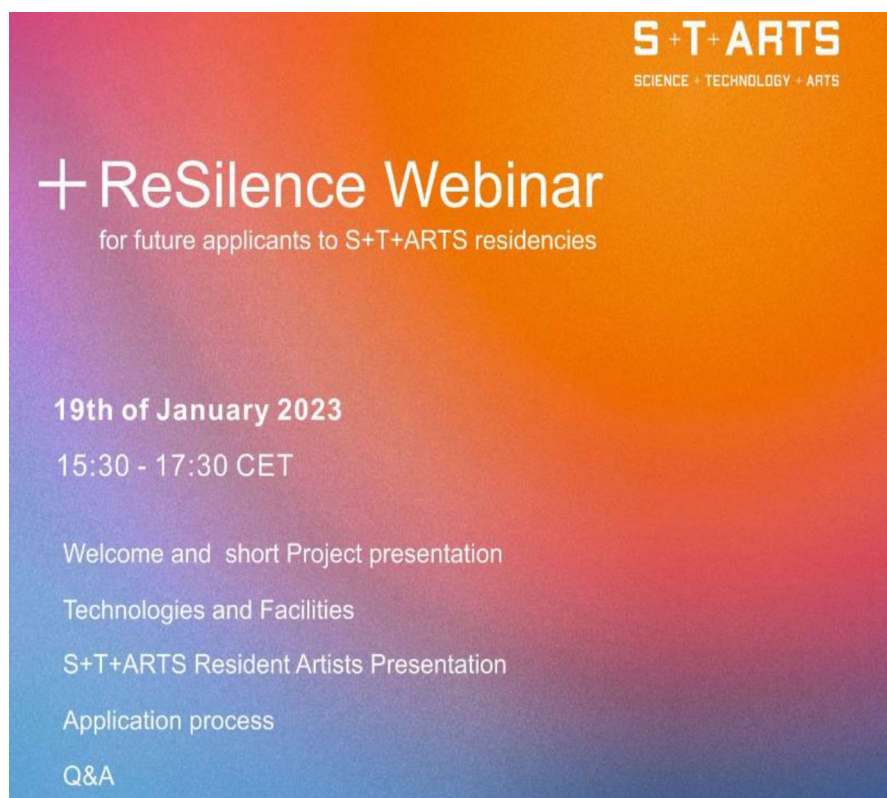


Figure 23: ReSilence Open Call webinar poster

### 3.2.3 Open Calls announcements

Both Open Calls were announced on all ReSilence social media platforms with several posts and stories, an example for both call posters can be seen in Figure 24 and Figure 25 respectively. Additionally, the calls were announced through the ReSilence (Figure 26) and starts.eu website (Figure 27) websites and the S+T+ARTS newsletter. For both Open Calls we received a total of over 260 applications from all over the world of both Artists and Artists and SME pairs. The consortium selected a total of 15 artists, 5 from the first Open Call, 3 as individual artists and 2 as Artists and SME pairs. A total of 10 artists from the second call, 6 as individual artists or collective and 4 artists and SME pairs.



Figure 24: First Open Call post



Figure 25: Second Open Call post

#### ReSilence Open Call Announcement

January 9, 2023 / News

We are very pleased to announce that ReSilence will offer a number of artist residencies as part of the Starts Residencies program. Submission Deadline : 17th of March 2023

You can find all the necessary information in the [Open Call Page](#).



Figure 26: First Open Call ReSilence website announcement

BACK TO NEWS  
BACK TO CLOSED CALLS  
New Submission Deadline : September 15th 2023



#### Open Call: ReSilence S+T+ARTS Residencies

ReSilence project aims to stimulate and support the development of art-driven technologies in the spirit of the broader S+T+ARTS initiative. The focus is on designing the soundscape of future cities through the collaboration of artists, architects, urban designers, scientists, engineers and researchers.

#### About ReSilence

As part of the S+T+ARTS program, ReSilence in collaboration with artists is developing technologies to shape in novel ways our urban environments and soundscapes, re-positioning the role of silence and that of sound. To design the soundscape of future cities, ReSilence project supports the development of art-driven technologies in the spirit of S+T+ARTS through the

Figure 27: Second Open Call starts.eu website announcement

## 4. FORESEEN DISSEMINATION ACTIVITIES

ReSilence dissemination strategy outlined in Section B and subsection 2.2.1 in the DoA it identifies a diverse group of audience with different interests and needs related to the project. These include end users of artists, scientists, and potential creative industry stakeholders as well as researchers and academics. Each group requires a unique approach by the project consortium for communication, meaning that the information that should be conveyed, as well as the means used should take into consideration the background knowledge and the interests of the targeted group. Our primary dissemination objective at this stage is to present the concept, objectives, and use cases of ReSilence and demonstrate the work in progress of individual components of the artists in residency in several events. Networking activities are also important to establish direct contact with potentially interested target groups and researchers working in similar areas. ReSilence will actively pursue high profile scientific, academic, and commercially relevant events and conferences within the project's domain of interest. This includes academic and scientific conferences targeted toward the research areas of the individual ReSilence partner research as well as the collective ReSilence research scope. Commercial events will also include art, music and sound related scientific and cultural conferences, fairs, and exhibitions.

### 4.1 List of foreseen publications, Events and Academic Conferences

ReSilence partners have started in collaboration with Fundamental Research (FR) to scout possible locations and suitable exhibition spaces for the ReSilence forthcoming events. This systematic dissemination strategy includes, aside from identification of facilities, ecosystems, and networks such as music- art institutions, the articulation of narratives and an early on documentation of the overall planning. These discussions are expected to conclude in a variety of possible dissemination endeavours. FR has started to conduct one to one meeting with the artists to identify the outcomes of each residency and how they envision to realise and exhibit their project.

Listed below are several dissemination actions planned for the very immediate future. The list highlights some of the most important events targeted by the consortium.

- **Ars Electronica 2024** - ReSilence will participate at Ars Electronica 2024. This year in Linz, Austria, from September 4-8, 2024. This year's theme is going to be announced in April 2024. Regardless, ReSilence will present the Open Calls, the project objectives and works being done by artists in residence related to this year's topic.
- **SONAR+D 2024** - Sónar+D is the international meeting of art, science, and digital culture hosted by Sónar during the festival, exploring how creativity changes the present and imagines new futures. Since 2013, this anti-disciplinary event has brought together leading artists, technologists, creatives, musicians, designers, thinkers, scientists, and entrepreneurs in Barcelona for a carefully curated programme of talks, masterclasses, and groundbreaking performances, with a focus on inspiration and networking. This year it will take place during 13-15 June 2024
- Festival della Scienza 2024, Genoa (The main Italian Science Festival), <https://www.festivalscienza.it/> The President of the Festival Fulvia Mangili was invited to the July 2023 Project Meeting; the Consortium agreed to consider to propose to the

Festival a participation of ReSilence to the next edition of the Festival (October-November 2024). This possibility will be discussed at next Project Meeting in Barcelona (March 2024).

## 4.2 Foreseen User Workshops, Demonstrations, & Open Days

The ReSilence consortium will organise several of its own events during the project duration. Among these, several events aimed at demonstrating the ReSilence technologies to the public and receiving constructive feedback to improve the supported features and enlarge its potential impact. These events will focus on augmenting and improving the project objectives and system functionality, receiving instructive feedback from the users, and building networks for potential exploitation opportunities and impacts. Additionally, all Open Call selected artists will conduct several experiments in the form of workshops, exhibitions, case studies etc. So far two Open Call selected artists have conducted workshops and exhibitions as presented in Table 1 in section 3.1.

## 4.3 Foreseen Cooperative Initiatives

The ReSilence consortium is planning to expand its collaboration with other European projects through meetings and sharing events within the S+T+ARTS Ecosystem and with all the STARTS initiatives.

## 4.4 Dissemination plan timeline

Below the initial dissemination plan is presented, ReSilence has fulfilled all commitments of the first year and will now greatly enhance its dissemination activities given that all Open Call artists have been selected, as of December 2023, and will soon start producing their first results.

Year 1	<ul style="list-style-type: none"> <li>▪ Raise Awareness</li> <li>▪ Address the target audience and their needs</li> <li>▪ Start recruiting users</li> <li>▪ Open Call announcement</li> </ul>	<ul style="list-style-type: none"> <li>▪ Website development and starts.eu content update, including social media</li> <li>▪ Publication of support material, mass media</li> <li>▪ Submitting scientific papers to relevant journals and conferences</li> <li>▪ Co-organisation of events with similar EU or national projects</li> </ul>
Year 2	<ul style="list-style-type: none"> <li>▪ Active involvement of users and artists</li> <li>▪ Continue engaging users</li> <li>▪ Monitoring of artists</li> </ul>	<ul style="list-style-type: none"> <li>▪ Organisation of Focus Group workshops</li> <li>▪ Artists engagement through workshops</li> <li>▪ Enrich starts.eu website and all mass media channels</li> </ul>

<p>Year 3 and beyond</p>	<ul style="list-style-type: none"> <li>▪ Solicit 1st business interest to customers             <ul style="list-style-type: none"> <li>▪ Promote the exploitation of the ReSilence product/service</li> </ul> </li> <li>▪ Promote the findings to key stakeholders</li> </ul>	<ul style="list-style-type: none"> <li>▪ Organisation of a pan-European Workshop             <ul style="list-style-type: none"> <li>▪ Continue Focus Group with the UG</li> <li>▪ Enrich starts.eu website and all social and mass media channels</li> <li>▪ Create engaging training content</li> <li>▪ Submit scientific papers to relevant journals and conferences</li> </ul> </li> </ul>
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Table 2: Dissemination plan timeline

## 5. EXPLOITATION PLAN AND MARKET ANALYSIS

### 5.1 Stakeholder Analysis

According to Smith (2000), “*stakeholder analysis refers to the range of techniques or tools to identify and understand the needs and expectations of major interests inside and outside the project environment*”; the objective of stakeholder analysis is to ensure that the opinions of stakeholders are considered, allowing for better decision-making and effective management of potential conflicts, since not all stakeholders “deserve” the same amount of attention. It is, therefore, crucial that all the stakeholders for ReSilence be identified and tailored to.

In this section, the key stakeholders will be identified, as well as analysis of said stakeholders and how to engage the key stakeholders, to properly line up their interests with the interests of the project.

#### 5.1.1 Stakeholder Analysis Methods

There are a vast variety of different approaches noted down in the literature corresponding to identification of stakeholder and analysis of their influence as well as effect. According to Project Management Institute (PMI®, 1996), performing a stakeholder analysis involves these four steps:

- Step 1: Identifying stakeholders: a comprehensive list of all individuals and groups who may impact or be impacted by a project (positively or negatively) (e.g. local residents; NGO; associations and community groups; local and national government & regulatory authorities; consumers; company investors; businesses). One common type of stakeholders’ identification is the internal (individuals or groups within an organisation) and the external (individuals or groups outside of the organisation but affected by its decisions and actions) ones.



stakeholder allocates on the grid shows the actions to take with them:

- High power, highly interested people means that these stakeholders should be fully engaged, and greatest efforts should be considered to satisfy them.
- High power, less interested people mean keeping these stakeholders satisfied, by meeting their needs.
- Low power, highly interested people means that these stakeholders should be adequately informed, so no major issues arise, as people in this category can often be very helpful with the details of a project in a supportive role.
- Low power, less interested people means that these stakeholders need monitoring but not excessive communication.

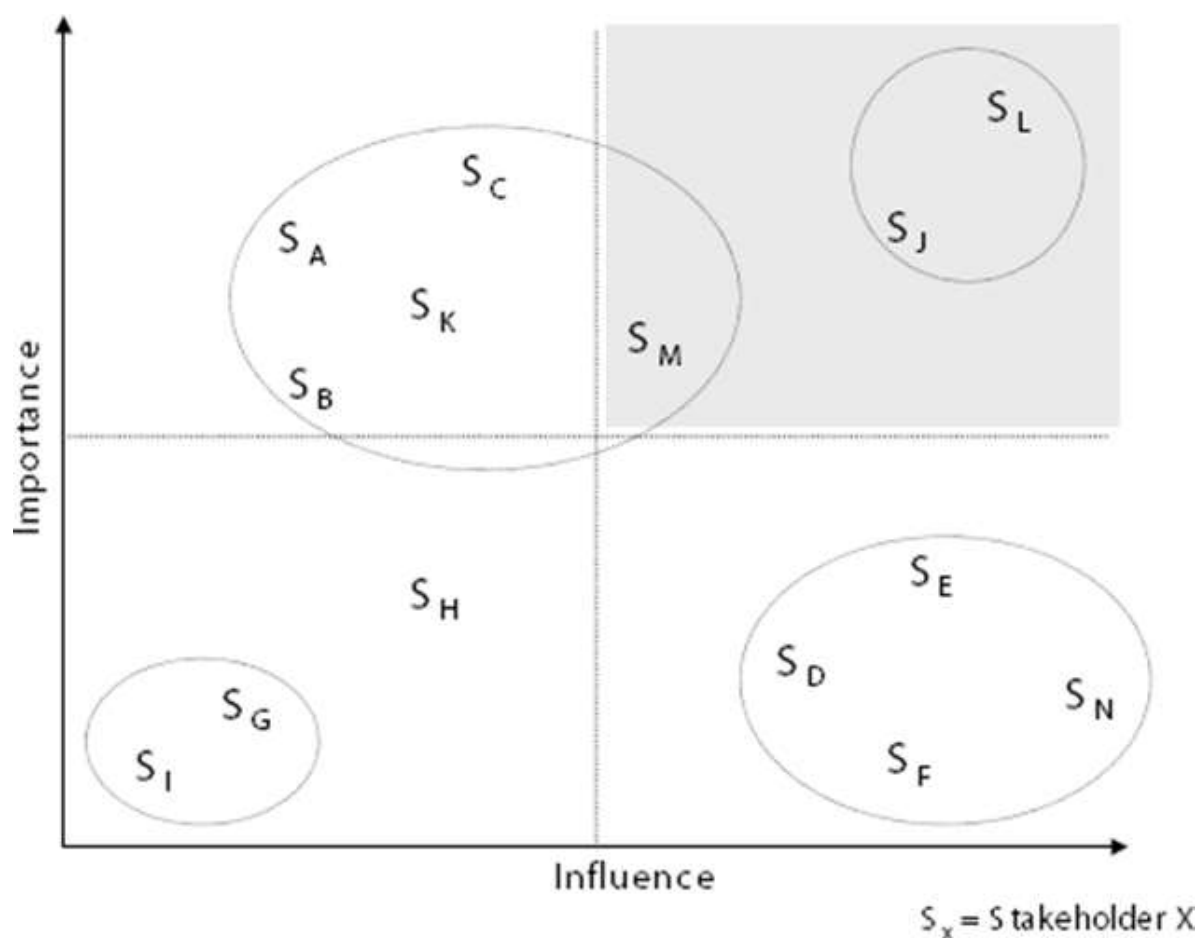


Figure 29: Interest-Influence Classification

### 5.1.2 Stakeholders of ReSilence

In the context of ReSilence, the initial stakeholders identified by partners are:

- Artists
- Inhabitants and visitors/tourists

- People with disabilities (e.g. blind or low vision)
- City Planners
- Architects / Interior Designers

Table 3 provides an overview of the Importance and the Interest of these stakeholders in the project. Figure 30 maps the table of stakeholders in the Influence/Interest Grid proposed in Figure 29.

Stakeholder	Importance	Interest
Artists (ART)	4	4
Inhabitants and Visitors/Tourists (HT)	2	3
People with disabilities (PD)	3	4
City Planners (CP)	5	4
Architects (ARC) / Interior Designers (ID)	4	3

Table 3: Initial Stakeholders of Resilience

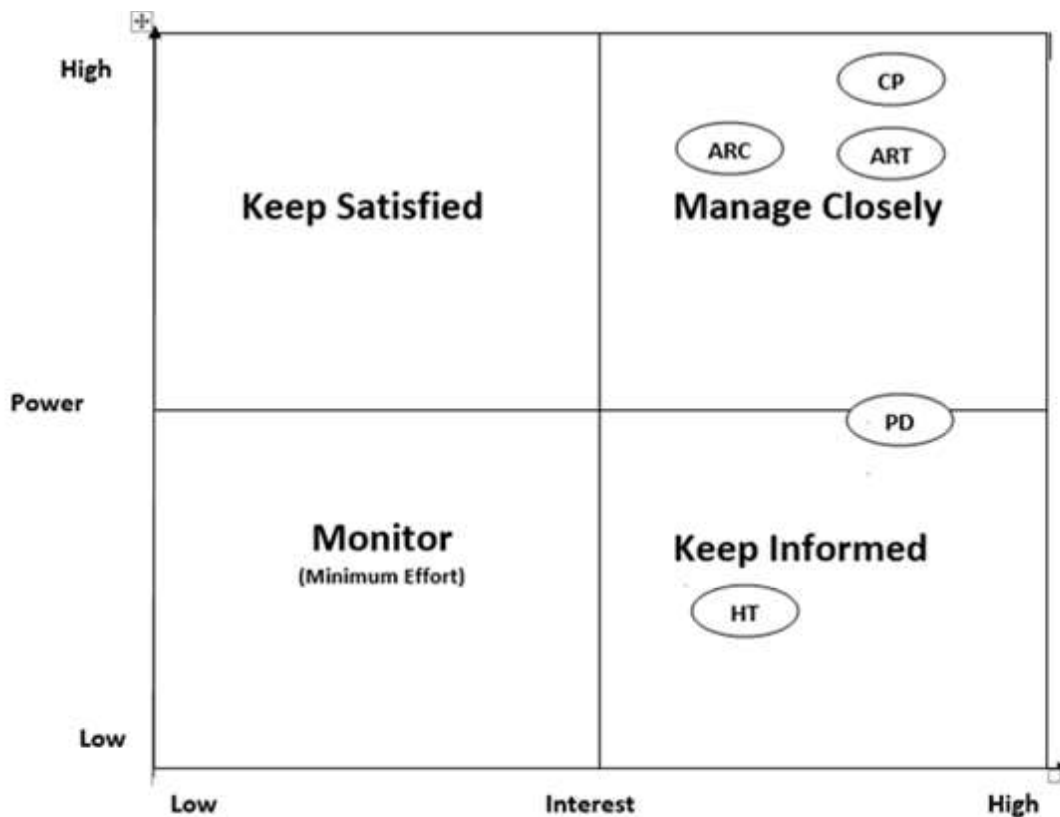


Figure 30: Initial Stakeholder Influence/Interest Grid

## 5.2 SWOT ANALYSIS

Another framework to analyse ReSilence is the SWOT analysis. A SWOT analysis is a strategic planning technique that puts a project, idea, business, or organisation in perspective using the following lenses: Strengths, Weaknesses, Opportunities, and Threats. Using a SWOT analysis helps identify ways that can improve and maximise opportunities, while simultaneously determining negative factors that might hinder chances of success (Peterdy, n.d.).

SWOT analyses can provide valuable insights and strategic guidance to the ReSilence project by assessing the internal and external factors that impact the project and its stakeholders. SWOT analyses are a critical strategic tool that can significantly benefit the ReSilence project in several ways:

- **Strategic Planning:** SWOT analysis helps the project team identify its strengths and weaknesses, enabling them to leverage strengths and address weaknesses in project planning and execution. For example, if the analysis reveals a strength in technical expertise, the project can focus on leveraging this expertise for maximum impact.
- **Risk Mitigation:** By identifying weaknesses and threats, SWOT analysis helps the project team anticipate potential challenges and risks. This allows for proactive risk mitigation strategies to be developed, reducing the likelihood of setbacks during project implementation.
- **Resource Allocation:** SWOT analysis assists in resource allocation decisions. Knowing the project's strengths can help allocate resources effectively, while awareness of weaknesses can guide resource allocation to areas that need improvement.
- **Opportunity Maximisation:** Identifying opportunities through the analysis allows the project to capitalise

on external factors that can benefit the project. For instance, if an opportunity is identified in the form of a growing interest in interactive art, the project can tailor its offerings to align with this trend.

- **Stakeholder Engagement:** SWOT analysis can help in tailoring project activities to meet the needs and expectations of various stakeholders. By understanding the interests and concerns of artists, habitants, people with disabilities, city planners, and architects/interior designers, the project can engage stakeholders more effectively.
- **Decision-Making:** The insights from SWOT analyses provide a basis for informed decision-making throughout the project lifecycle. When faced with choices or challenges, the project team can refer to the SWOT analysis to guide decision-making that aligns with project goals.
- **Adaptation and Flexibility:** SWOT analyses are not static and can be updated as the project progresses and the external environment changes. This allows the project to adapt to evolving conditions and stay responsive to emerging opportunities and threats.
- **Communication and Reporting:** SWOT analyses serve as a clear and concise way to communicate the project's strategic position. They provide a structured format for reporting progress and challenges.

In summary, SWOT analyses are a valuable tool for strategic planning and decision-making in the ReSilence project. They provide a comprehensive view of the project's internal strengths

and weaknesses and external opportunities and threats, enabling the project team to make informed choices and navigate challenges effectively.

### **Strengths**

ReSilence toolkit incorporates collaboration among researchers, developers, artists, accessibility experts, which is essential to create innovative solutions and Artificial Intelligence technologies with a focus on accessibility and inclusivity.

User-centric design is a fundamental strength of the ReSilence toolkit. It places a paramount focus on the needs and preferences of end-users, ensuring that the technologies developed are tailored to address specific accessibility challenges effectively. This approach enhances the overall user experience and usability of the toolkit, making it more intuitive and user-friendly. By prioritizing the user's perspective, the toolkit aims to create solutions that are genuinely impactful and user centric.

The ReSilence toolkit leverages cutting-edge Artificial Intelligence (AI) technologies, which is another notable strength. These advanced AI technologies enable the toolkit to offer a wide range of innovative solutions for accessibility and inclusivity. Whether it's real-time language translation, audio descriptions, or interactive sound environments, the toolkit's reliance on AI enhances its capabilities, providing state-of-the-art solutions for accessibility challenges.

Furthermore, the integration of the ReSilence toolkit into urban planning presents a unique opportunity. It has the potential to optimise urban spatial layouts and improve the construction of barrier-free service facilities. By focusing on sound environments as a core factor affecting security and comfort for visually impaired individuals, the toolkit contributes to creating safer and more accessible urban spaces. This can be particularly impactful in areas with complex soundscapes, such as markets, bus stops, and hospitals, where the equivalent sound pressure level exceeds 65Db, leading to discomfort and a sense of unsafety among visually impaired people.

### **Weaknesses**

One of the weaknesses of the ReSilence toolkit is the presence of technical challenges. The development and implementation of this technology may encounter technical obstacles, including issues related to compatibility with various platforms and devices. These challenges could potentially limit the widespread adoption and use of the toolkit, as users may face difficulties in integrating it into their existing systems or devices.

Another weakness to consider is the need for substantial support and training. To ensure that users and professionals can effectively utilise the toolkit, comprehensive training and ongoing support are essential. Providing such training and support can be resource-intensive and may require a significant investment of time and effort.

User acceptance is a crucial aspect of the toolkit's success, but it can also be a potential weakness. Users and the broader community may take time to adapt to and accept the new technologies offered by the ReSilence toolkit. Overcoming resistance to change and ensuring that users embrace the technology can be challenging.

Additionally, securing adequate funding for the development, maintenance, and expansion of the ReSilence toolkit can be a potential weakness. The toolkit's advancement and sustainability depend on financial resources, and obtaining the necessary funding may be a

continuous challenge, especially in a competitive funding landscape.

### **Opportunities**

According to Madden (2023), professor of Practice in City Futures of Cardiff University, sound should not only be considered as “noise” but as fundamental component of cities and their vibrancy as well; sound can contribute positively to the urban context, as part of the sense of place (e.g. hubbub of cafes), while it complements other senses even during navigation in towns and cities, however, often disregarded especially in culture and design.

Research has shown that vision is considered as the main perceptual channel to access external information; if visual problems arise, human perception of the spatial environment is almost completely lost. However, visually impaired people can feel the characteristics of various urban spaces through the sound environment and this fact seems very important for city planners to optimise the urban spatial layout and improve the construction of urban barrier-free service facilities (Zhang et. al., 2022), since sound seems to be a core factor affecting the security of urban walking space for visually impaired people (Jianxi and Xinren, 2020). ReSilence tools should be considered for application especially in vegetable/open-space markets, bus stops, and hospital spaces, where a more complicated sound environment exists due to the large traffic volume and mixed traffic of people and vehicles (it is estimated that in these places, equivalent sound pressure level exceeds 65Db), causing visual impaired people a strong feeling of discomfort and unsafety, due to lack of sound clarity.

Another opportunity is the fact that several Artificial Intelligence technologies have been developed as assistive devices to people with disabilities; for example, screen readers can interpret the content of web pages and documents, providing audio descriptions or alternative text to make them accessible to individuals with visual impairments. Moreover, Artificial Intelligence translation models can aid individuals with language barriers or hearing impairments with real-time translation technologies enabling effective communication and access to information across languages, as well as accurate captions for videos, making them accessible to individuals with hearing impairments.

Moreover, scientists and experts are working closely on developing policies and technologies in order to face “noisescape” in a context of understanding the pattern, type and intensity of noise, so ReSilence toolkit can move this research one step forward to reduce noise pollution and “exploit” it in a more imaginative way.

### **Threats**

When it comes to digital technology, Artificial Intelligence (AI) systems certainly raise a host of ethical questions about privacy and data protection, especially having in mind that users will come to rely on them as AI products will successfully help in addressing on-the-go problems more and more. Additionally, a threat that the project may face is regarding the deployment of electroencephalography (EEG) technologies that should be carried out with respect for social ethical frameworks.

For the protection of private information about users and confidential data, cybersecurity is crucial; encryption of information, strict controls on access, and regular checks for safety seems necessary. According to Qasim (2023), the key components are user and computer security, response to incidents methods complying with regulations, and cyber threat tracking.

### 5.2.1 Stakeholders SWOT Analysis

The modules for the ReSilence project are presented analytically in the deliverables D5.1 “Roadmap towards the implementation of ReSilence toolkit” and D6.1 “Pilot use cases and initial requirements and challenges”.

These modules are Crawling and Scraping service, Audio to Image techniques, Image to Audio techniques, Tactile Sound, Multilingual Language Analysis Pipeline, Multilingual Natural Language Generation Workbench, EyesWeb platform and libraries, Interactive movement sonification and Self and other whole-body perception and interaction.

The following SWOT analysis offers a detailed overview of the potential impacts, challenges, and opportunities that the ReSilence project's selected modules present for each stakeholder group (Artists, Inhabitants and Visitors/Tourists, People with disabilities (e.g. blind or low vision), City Planners and Architects / Interior Designers).

#### 1. Artists

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Access to innovative modules like Audio to Image and Tactile Sound, expanding creative possibilities.</li> <li>• Potential for groundbreaking artwork through technologies like EyesWeb platform.</li> <li>• Opportunities for diverse artistic expression and sensory experiences.</li> <li>• Avenue for interdisciplinary collaboration and exploration.</li> </ul>	<ul style="list-style-type: none"> <li>• Possible reliance on complex technical tools, potentially limiting spontaneity.</li> <li>• Need for training to master the sophisticated toolkit.</li> <li>• Risk of technological overwhelm, overshadowing artistic intent.</li> <li>• Dependence on the technical maturity of the toolkit for project execution.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Potential to lead in blending art with advanced technology.</li> <li>• Opportunity to attract international attention through innovative projects.</li> <li>• Chance to pioneer in creating multisensory art installations.</li> <li>• Prospect of setting new artistic trends, leveraging the unique toolkit.</li> </ul>	<ul style="list-style-type: none"> <li>• Technical glitches that may hinder artistic expression.</li> <li>• Overcomplexity of the tools, potentially intimidating artists.</li> <li>• Risk of the artwork being overshadowed by the technology.</li> <li>• Possibility of the toolkit not fully aligning with the artists' vision.</li> </ul>

#### 2. Inhabitants and Visitors/Tourists

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Access to enriched urban experiences with interactive installations.</li> <li>• Chance to engage directly with innovative art and technology.</li> </ul>	<ul style="list-style-type: none"> <li>• Potential resistance to the integration of unfamiliar technology.</li> <li>• Possible misunderstanding of the installations' purpose.</li> </ul>

**S+T+ARTS**

<ul style="list-style-type: none"> <li>• Opportunity for immersive experiences in everyday spaces.</li> <li>• Enhanced cultural and aesthetic value of the city.</li> </ul>	<ul style="list-style-type: none"> <li>• Risk of technological exclusivity, alienating non-tech-savvy individuals.</li> <li>• Possibility of sensory overload or discomfort due to new experiences.</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Enrichment of urban life through innovative, interactive spaces.</li> <li>• Educational potential through engagement with art and technology.</li> <li>• Enhancement of city attractiveness for tourists.</li> <li>• Chance for community building around new urban experiences.</li> </ul>	<ul style="list-style-type: none"> <li>• Disruption of the familiar urban environment.</li> <li>• Installation accessibility and inclusivity concerns.</li> <li>• Potential cultural or societal resistance to technological integration.</li> <li>• Risks of vandalism or misuse of the installations.</li> </ul>

**3. People with Disabilities (e.g., blind or low vision)**

<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Inclusive design, improving access to urban experiences.</li> <li>• Potential for novel sensory experiences tailored to their needs.</li> <li>• Opportunity for enhanced social participation and interaction.</li> <li>• Access to multisensory experiences, elevating the quality of urban life.</li> </ul>	<ul style="list-style-type: none"> <li>• Potential barriers due to technological complexity.</li> <li>• Risk of unequal access based on disability type or severity.</li> <li>• Dependence on effective and inclusive design considerations.</li> <li>• Possibility of feeling marginalised if not adequately consulted.</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Chance to actively contribute to the design for inclusivity.</li> <li>• Possibility for increased autonomy in urban navigation.</li> <li>• Opportunity for the disabled community to influence inclusive urban development.</li> <li>• Enhanced awareness and understanding of disabilities through inclusive design.</li> </ul>	<ul style="list-style-type: none"> <li>• Overlooking the specific needs of this group in design and implementation.</li> <li>• Inadequate consultation or feedback mechanisms with the disabled community.</li> <li>• Risk of creating solutions that do not effectively address actual needs.</li> <li>• Potential for the technology to be inaccessible or not user-friendly.</li> </ul>

**4. City Planners**

<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Access to tools for creating sustainable,</li> </ul>	<ul style="list-style-type: none"> <li>• Challenges in integrating new</li> </ul>

<p>engaging urban spaces.</p> <ul style="list-style-type: none"> <li>• Potential to address urban challenges like noise pollution innovatively.</li> <li>• Opportunity to enhance urban aesthetics and functionality.</li> <li>• Capability to integrate cutting-edge technology into urban development.</li> </ul>	<p>technologies into existing urban frameworks.</p> <ul style="list-style-type: none"> <li>• Risk of public resistance to new urban interventions.</li> <li>• Complexity in aligning technological solutions with urban policies.</li> <li>• Potential for increased costs and complexity in urban planning.</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Potential to redefine urban spaces as interactive, dynamic environments.</li> <li>• Chance to lead in sustainable and innovative urban development.</li> <li>• Opportunity for improved urban livability and attractiveness.</li> <li>• Prospect of setting new standards in urban planning and design.</li> </ul>	<ul style="list-style-type: none"> <li>• Technical and logistical complexities in integrating new solutions.</li> <li>• Risk of misalignment with public interests or urban strategy.</li> <li>• Potential for escalating costs and project delays.</li> <li>• Challenges in ensuring the long-term viability and maintenance of the installations.</li> </ul>

## 5. Architects / Interior Designers

<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Opportunity to incorporate unique sensory experiences into designs.</li> <li>• Access to a suite of advanced sound and interaction technologies.</li> <li>• Differentiation in the market through innovative design solutions.</li> <li>• Potential collaboration with artists and technologists for unique projects.</li> </ul>	<ul style="list-style-type: none"> <li>• Need for specialised knowledge for technology integration.</li> <li>• Dependence on the toolkit's reliability and compatibility.</li> <li>• Risk of technological complexity overshadowing design intent.</li> <li>• Potential for increased project costs and complexity.</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Chance to pioneer in multisensory and interactive space design.</li> <li>• Opportunity for market leadership in innovative architectural solutions.</li> <li>• Prospect of creating landmark projects with unique user experiences.</li> <li>• Potential for long-term partnerships with artists and technologists.</li> </ul>	<ul style="list-style-type: none"> <li>• Risk of rapid technological obsolescence in design solutions.</li> <li>• Potential for increased project costs and delays due to technology integration.</li> <li>• Complexity in aligning technological solutions with design aesthetics.</li> <li>• Risk of the technology not meeting the project's long-term needs or vision.</li> </ul>

### 5.2.2 Modules SWOT Analysis

The following SWOT analysis offers a detailed overview of the potential strengths, weaknesses, opportunities, and threats of each selected module for the identified ReSilence project's stakeholders.

As mentioned above the modules are Crawling and Scraping service, Audio to Image techniques, Image to Audio techniques, Tactile Sound, Multilingual Language Analysis Pipeline, Multilingual Natural Language Generation Workbench, EyesWeb platform and libraries, Interactive movement sonification and Self and other whole-body perception and interaction.

#### 1. Crawling and Scraping service

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• <b>Data Accessibility:</b> The Crawling and Scraping service offers easy access to a wealth of data from various online sources, empowering stakeholders to gather valuable information for their respective needs.</li> <li>• <b>Data-Driven Creativity:</b> Artists can harness the tool's data collection capabilities to inspire and inform their creative projects, resulting in data-driven artworks and experiences.</li> <li>• <b>Urban Insights:</b> City Planners can use the service to gather urban data and trends, aiding in evidence-based decision-making for urban development and planning.</li> <li>• <b>Design Research:</b> Architects and Interior Designers can utilise scraped data for design research, gaining insights into architectural trends and user preferences.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Ethical and Legal Concerns:</b> Crawling and scraping data from websites may raise ethical and legal issues related to data privacy and copyright infringement, necessitating careful consideration and compliance.</li> <li>• <b>Technical Challenges:</b> Implementing web scraping requires technical expertise, and maintaining scraping scripts can be complex and resource intensive.</li> <li>• <b>Data Quality:</b> The quality of scraped data may vary, leading to potential inaccuracies and incomplete information, which can affect decision-making.</li> <li>• <b>Dependency on Websites:</b> The tool is dependent on the structure and availability of websites, and changes to website structures may disrupt scraping processes.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• <b>Enhanced Artistic Inspiration:</b> Artists can explore new artistic avenues by incorporating data-driven elements into their work, offering fresh and engaging experiences to audiences.</li> <li>• <b>Informed Urban Planning:</b> City Planners can use scraped data to gain insights into urban trends, enabling data-informed decision-making for urban development and sustainability.</li> <li>• <b>Tourist Insights:</b> Habitants and tourists</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Legal Risks:</b> Non-compliance with data scraping regulations and copyright laws can lead to legal consequences and reputational damage.</li> <li>• <b>Data Security:</b> Handling scraped data requires robust data security measures to protect against data breaches and unauthorised access.</li> <li>• <b>Technological Changes:</b> Rapid changes</li> </ul>

<p>can benefit from information gathered through scraping, such as local events and attractions, enhancing their urban experiences.</p> <ul style="list-style-type: none"> <li>• <b>Design Innovation:</b> Architects and Interior Designers can leverage scraped data to inform innovative and user-centric design choices, creating more appealing and functional spaces.</li> </ul>	<p>in website technologies and anti-scraping measures can render scraping scripts obsolete, requiring continuous adaptation.</p> <ul style="list-style-type: none"> <li>• <b>Data Reliability:</b> Reliance on scraped data may lead to decisions based on potentially unreliable or biased information, impacting project outcomes.</li> </ul>
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## 2. Audio to Image techniques

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• <b>Multisensory Experience:</b> Audio to Image techniques enhance the artistic experience for artists, habitants, and tourists by allowing them to perceive and interact with art through both visual and auditory senses.</li> <li>• <b>Accessibility:</b> For people with disabilities, particularly those with visual impairments, this technology provides an inclusive way to engage with art, making it accessible to a wider audience.</li> <li>• <b>Environmental Enhancement:</b> City Planners and Architects/Interior Designers can utilise audio to image techniques to enhance the auditory and visual ambiance of public spaces, creating more engaging environments.</li> <li>• <b>Creative Freedom:</b> Artists benefit from the creative freedom to experiment with the fusion of audio and visual elements, leading to innovative and immersive art forms.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Complex Integration:</b> Implementing audio to image techniques may require technical expertise and resources, making it a challenging endeavour for some artists and stakeholders.</li> <li>• <b>Compatibility Issues:</b> Ensuring compatibility across various devices and platforms can be a challenge, potentially limiting the reach and accessibility of the art.</li> <li>• <b>Quality Control:</b> Maintaining high-quality audio-visual synchronisation can be challenging, and errors in the conversion process may impact the overall experience.</li> <li>• <b>Perception Variability:</b> Different individuals may perceive audio-visual combinations differently, potentially leading to varied interpretations of the art.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• <b>Enhanced Tourism:</b> Tourists can have a richer cultural experience by engaging with art that combines audio and visual elements, making tourist destinations more attractive.</li> <li>• <b>Inclusive Art:</b> People with disabilities can participate in cultural and artistic activities more inclusively, promoting diversity and accessibility in the arts.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Technical Challenges:</b> Technical issues in audio-visual synchronisation or data handling can disrupt the artistic experience and discourage further adoption.</li> <li>• <b>Cost and Resource Constraints:</b> The implementation and maintenance of audio to image techniques may require significant financial resources, which could be a barrier for</li> </ul>

<ul style="list-style-type: none"> <li>• <b>Urban Planning Innovation:</b> City Planners can use audio to image techniques to revitalise urban spaces, making them more vibrant and engaging for residents and visitors.</li> <li>• <b>Architectural Integration:</b> Architects and Interior Designers can integrate audio-visual elements into their designs, creating immersive and memorable built environments.</li> </ul>	<p>artists and stakeholders with limited budgets.</p> <ul style="list-style-type: none"> <li>• <b>Privacy Concerns:</b> Privacy considerations related to audio capture and image generation may raise concerns among stakeholders and the public.</li> <li>• <b>Artistic Sensitivity:</b> There is a risk of misinterpretation or insensitivity in the use of audio-visual elements, which could have negative cultural or social implications.</li> </ul>
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### 3. Image to Audio techniques

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• <b>Accessibility Enhancement:</b> Image to Audio techniques provide an inclusive way for people with visual impairments to engage with visual content, making art and information accessible to a broader audience.</li> <li>• <b>Creative Versatility:</b> Artists benefit from the ability to transform visual elements into auditory experiences, allowing for innovative and multisensory artistic expressions.</li> <li>• <b>Enhanced Architectural Design:</b> Architects and Interior Designers can incorporate audio-based elements into their designs, creating immersive and memorable environments for inhabitants and visitors.</li> <li>• <b>Educational Value:</b> Image to Audio techniques can be used for educational purposes, enhancing the learning experience by providing audio descriptions of visual content.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Quality Limitations:</b> The accuracy and quality of image-to-audio conversion may vary, impacting the clarity and effectiveness of the auditory representation.</li> <li>• <b>Technical Challenges:</b> Implementing these techniques may require technical expertise and resources, making it challenging for some artists and stakeholders.</li> <li>• <b>Interpretation Variability:</b> Different individuals may interpret audio descriptions of visual content differently, potentially leading to varied understandings of the art or information.</li> <li>• <b>Compatibility Issues:</b> Ensuring compatibility across different devices and platforms can be complex, potentially limiting accessibility.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• <b>Inclusive Art and Information:</b> Image to Audio techniques promote inclusivity by providing access to art and information for individuals with visual impairments, contributing to a more diverse cultural landscape.</li> <li>• <b>Immersive Architectural Experiences:</b> Architects and Interior Designers can create immersive and engaging environments by integrating audio-based elements into their designs.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Technical Issues:</b> Technical challenges related to image recognition, audio generation, or synchronisation may disrupt the quality of the auditory experience, leading to user dissatisfaction.</li> <li>• <b>Cost and Resource Constraints:</b> The implementation and maintenance of image to audio techniques may require significant financial resources, which could be a barrier for artists and stakeholders with limited budgets.</li> </ul>

<ul style="list-style-type: none"> <li>Enhanced Tourism: Tourists and visitors can have enriched experiences by engaging with visual content through audio descriptions, making tourist destinations more appealing.</li> <li>Innovative Art Forms: Artists have the opportunity to explore new forms of artistic expression by combining visual and auditory elements, pushing the boundaries of creativity.</li> </ul>	<ul style="list-style-type: none"> <li>Privacy Concerns: Privacy considerations related to image capture and audio generation may raise concerns among stakeholders and the public.</li> <li>Artistic Sensitivity: There is a risk of misinterpretation or insensitivity in the use of audio descriptions, which could have negative cultural or social implications.</li> </ul>
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#### 4. Tactile Sound

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>Inclusive Experience: Tactile Sound technology enhances inclusivity by providing tactile sensations for sound and music, making it accessible to people with visual or hearing impairments.</li> <li>Multisensory Art: Artists can create multisensory art experiences by integrating tactile sound into their work, appealing to a broader range of senses.</li> <li>Enhanced Urban Planning: City Planners can use tactile sound to enhance public spaces, creating engaging and accessible environments for habitants and tourists.</li> <li>Architectural Innovation: Architects and Interior Designers can incorporate tactile sound elements into their designs, enhancing the sensory experience within buildings and spaces.</li> </ul>	<ul style="list-style-type: none"> <li>Technical Complexity: Implementing tactile sound technology may require technical expertise and specialised equipment, making it challenging for some artists and stakeholders.</li> <li>Cost Considerations: The cost of tactile sound devices and equipment can be a barrier to adoption, especially for artists and organisations with limited budgets.</li> <li>Maintenance Requirements: Ensuring the proper functioning of tactile sound devices may involve maintenance and upkeep, which can be resource intensive.</li> <li>Limited Awareness: There may be limited awareness among the general public about tactile sound technology, potentially impacting its adoption and use.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>Inclusive Art and Entertainment: Tactile Sound technology can expand the reach of inclusive art and entertainment, providing accessible experiences for people with disabilities.</li> <li>Immersive Urban Environments: City Planners can create immersive and engaging urban environments by incorporating tactile sound elements into public spaces.</li> <li>Enhanced Tourism: Tourists and visitors can have unique and memorable experiences in destinations that offer tactile sound-enhanced</li> </ul>	<ul style="list-style-type: none"> <li>Technical Challenges: Technical issues with tactile sound devices or infrastructure may disrupt the sensory experience, affecting the quality of art and entertainment.</li> <li>Cost and Resource Constraints: The cost of implementing and maintaining tactile sound technology may be prohibitive for some artists and stakeholders.</li> <li>Privacy Concerns: Privacy considerations related to the use of tactile sound devices and data may raise concerns among stakeholders and visitors.</li> </ul>

<p>attractions.</p> <ul style="list-style-type: none"> <li>• <b>Sensory Architecture:</b> Architects and Interior Designers can explore innovative architectural designs that incorporate tactile sound, creating more immersive built environments.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Limited Awareness and Adoption:</b> The technology may not gain widespread adoption if there is limited awareness and understanding of its benefits.</li> </ul>
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## 5. Multilingual Language Analysis Pipeline

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• <b>Multilingual Accessibility:</b> The Multilingual Language Analysis Pipeline facilitates multilingual communication and content analysis, making information accessible to diverse audiences, including tourists and habitants.</li> <li>• <b>Enhanced Urban Planning:</b> City Planners can leverage multilingual analysis to better understand the linguistic diversity of their communities and tailor urban development plans accordingly.</li> <li>• <b>Inclusive Design:</b> Architects and Interior Designers can use multilingual analysis to create inclusive spaces that consider the linguistic needs of visitors and habitants.</li> <li>• <b>Cultural Insights:</b> Artists can gain insights into cultural nuances and trends through multilingual analysis, enriching their creative projects.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Complexity:</b> Implementing and managing a Multilingual Language Analysis Pipeline may require technical expertise and resources, posing challenges for some stakeholders.</li> <li>• <b>Data Privacy:</b> Handling multilingual data involves privacy considerations, and mishandling or misuse of data can lead to legal and ethical concerns.</li> <li>• <b>Integration Challenges:</b> Ensuring seamless integration with existing systems and processes can be technically challenging and may require customisation.</li> <li>• <b>Quality Control:</b> Maintaining high-quality multilingual analysis, including accurate translation and sentiment analysis, can be demanding and may impact the reliability of insights.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• <b>Multilingual Cultural Experiences:</b> Artists can create multilingual art experiences that resonate with diverse audiences, enhancing cultural exchange and understanding.</li> <li>• <b>Inclusive Urban Planning:</b> City Planners can use multilingual insights to develop inclusive urban spaces that cater to the linguistic diversity of habitants and visitors.</li> <li>• <b>Enhanced Tourism:</b> Tourists can have more immersive and welcoming experiences in destinations that offer multilingual services and</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Technical Challenges:</b> Technical issues with the Multilingual Language Analysis Pipeline may disrupt multilingual services and impact stakeholder experiences.</li> <li>• <b>Data Security Concerns:</b> Mishandling multilingual data can result in data breaches, privacy violations, and legal consequences, posing a threat to stakeholders.</li> <li>• <b>Cost and Resource Constraints:</b> Implementing and maintaining multilingual analysis systems may require significant</li> </ul>

<p>content.</p> <ul style="list-style-type: none"> <li>• <b>Architectural Inclusivity:</b> Architects and Interior Designers can design spaces that accommodate various languages, making them more inclusive and welcoming.</li> </ul>	<p>financial resources, which could be a barrier for some stakeholders.</p> <ul style="list-style-type: none"> <li>• <b>Misinterpretation:</b> Misinterpretation of multilingual content or sentiments can lead to cultural insensitivity or misunderstandings, affecting stakeholder interactions.</li> </ul>
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## 6. Multilingual Natural Language Generation Workbench

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• <b>Multilingual Content Creation:</b> The Multilingual Natural Language Generation Workbench enables the creation of multilingual content, enhancing communication and engagement with diverse audiences, including tourists and habitants.</li> <li>• <b>Personalisation:</b> Artists can personalise their artistic messages and content in multiple languages, making their work more relatable to a global audience.</li> <li>• <b>Inclusive Urban Information:</b> City Planners can use multilingual content to provide inclusive urban information, ensuring that habitants and visitors of different linguistic backgrounds can access important information.</li> <li>• <b>Architectural Narratives:</b> Architects and Interior Designers can use multilingual narratives to enhance the storytelling aspect of their designs, making spaces more engaging.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Technical Complexity:</b> Implementing and managing a Multilingual Natural Language Generation Workbench may require technical expertise and resources, posing challenges for some stakeholders.</li> <li>• <b>Quality Control:</b> Ensuring accurate and contextually appropriate multilingual content generation can be demanding and may require continuous quality control efforts.</li> <li>• <b>Integration Challenges:</b> Integrating multilingual content seamlessly into various platforms and systems can be technically challenging.</li> <li>• <b>Cultural Sensitivity:</b> Misinterpretation or insensitivity in multilingual content generation can lead to cultural misunderstandings and affect stakeholder interactions.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• <b>Global Art Reach:</b> Artists can expand their reach to global audiences by generating content in multiple languages, fostering international appreciation of their work.</li> <li>• <b>Inclusive Urban Planning:</b> City Planners can communicate urban plans and developments in multiple languages, ensuring inclusivity and understanding among diverse habitants and visitors.</li> <li>• <b>Enhanced Tourism:</b> Tourists and visitors can have more enriching experiences in</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Technical Challenges:</b> Technical issues with the Multilingual Natural Language Generation Workbench may result in errors in multilingual content generation, impacting the quality of communication.</li> <li>• <b>Data Privacy Concerns:</b> Handling multilingual data and content generation may raise privacy and data security concerns among stakeholders.</li> <li>• <b>Cost and Resource Constraints:</b> Implementing and maintaining multilingual</li> </ul>

<p>destinations that offer multilingual content, making travel more accessible and enjoyable.</p> <ul style="list-style-type: none"> <li>• <b>Architectural Storytelling:</b> Architects and Interior Designers can use multilingual narratives to tell the stories behind their designs, creating a deeper connection with users.</li> </ul>	<p>content generation systems may require significant financial resources, which could be a barrier for some stakeholders.</p> <ul style="list-style-type: none"> <li>• <b>Misinterpretation and Language Nuances:</b> Misinterpretation of language nuances in multilingual content generation can lead to misunderstandings and unintended cultural insensitivity, affecting stakeholder relations.</li> </ul>
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## 7. EyesWeb platform and libraries

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• <b>Interactive Multimedia Development:</b> The EyesWeb platform and libraries provide a robust environment for interactive multimedia system development, allowing artists to create engaging and immersive multimedia experiences.</li> <li>• <b>Accessibility Enhancement:</b> People with disabilities can benefit from the accessibility features and assistive technologies integrated into EyesWeb, improving their access to multimedia content.</li> <li>• <b>Enhanced Urban Experiences:</b> City Planners can use EyesWeb to design interactive and engaging urban spaces, enhancing the experience of habitants and tourists.</li> <li>• <b>Architectural Innovation:</b> Architects and Interior Designers can leverage EyesWeb for creating innovative and interactive architectural elements, making spaces more dynamic and engaging.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Technical Complexity:</b> Implementing EyesWeb and utilizing its full capabilities may require technical expertise and resources, making it challenging for some artists and stakeholders.</li> <li>• <b>Cost Considerations:</b> The cost of using EyesWeb and its associated hardware and software components can be a barrier for artists and organisations with limited budgets.</li> <li>• <b>Maintenance Requirements:</b> Ensuring the proper functioning of EyesWeb systems may involve ongoing maintenance, which can be resource intensive.</li> <li>• <b>Learning Curve:</b> Artists and stakeholders may need time to learn and master the intricacies of EyesWeb, potentially delaying project timelines.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• <b>Immersive Art Installations:</b> Artists can create immersive art installations and performances using EyesWeb, providing unique and captivating experiences to audiences.</li> <li>• <b>Inclusive Urban Planning:</b> City Planners</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Technical Challenges:</b> Technical issues with EyesWeb systems, software compatibility, or hardware failures may disrupt the interactive multimedia experience, affecting stakeholder satisfaction.</li> </ul>

<p>can design urban spaces with interactive elements powered by EyesWeb, promoting inclusivity and engagement among habitants and visitors.</p> <ul style="list-style-type: none"> <li>• Enhanced Tourism: Tourists and visitors can have memorable experiences in destinations that incorporate EyesWeb-powered interactive attractions.</li> <li>• Architectural Dynamism: Architects and Interior Designers can introduce dynamic and interactive architectural features using EyesWeb, enhancing the aesthetic appeal of spaces.</li> </ul>	<ul style="list-style-type: none"> <li>• Cost and Resource Constraints: The cost of implementing and maintaining EyesWeb systems can be prohibitive for some artists and stakeholders.</li> <li>• Privacy Concerns: Privacy considerations related to the use of interactive multimedia systems may raise concerns among stakeholders and the public.</li> <li>• Limited Awareness and Adoption: The technology may not gain widespread adoption if there is limited awareness and understanding of its capabilities and benefits.</li> </ul>
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## 8. Interactive movement sonification

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Enhanced Artistic Expression: Interactive movement sonification allows artists to express themselves by translating movement into sound, creating unique and immersive art experiences.</li> <li>• Accessibility and Inclusion: People with disabilities, including those with limited mobility, can participate in and enjoy interactive art installations and performances, promoting inclusivity.</li> <li>• Urban Engagement: City Planners can use movement sonification to design urban spaces that encourage physical interaction and engagement, enhancing habitants' urban experiences.</li> <li>• Innovative Architectural Elements: Architects and Interior Designers can incorporate movement sonification into architectural designs, introducing dynamic and interactive elements to spaces.</li> </ul>	<ul style="list-style-type: none"> <li>• Technical Complexity: Implementing interactive movement sonification systems may require technical expertise and specialised equipment, posing challenges for some artists and stakeholders.</li> <li>• Cost Considerations: The cost of interactive movement sonification technology and hardware can be a barrier to adoption, especially for artists and organisations with limited budgets.</li> <li>• Maintenance Requirements: Ensuring the proper functioning of interactive systems may involve maintenance and upkeep, which can be resource intensive.</li> <li>• Limited Awareness: There may be limited awareness among the general public about movement sonification, potentially impacting its adoption and use.</li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Innovative Art Forms: Artists can explore new and innovative art forms by</li> </ul>	<ul style="list-style-type: none"> <li>• Technical Challenges: Technical issues with movement sonification systems,</li> </ul>

<p>integrating movement sonification into their work, attracting diverse audiences.</p> <ul style="list-style-type: none"> <li>• <b>Inclusive Urban Design:</b> City Planners can design urban spaces with interactive movement sonification elements, fostering inclusivity and community engagement.</li> <li>• <b>Enhanced Tourism:</b> Tourists and visitors can have unique and memorable experiences in destinations that offer movement sonification-enhanced attractions.</li> <li>• <b>Architectural Dynamism:</b> Architects and Interior Designers can introduce dynamic and interactive architectural features using movement sonification, creating more engaging built environments.</li> </ul>	<p>sensor calibration, or software malfunctions may disrupt the interactive experience, affecting stakeholder satisfaction.</p> <ul style="list-style-type: none"> <li>• <b>Cost and Resource Constraints:</b> The cost of implementing and maintaining movement sonification systems can be prohibitive for some artists and stakeholders.</li> <li>• <b>Privacy Concerns:</b> Privacy considerations related to the use of interactive systems and data may raise concerns among stakeholders and the public.</li> <li>• <b>Limited Awareness and Adoption:</b> The technology may not gain widespread adoption if there is limited awareness and understanding of its capabilities and benefits.</li> </ul>
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## 9. Self and other whole-body perception and interaction.

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• <b>Immersive Art Experiences:</b> Self and other whole-body perception and interaction enables artists to create immersive art experiences that engage the entire body, offering unique and memorable encounters.</li> <li>• <b>Inclusivity:</b> The technology can be adapted to accommodate people with disabilities, providing them with inclusive opportunities to engage with art and urban spaces.</li> <li>• <b>Urban Engagement:</b> City Planners can use whole-body interaction to design urban spaces that encourage physical engagement, enhancing habitants' and tourists' experiences.</li> <li>• <b>Architectural Innovation:</b> Architects and Interior Designers can incorporate whole-body interaction into architectural</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Technical Complexity:</b> Implementing self and other whole-body perception and interaction systems may require technical expertise and specialised equipment, posing challenges for some artists and stakeholders.</li> <li>• <b>Cost Considerations:</b> The cost of the technology and hardware required for whole-body interaction can be a barrier to adoption, especially for artists and organisations with limited budgets.</li> <li>• <b>Maintenance Requirements:</b> Ensuring the proper functioning of interactive systems may involve maintenance and upkeep, which can be resource intensive.</li> <li>• <b>Space Limitations:</b> Some urban environments may have space limitations that restrict the deployment</li> </ul>

designs, introducing dynamic and interactive elements to spaces.	of whole-body interaction installations, limiting their accessibility.
Opportunities	Threats
<ul style="list-style-type: none"> <li>• <b>Innovative Art Forms:</b> Artists can explore new and innovative art forms by integrating self and other whole-body perception and interaction into their work, attracting diverse audiences.</li> <li>• <b>Inclusive Urban Design:</b> City Planners can design urban spaces with interactive whole-body elements, fostering inclusivity and community engagement.</li> <li>• <b>Enhanced Tourism:</b> Tourists and visitors can have unique and memorable experiences in destinations that offer whole-body interaction-enhanced attractions.</li> <li>• <b>Architectural Dynamism:</b> Architects and Interior Designers can introduce dynamic and interactive architectural features using whole-body interaction, creating more engaging built environments.</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Technical Challenges:</b> Technical issues with whole-body interaction systems, sensor calibration, or software malfunctions may disrupt the interactive experience, affecting stakeholder satisfaction.</li> <li>• <b>Cost and Resource Constraints:</b> The cost of implementing and maintaining whole-body interaction systems can be prohibitive for some artists and stakeholders.</li> <li>• <b>Privacy Concerns:</b> Privacy considerations related to the use of interactive systems and data may raise concerns among stakeholders and the public.</li> <li>• <b>Limited Awareness and Adoption:</b> The technology may not gain widespread adoption if there is limited awareness and understanding of its capabilities and benefits.</li> </ul>

### 5.3 Current Tools, Trends and Market Requirements

While some of these technologies are available, the ReSilence project likely aims to integrate and further develop these technologies in unique ways to create innovative and immersive multisensory experiences. The uniqueness of ReSilence could lie in the integration, customisation, and application of these technologies to create novel multisensory experiences tailored to the project's specific goals and the needs of the identified stakeholders.

Switzerland-based MindMaze, during 2016, got a \$100 million investment to bring its blend of virtual reality hardware and neuroscience to market, after its approval from regulators in Europe, regarding an application for brain injury victims; by using the MindMaze goggles, a patient who has lost control of his/her left hand due to stroke but can still move his/her right hand, sees a 3-D image, or avatar, of his/her left hand that moves as he/she moves his/her right hand. VR works by tricking the brain into believing what it's seeing is three-dimensional and, often, lifelike, according to vice president of research at information technology research firm Gartner (Taves, 2016).

The BrainPort Vision Pro by Wicab Inc., is an oral electronic vision aid that provides electro-

tactile stimulation to aid profoundly blind patients in orientation, mobility, and object recognition as an adjunctive device to other assistive methods (white cane, guide dog); this technology translates digital information from a wearable video camera into gentle electrical stimulation patterns on the surface of a person's tongue (white pixels from the camera are felt on the tongue as strong stimulation, black pixels as no stimulation, and grey levels as medium levels of stimulation). Users feel moving patterns on their tongue which they learn to interpret as the shape, size, location and motion of objects in their environment (<https://www.wicab.com/brainport-vision-pro>).

The vOICe vision technology, developed by Dr. Peter Meijer, offers the experience of live camera views for the totally blind, through image-to-sound renderings; images are converted into sound by scanning them from left to right while associating elevation with pitch and brightness with loudness. By exploiting the neural plasticity of the human brain, this technology leads to synthetic vision with visual sensations (<https://www.seeingwithsound.com/>). For example, the vOICe for Android, which is available on Google Play and Amazon Appstore, grabs sound snapshot from a camera; each camera snapshot is sounded via a polyphonic left-to-right scan through the snapshot while associating height with pitch and brightness with loudness. The visual sounds encode a visual resolution of up to 176 × 64 pixels while running in landscape mode.

On the other side, similar to “image to audio” techniques, have been used to develop SignAloud, a pair of gloves that can recognise hand gestures that correspond to words and phrases in American sign language; each glove contains sensors that record hand position and movement and send data wirelessly via Bluetooth to a central computer. The computer looks at the gesture data through various sequential statistical regressions, similar to a neural network; if the data match a gesture, then the associated word or phrase is spoken through a speaker (<https://multilingual.com/signaloud-gloves/>).

Microsoft Soundscape app, free on iOS and iPhone in the US and UK, assists people with sight loss to explore the world around them through a 3D audio experience; the technology set beacons at landmarks and then use 3D audio cues, so with a stereo headset, one can perceive sounds coming from the point of interest and build a mental image of what's around from the soundscape (the acoustic environment), in conjunction with navigation or other applications, causing less anxiety to people with sight loss while they are moving (<https://www.microsoft.com/en-us/research/product/soundscape/>).

Additionally, Neosensory company (<https://neosensory.com>), which builds non-invasive brain-machine interfaces to create new senses, has developed a patented wristband that listens to surroundings and provides information to brain via over 4 billion patterns of vibrations on the skin; it converts the incoming sound detected by a microphone into four corresponding vibrations, each in different frequency bands and deaf people use that to first of all detect that there is a sound.

Regarding multilingual technologies, one practical example is live translation, which Samsung plans to launch on its 2024 Galaxy devices (<https://www.zdnet.com>); the translation feature, called AI Live Translate Call, will be integrated into the native call feature, so third-party apps won't be needed. Tourists and visitors will be able to get information about the place they

want to visit, without worrying about whether staff speak the same language as they do; as they speak during a call with someone speaking another language, audio and text translation will appear in real time, as the company declares.

Another tool that is developed, is the new talking and projecting AI Pin from Humane, a start-up backed by investors including OpenAI's Sam Altman (<https://hu.ma.ne/aipin>), a gadget designed for interacting with large language models, not apps, and for talking instead of typing to get real-time translation by just clipping a screenless personal translator and travel assistant to tourists' chest; moreover, the company intends to add navigation and shopping capabilities, though, and plans to give developers ways to build tools of their own.

Hush City is a free, citizen science mobile app, which empowers people to identify and assess quiet areas in cities to create an open-access, web-based map of quiet areas, with the potential of orientating plans and policies for healthier living, in response to issues framed by European environmental policies (e.g. the EC END 49/2002); invented by Dr. Arch. Antonella Radicchi, it was launched in 2017 within the context of a pilot study in Berlin and now is used internationally and available in 5 languages (English, German, Italian, Spanish and Portuguese). Hush City has been adopted by the City Councils of [Berlin](#) and [Limerick](#) within the context of the creation of the Quiet Areas Plans; it runs on both iOS and Android operating systems, while a titanium platform is used as a framework to record and store the data and a LAMP stack is used as a repository (<https://opensourcesoundscapes.org/hush-city/>).

Regarding market requirements and artists, in correlation with tourism sector, according to Díazgranados (2023), music has become a powerful medium of connection especially after the social isolation of the pandemic; the connection between musical events and the increase in flight searches and bookings is evident (e.g. when Coldplay's announced concerts in Greece for 2024, there was a significant impact on flight searches and bookings to Athens). This trend suggests a shift towards unconventional travel experiences, incorporating music and digitalisation at the same time.

Concerning tourists, according to TrekkSoft (<https://www.trekksoft.com>), the largest provider of booking and channel management software to tour and activity providers in Europe, the tourism landscape has been reshaped in recent years, with tour and activity operators tapping into their resilience and creativity, as they navigate the highs and lows of an ever-evolving sector. Artificial Intelligence (AI) is being applied in the tourism sector through various avenues, and its imprint on the market stands out, since implementing AI transformation in tourism occurs on average 16 months faster than transformation with digital technology in general. As Condé Nast Traveler (<https://www.cntraveler.com>) mentions, a wave of new AI-powered features and products aims to support travellers on the ground.

Discussing the tourism trends, AI systems can create content, such as ChatGPT, Jasper, PepperType, and others; these systems can write text, design images, and even compose music. It worth to be mentioned that 40% of US adults are interested in AI powered virtual travel agents (<https://www.business2community.com>), while AI can personalise customer interactions and instant customer service via chatbots, write blog posts, emails, and social media content, or customised tour recommendations based on past behaviors and preferences, resulting to increased sales; according to Forbes (<https://www.forbes.com>),

forecasts and other quantitative assessments of the progress of AI found that business leaders say chatbots have increased sales by 67% on average.

Moreover, digital platforms are revolutionizing customer engagement in the tourism industry, where digitalisation can offer a seamless customer experience, from booking to post-trip reviews; that way, digital transformation helps businesses meet customer expectations, offer customers the convenience and flexibility they demand, and improve operational efficiency (<https://financesonline.com>). After all, even though 58% of smartphone users have admitted that they are trying to limit their device usage, less than 40% succeeded, meaning that using technological offerings can genuinely enhance the customer experience (<https://www.slicktext.com>).

Regarding market requirements and people with disabilities, it is expected that Virtual Reality (VR) will continue to play a part in helping the recovery of those who had a sports injury or even a stroke which resulted to a physical disability, by improving motor skills and enhancing muscle recovery; when a person imagines that he/she does an activity, it is proven that the relevant parts of the brain needed to do that movement, are stimulated (Cahalane, 2017). Additionally, she mentions that technology based on VR, can offer a richer cultural or game experience to deaf persons, by translating sign language into audio or text within an experience, giving the chance to deaf people to connect with speaking people and characters.

On the other side, according to Lighthouse Guild (<https://lighthouseguild.org>), people who are blind or visually impaired, can use their hearing to compensate for vision loss; the ability of the brain to change its activity, it's called "plasticity" and allows a user to — without sight — achieve something close to visual perception through audio feedback.

Concerning interior designers and architects, there are numerous Internet of Things (IoT) opportunities in various industries from tourism to healthcare; Qasim (2023) indicatively mentions things like air conditioning, where hotels are beginning to use IoT-enabled sensors and voice control devices, so visitors and inpatients can easily manage the temperature, lighting, and curtains with an in-room tablet, changing the overall feel of the space and further personalizing their stay.

Follows an analytically assessment of whether similar tools or technologies are already available in the market for each of the specified modules:

### 1. Crawling and Scraping service

Web crawling and scraping services are well-established and widely used in various sectors for data collection and analysis. These services are widely used in various sectors, including market research, data mining, content aggregation, and more. Tools like Scrapy, BeautifulSoup, Selenium and Octoparse are popular in this space.

- Scrapy (<https://scrapy.org/>):

- **Functionality:** An open-source web-crawling framework written in Python. It allows for writing spiders, which are self-contained crawlers that are given a set of instructions.

- Use Cases: Ideal for large-scale data extraction, Scrapy is used in data mining, monitoring, and automated testing.
- Features: Customizable middlewares and extensions, built-in support for extracting data (CSS, XPath), and an interactive shell for testing.
- Beautiful Soup (<https://www.crummy.com/software/BeautifulSoup/>):
  - Functionality: A Python library designed for quick turnaround projects like screen-scraping. It provides Pythonic idioms for navigating, searching, and modifying a parse tree.
  - Use Cases: It's particularly useful for projects where you need to extract data from HTML or XML documents.
  - Features: Parses HTML/XML documents, navigates parse tree or search for elements, and automatically converts incoming documents to Unicode and outgoing documents to UTF-8.
- Selenium (<https://www.selenium.dev/>):
  - Functionality: Primarily used for automating web applications for testing purposes but is also capable of web scraping.
  - Use Cases: It's particularly useful when you need to scrape data from dynamically generated web pages.
  - Features: Supports multiple browsers and languages, provides a record/playback tool for authoring tests without learning a test scripting language.
- Octoparse (<https://www.octoparse.com/>):
  - Functionality: A user-friendly and powerful visual web data extraction tool (web scraper) that turns unstructured or semi-structured data from websites into a structured dataset.
  - Use Cases: Market research, competitor price monitoring, real estate data aggregation, and more.
  - Features: Point-and-click UI, automatic IP rotation to prevent IP bans, cloud-based service (no need for local machines to run the crawlers).

These tools provide a wide range of functionalities, from simple HTML parsing to complex data extraction and browser automation. They are crucial for businesses and researchers who rely on accurate and timely data from the web. Depending on the specific needs of a project, developers can choose the appropriate tool to scrape data efficiently, handle dynamic content, and manage large-scale data extraction tasks.

## 2. Audio to Image techniques

There are technologies that can convert audio waveforms into visual representations. Audio to image techniques involve the conversion of sound waves into visual forms, allowing for the analysis and understanding of audio data through visual means. These techniques are particularly useful in various fields such as music production, sound design, and audio analysis. Spectrograms and Software like Adobe Audition and Audacity can visualise audio in this way.

- Spectrograms (<https://pnsn.org/>):
  - Functionality: A spectrogram is a visual representation of the spectrum of frequencies in a sound or other signal as they vary with time or some other variable. Spectrograms are used extensively in the fields of music, linguistics, sonar, radar, speech processing, seismology, and others.
  - Features: Spectrograms display how the frequencies present in the audio change over time, representing the signal strength (or amplitude) of the frequencies in different colours.
- Software Implementations:
  - a. Adobe Audition ([https://www.adobe.com/gr\\_en/products/audition.html](https://www.adobe.com/gr_en/products/audition.html)):
    - Functionality: A professional audio workstation used for audio editing, mixing, and sound restoration. It's part of the Adobe Creative Cloud.
    - Features: It offers a spectral frequency display, adaptive noise reduction, and a multitrack editing environment. Users can visualise audio frequencies using its spectral view, allowing for precise editing, such as removing unwanted noise or enhancing certain frequencies.
  - b. Audacity (<https://www.audacityteam.org/>):
    - Functionality: A free, open-source, cross-platform audio software. While it's not as feature rich as Adobe Audition, it's widely used for audio editing and recording.
    - Features: Audacity allows users to view spectrograms of audio files, offering various visualisation settings. It's particularly useful for educational purposes, sound analysis, and basic audio editing tasks.

These audio to image techniques and tools serve a critical role in various industries. For musicians and sound engineers, they provide a way to visually identify and manipulate specific aspects of a sound. For researchers and professionals working with speech and environmental sounds, they offer a method to analyse and classify audio data efficiently. The visual representation of sound not only makes certain types of editing and analysis possible but also provides a unique way to understand and interpret audio data.

### 3. Image to Audio techniques

Though less common than audio to image conversion, image to audio techniques offer a distinctive approach by transforming visual elements into auditory experiences, often using pixel data, colour, brightness, or shapes to determine sound characteristics like frequency, amplitude, or timbre. Tools like Adobe Audition, typically used for creating spectrograms from audio, are complemented by advanced machine learning models capable of generating sound based on image analysis. This fusion of visual and auditory data is not only pivotal in experimental and artistic projects, where it offers a novel medium for expression and interaction, but also holds significant promise in developing accessibility tools for the visually impaired, enabling them to “hear” images and thus interact with their environment in a more inclusive manner. Follows a more detailed description at the concept and some instances where these techniques are applied:

- Sonification of Images (<https://sites.google.com/umich.edu/eecs351-project-sonify/home>):

- **Functionality:** This process involves assigning sounds to different visual elements in an image. The sounds can vary based on the colour, intensity, or position of pixels within the image, providing an auditory representation of the visual data.
- **Applications:** It's used in various fields, from helping visually impaired individuals “see” images through sound to creating unique musical compositions based on visual inputs.

- Software and Tools:

- a. Photosounder (<https://photosounder.com/>):

- **Functionality:** A software that offers a unique approach by allowing every pixel and colour of an image to be associated with a specific sound. Users can manipulate both the image and the sound in a cohesive environment.
    - **Features:** It provides tools for detailed sound manipulation based on the visual characteristics of an image, and vice versa, offering a wide range of possibilities for sound synthesis and design.

Image to audio techniques, though less conventional than audio to image, open up a wide array of possibilities for artistic expression, data interpretation, and accessibility. By converting visual data into auditory information, these techniques allow for a different, often more inclusive, way of experiencing and interacting with visual content.

### 4. Tactile Sound

Technologies that convert sound into tactile sensations have been explored, especially for accessibility purposes. Products like wearable haptic feedback devices provide tactile sensations for music or environmental sounds. Devices like haptic suits or vests (e.g., Woojer) are used in gaming and VR to provide immersive experiences.

Tactile sound technologies are designed to bridge the gap between auditory and tactile sensory experiences, creating a richer and more inclusive way to perceive sound. These technologies have gained traction, primarily in two contexts:

- Accessibility and Inclusivity:
  - **Functionality:** Tactile sound technologies aim to enhance accessibility for individuals with visual impairments or hearing impairments by conveying sound information through tactile sensations. This can include vibrations, haptic feedback, or other tactile cues.
  - **Applications:** These technologies are used to help visually impaired individuals “feel” and interpret their surroundings through tactile feedback. For example, a wearable device might convey the proximity of objects or the rhythm of music through vibrations or pressure changes.
- Gaming and Virtual Reality (VR):
  - **Functionality:** In the gaming and VR realms, tactile sound technologies are used to provide immersive experiences by translating in-game or virtual world sounds into physical sensations. These sensations can include vibrations, pulses, or haptic feedback that correspond to in-game events or environmental audio.
  - **Applications:** Gaming peripherals like haptic suits or vests (e.g., Woojer) incorporate multiple tactile feedback points to create a sense of presence and realism. When a player, for instance, experiences an explosion or gunfire in the game, they feel corresponding vibrations or sensations on their body, heightening the gaming experience.

#### Key Examples:

- **Woojer:** Woojer is a notable example of a wearable tactile sound device that provides haptic feedback for audio experiences. It's used in gaming, music, and VR to create a more immersive and sensory-rich experience by allowing users to “feel” the sound (<https://www.wooger.com/>).

- **Functionality:**
  - **Haptic Feedback for Audio:** Woojer is primarily designed to enhance audio experiences by providing haptic feedback. It does so by translating audio signals into vibrations that can be felt by the user, adding a tactile dimension to sound.
  - **Immersion and Sensory Enhancement:** The device aims to create a more immersive and sensory-rich audio experience. When users wear Woojer, they can “feel” the sound, whether it's the deep bass in music, the rumble of explosions in gaming, or the ambiance in VR environments.
  - **Compatibility with Various Sources:** Woojer can be connected to a

variety of audio sources, including smartphones, gaming consoles, music players, and VR headsets. This versatility allows users to incorporate tactile feedback into different forms of entertainment and media consumption.

- Customizable Intensity: Users can often adjust the intensity of the haptic feedback to suit their preferences and the content they are experiencing. This customisation enhances user control over the sensory experience.

○ Features:

- Compact and Wearable: Woojer is designed to be compact and wearable. It can be worn on the body, typically as a chest-mounted or body-worn device. This design ensures that users can carry it comfortably during various activities.
- Multiple Transducers: Woojer devices often feature multiple transducers (vibrating elements) strategically placed to deliver haptic feedback across a range of frequencies. This allows for a nuanced and accurate representation of audio.
- Battery-Powered: Woojer is typically powered by a rechargeable battery, providing users with a portable and wireless solution for tactile sound feedback.
- Cross-Platform Compatibility: Many Woojer models are designed to be compatible with different platforms and audio sources, making it accessible to a broad user base.
- Audio Passthrough: Some Woojer models incorporate audio passthrough functionality, allowing users to simultaneously hear the audio through headphones or speakers while feeling the tactile feedback. This maintains the integrity of the original audio.

○ Applications:

- Gaming: Woojer enhances gaming experiences by adding physical sensations to in-game audio effects. Players can feel the impact of actions, such as gunshots or explosions, creating a more immersive gaming environment.
- Music: In the realm of music, Woojer allows listeners to “feel” the bass and rhythm of music, adding a tactile dimension to the auditory experience. It's used by music enthusiasts and performers for live shows.
- Virtual Reality (VR): Woojer is popular in the VR industry, where it complements visual and auditory stimuli with tactile feedback. Users can feel the vibrations corresponding to virtual interactions, enhancing the sense of presence in VR environments.
- Accessibility: Woojer has potential applications in accessibility by providing individuals with hearing impairments a way to experience

audio content through touch and vibrations.

· Tactile Graphics: In the context of accessibility, tactile sound technologies extend to tactile graphics, where raised patterns and textures on surfaces allow individuals with visual impairments to interpret graphical information, such as maps or images, through touch.

○ Functionality:

- Accessible Information: Tactile graphics aim to make visual information accessible to individuals who are blind or have low vision. They provide a tactile representation of graphical elements, allowing users to interpret the information through touch.
- Raised Patterns and Textures: Tactile graphics use raised patterns, textures, and shapes on a flat surface to represent various elements found in visual graphics, such as maps, diagrams, charts, or images. These raised elements can be felt and explored with the fingers.
- Tactile Discrimination: Users rely on their sense of touch to discriminate between different elements and interpret their meaning. The variations in height, texture, and shape convey information about the graphical content.
- Enhanced Learning and Communication: Tactile graphics facilitate learning and communication for individuals with visual impairments. They are widely used in educational settings to provide access to educational materials and in communication to convey complex ideas.

○ Features:

- Braille Labels: Some tactile graphics incorporate Braille labels to provide additional textual information alongside the tactile representations. Braille labels offer a way to convey detailed information, such as labels on a map or the description of an image.
- Multiple Materials: Tactile graphics can be created using various materials, including paper, plastic, or metal. The choice of material can impact the durability, texture, and clarity of the tactile representations.
- Tactile Printers: Specialised tactile printers or embossers are used to create tactile graphics. These devices convert digital graphics into tactile representations by embossing the raised patterns onto the chosen material.
- Scale and Precision: The scale and precision of tactile graphics are crucial. Detailed and finely crafted representations are essential for conveying complex graphical information accurately.
- Colour and Contrast: While individuals with visual impairments may not perceive colour, colour and contrast can still be used effectively in tactile graphics. Variations in colour and contrast can enhance the differentiation of elements.

○ Applications:

- Education: Tactile graphics are extensively used in educational materials, textbooks, and learning resources. They allow students with visual impairments to access and understand subjects such as geography, mathematics, and science.
- Navigation: Tactile maps are used for orientation and navigation in public spaces. They provide tactile representations of buildings, landmarks, and transportation systems, enabling individuals with visual impairments to navigate independently.
- Accessibility: Tactile graphics are essential for making various forms of information, from museum exhibits to public transportation schedules, accessible to everyone, regardless of their visual abilities.
- Inclusivity: Tactile graphics promote inclusivity by ensuring that individuals with visual impairments can fully participate in activities that involve graphical information, such as exhibitions, presentations, and conferences.

These technologies are at the forefront of enhancing sensory experiences and accessibility, whether by making gaming more immersive or by empowering individuals with sensory impairments to engage with the world in new ways. They demonstrate the potential for technology to bridge gaps and provide a more inclusive and interactive environment for all users.

## 5. Multilingual Language Analysis Pipeline

There are advanced language analysis tools available, especially from major tech companies like Google, IBM, and Microsoft, which offer natural language processing services capable of understanding and analysing multiple languages.

• Google: Google's Cloud Natural Language Processing (<https://cloud.google.com/natural-language>)

### ○ Functionality:

- Multilingual Support: Google's Cloud NLP offers extensive multilingual support, allowing users to analyse text in multiple languages, including those with complex linguistic structures.
- Sentiment Analysis: The service provides sentiment analysis capabilities, enabling businesses to understand the emotional tone of text data, whether it's positive, negative, or neutral.
- Entity Recognition: Google's NLP can identify and extract entities such as names of people, organisations, locations, and more from text, enhancing information retrieval.
- Translation Services: The platform offers translation services, allowing users to translate text from one language to another while preserving context.

### ○ Features:

- Syntax Analysis: It includes syntax analysis to extract grammatical structure and relationships within sentences, offering insights into the linguistic structure of the text.
- Entity Sentiment Analysis: This feature assesses the sentiment associated with specific entities mentioned in the text, providing a more detailed view of sentiment.
- Content Classification: Google's NLP can classify content into predefined categories or custom categories created by users, aiding in content organisation and filtering.
- Custom Entity Recognition: Users can define custom entity recognition models for domain-specific entity identification.

IBM Watson Language Translator  
(<https://www.ibm.com/docs/en/openpages/9.0.0?topic=integrations-watson-language-translator>)

○ Functionality:

- Multilingual Support: IBM Watson Language Translator supports a wide range of languages, making it suitable for global applications.
- Chatbots and Language Translation: It is utilised in chatbots to enable multilingual conversations and offers language translation services for various applications.
- Customisation: Users can customise translation models to align with specific industry terminology and context.

○ Features:

- Domain-Specific Models: IBM Watson provides domain-specific translation models, ensuring accurate and context-aware translations for specialised industries.
- Language Identification: It can automatically detect the language of the input text, eliminating the need to specify the source language explicitly.
- Quality Estimation: Users can assess the quality of translation output, helping ensure accuracy and fluency in translated content.

Microsoft Azure Cognitive (<https://azure.microsoft.com/en-us/products/ai-services>)

○ Functionality:

- Multilingual Support: Azure Cognitive Services offers multilingual support for various NLP tasks, including sentiment analysis, key phrase extraction, and language detection.
- Sentiment Analysis: Users can analyse text data in multiple

languages to determine sentiment, allowing businesses to gauge customer sentiment on a global scale.

- Language Detection: The Text Analytics API can automatically identify the language of input text.

- Features:

- Key Phrase Extraction: It extracts key phrases from text, aiding in summarisation and content understanding.
- Language Detection Confidence Scores: The API provides confidence scores for language detection, helping users assess the reliability of language identification.
- Named Entity Recognition: Azure Cognitive Services can recognise and classify named entities in text, enhancing information extraction and analysis.

These platforms from Google, IBM, and Microsoft offer comprehensive multilingual language analysis solutions, making them valuable tools for businesses, researchers, and developers working with text data from diverse linguistic backgrounds. Their advanced functionalities and features contribute to improved accuracy, context awareness, and user customisation in multilingual NLP tasks.

## 6. Multilingual Natural Language Generation Workbench

There are sophisticated language generation models, which support multiple languages and are capable of generating coherent and contextually relevant text based on the input. Some examples are:

- OpenAI's GPT-3 (<https://openai.com/blog/gpt-3-apps>):

- Functionality:

- Multilingual Support: GPT-3 supports multiple languages, making it a versatile choice for multilingual natural language generation.
- Contextual Generation: GPT-3 excels at understanding and generating text that is contextually relevant, which is crucial for creating coherent and meaningful content.
- Language Translation: It can be used for language translation tasks, allowing for seamless content adaptation between languages.

- Features:

- Custom Prompts: Users can provide prompts or input text to GPT-3, and it generates text based on the context and instructions provided.
- Fine-Tuning: GPT-3 can be fine-tuned for specific tasks or industries, further enhancing its ability to generate specialised content.

- Scaling and Output Control: Users can control the length and style of the generated text, ensuring it aligns with their specific requirements.

• BERT (Bidirectional Encoder Representations from Transformers) (<https://devopedia.org/bert-language-model>):

- Functionality:

- BERT is a transformer-based model developed by Google that excels in understanding the context of words in a sentence. While it is primarily known for its natural language understanding capabilities, it has also been used for NLG tasks, including text completion and summarisation.

- Applications:

- BERT is widely used for search engine optimisation, question-answering systems, and content generation that requires a deep understanding of language context.

- Multilingual Support:

- BERT has multilingual versions that support various languages.

• XLNet (<https://arxiv.org/abs/1906.08237>):

- Functionality:

- XLNet is another transformer-based model that extends the bidirectional context understanding of BERT. It has been employed in NLG tasks, including text generation and language translation.

- Applications:

- XLNet is used for generating high-quality and contextually relevant text, making it suitable for applications such as content creation and chatbots.

- Multilingual Support:

- XLNet has been adapted for multilingual tasks, enabling content generation in multiple languages.

- T5 (Text-to-Text Transfer Transformer) (<https://arxiv.org/abs/1910.10683>):

- Functionality:

- T5 is designed to convert any NLP task into a text-to-text format, making it highly versatile. It can be fine-tuned for various NLG tasks and supports multiple languages.

- Applications:
  - T5 is used for NLG tasks such as text summarisation, translation, and text generation. It is particularly suitable for custom NLG applications.
- Multilingual Support:
  - T5 can be trained and fine-tuned for multilingual text generation tasks.

BART (Bidirectional and Auto-Regressive Transformers) (<https://arxiv.org/pdf/1910.13461.pdf>):

- Functionality:
  - BART is a model that excels in text generation tasks, including summarisation and translation. It can generate coherent and contextually relevant text in multiple languages.
- Applications:
  - BART is employed in NLG applications where high-quality text generation is essential, such as automatic content summarisation and language translation.
- Multilingual Support:
  - BART can be adapted for multilingual content generation.

These models and platforms are at the forefront of NLG technology, enabling businesses and developers to create content that is not only multilingual but also contextually accurate and engaging. They are essential tools for a wide range of applications, from chatbots and automated customer support to content marketing and global communication.

## 7. EyesWeb platform and libraries

EyesWeb, developed by InfoMus Lab, is a platform designed for creating and executing interactive multimedia systems. It's used for research and development in interactive multimedia systems, including dance, music, and therapy ([http://www.infomus.org/eyesweb\\_eng.php](http://www.infomus.org/eyesweb_eng.php)).

- Functionality:
  - Interactive Multimedia Systems: EyesWeb is designed to facilitate the development of interactive multimedia systems. These systems can incorporate a combination of audio, visual, and sensory elements, offering immersive and engaging experiences.
  - Real-time Processing: It excels in real-time data processing, making it suitable for applications where immediate responsiveness is critical,

such as live performances and therapy sessions.

- **Sensor Integration:** EyesWeb allows for the integration of various sensors, cameras, microphones, and other data sources, enabling the capture and analysis of sensory input.
  - **Visual Programming:** It often employs a visual programming approach, where users can create interactive systems by connecting visual elements and defining their behaviour, making it accessible to a wide range of users, including those without extensive programming experience.
- **Applications:**
    - **Dance:** In the realm of dance, EyesWeb is utilised to create interactive choreographies and performances. Dancers' movements and gestures can be tracked and translated into visual effects or soundscapes, enhancing the artistic expression of dance.
    - **Music:** Musicians and composers use EyesWeb to generate music in real-time based on various inputs, such as the movement of performers or audience interaction. This creates dynamic and responsive musical compositions.
    - **Therapy:** In therapy and rehabilitation, EyesWeb assists therapists in designing interactive exercises and interventions that respond to the movements and actions of patients. This can be particularly beneficial in improving motor skills and cognitive functions.
  - **Research and Development:**
    - EyesWeb is a valuable tool for researchers and developers in the field of interactive multimedia. It provides a platform for experimenting with novel ideas, testing theories, and conducting studies related to human-computer interaction and sensory experiences.
    - The platform's flexibility and extensibility make it a preferred choice for prototyping and developing custom multimedia applications.

EyesWeb's contribution to the development of interactive multimedia systems has had a significant impact on various creative and therapeutic fields. Its ability to bridge the gap between technology and artistic expression, as well as its potential in enhancing therapy and rehabilitation, underscores its importance in the world of interactive multimedia research and development.

## 8. Interactive movement sonification

There are systems and research projects that focus on converting movement into sound. This

is often used in performance art, rehabilitation, gaming and Training.

- Performance Art: In dance performances and interactive installations, movement sonification allows artists to create soundscapes that are directly influenced by their movements. This not only adds a layer of immersive sound to the performance but also allows performers to interact with and control the sound through their body movements, essentially turning their gestures into an instrument. Examples:
  - Mi.Mu Gloves (<https://www.mimugloves.com/>): Developed by musician Imogen Heap, these gloves translate hand gestures into musical commands, allowing artists to manipulate sound through movement.
- Functionality:
  - Gesture-Based Music Control: Mi.Mu Gloves are designed to enable gesture-based control of music and sound. They translate hand movements and gestures into musical commands, offering artists and performers a unique way to interact with digital music.
  - Real-time Sound Manipulation: The gloves allow for real-time manipulation of sound and music. As artists wear the gloves, their hand gestures directly affect various aspects of the music, such as pitch, volume, modulation, and effects.
  - Customizable Gestures: Users can often customise and program gestures to control specific musical parameters. This flexibility empowers musicians to create their own unique gestural vocabulary for musical expression.
  - Wireless Connectivity: Mi.Mu Gloves are typically equipped with wireless connectivity options, enabling seamless communication with music production software or hardware. This wireless capability enhances mobility and freedom during performances.
- Features:
  - Multiple Sensors: Mi.Mu Gloves are equipped with a variety of sensors, including accelerometers, gyroscopes, and bend sensors, placed strategically on the gloves. These sensors capture hand movements and orientation.
  - Haptic Feedback: Some iterations of Mi.Mu Gloves include haptic feedback mechanisms that provide tactile sensations to the wearer's hands. This feedback can enhance the sense of connection between the performer and the music.
  - Mapping and Configuration: Users have the ability to map specific gestures and hand movements to control parameters within digital

audio workstations (DAWs) or software synthesizers. This mapping and configuration process allows for a highly personalised and expressive musical experience.

- Integration with Music Software: Mi.Mu Gloves are often designed to seamlessly integrate with popular music production software and platforms, allowing artists to use them as MIDI controllers or instruments within their digital setups.
  - Live Performances: These gloves have gained popularity in live music performances, enabling artists to engage with their audience in a visually captivating way. The gestures and movements of the performer become an integral part of the live show.
  - Accessibility: Beyond artistic expression, Mi.Mu Gloves have the potential for accessibility applications, allowing individuals with physical disabilities to create music and engage with digital audio tools using hand movements.
- Impact:
    - Mi.Mu Gloves have had a significant impact on the music industry by offering a new paradigm for musical expression and live performances. They have been used by renowned musicians and composers to create innovative and immersive musical experiences.
    - The gloves have also contributed to the exploration of the intersection of technology, music, and gesture control, inspiring further research and development in the field of gestural music interfaces.
  - STEIM's Digital Gestures: STEIM (Studio for Electro-Instrumental Music) in Amsterdam had developed various interactive systems where movements and gestures of performers generate and control sounds in real-time (*in 2020 STEIM has stopped its operations, when their [request for funding](#) was denied; they are investigating the possibilities to create an online community site where they can share their archives*).
- Functionality:
    - Real-Time Sound Generation: STEIM's Digital Gestures systems were designed to enable real-time sound generation and control through the movements and gestures of performers. These systems translated physical actions into musical or sonic outputs.
    - Gesture-Based Interaction: Performers used various physical gestures, such as hand movements, body motion, or even specific touch interactions, to interact with the digital systems. These gestures became the interface for shaping and controlling sound.

- Sound Processing and Manipulation: The systems often included extensive sound processing and manipulation capabilities. This allowed performers to not only trigger sounds but also sculpt and modify them in real-time, creating dynamic and evolving sonic textures.
- Customisation: Performers could often customise the mapping of gestures to sound parameters. This flexibility allowed for the creation of unique gestural vocabularies and personalised interactions with the digital systems.
- Features:
  - Sensor Technology: STEIM's Digital Gestures systems incorporated a variety of sensors and technologies, including accelerometers, gyroscopes, touch sensors, and infrared sensors. These sensors captured performers' movements and interactions with precision.
  - Gesture Recognition: Advanced algorithms and software were employed to recognise and interpret performers' gestures accurately. This recognition process was essential for mapping gestures to specific sound actions effectively.
  - MIDI Integration: Many of these systems were designed to integrate with MIDI (Musical Instrument Digital Interface) controllers and software. This allowed for seamless communication with digital audio workstations (DAWs) and synthesizers.
  - Multi-Modality: Some systems combined multiple modes of interaction, such as physical gestures, touch-sensitive surfaces, and even proximity sensing. This multi-modality expanded the range of expressive possibilities for performers.
  - Visual Feedback: Visual feedback interfaces were often provided to performers. These interfaces could display the relationship between gestures and sound in real-time, aiding performers in understanding the impact of their actions.
  - Live Performances: STEIM's Digital Gestures systems were frequently used in live music performances, installations, and multimedia productions. They contributed to the creation of immersive and visually engaging sonic experiences.
  - Interdisciplinary Collaboration: STEIM fostered interdisciplinary collaboration between musicians, composers, sound artists, and technologists. This collaborative approach encouraged the development of innovative and experimental musical interfaces.

- Impact:
  - STEIM's Digital Gestures systems have had a significant impact on the field of electronic and experimental music. They have provided artists with tools to explore new sonic territories and push the boundaries of live performance.
  - These systems have contributed to the exploration of gestural interfaces and the integration of technology with traditional musical practices, opening new avenues for artistic expression and sonic experimentation.
- Rehabilitation and Therapy: Movement sonification is used in physical therapy and rehabilitation to provide auditory feedback to patients. For instance, when a patient performs a physical exercise correctly, the system can produce a pleasant sound, offering immediate feedback and motivation. This is particularly useful in motor rehabilitation, helping patients regain movement in limbs with audio cues to guide and encourage correct motion patterns. Examples:
  - Sonification in Stroke Rehabilitation: Research projects like "Sound of Motion" use sonification to provide auditory feedback for stroke patients. It helps in the rehabilitation of motor functions by encouraging specific movements through sound cues.
  - Interactive Sonification for Gait Rehabilitation: Systems have been developed that provide real-time auditory feedback based on the analysis of foot pressure and gait, helping patients improve their walking patterns.
- Gaming and Interactive Systems: In gaming, movement sonification enhances the user experience by providing auditory feedback corresponding to physical actions, making the gameplay more immersive. In interactive systems, such as educational tools or fitness programs, it can make the experience more engaging and informative, providing users with real-time auditory feedback that corresponds to their movements. Examples:
  - Nintendo Wii (<https://www.nintendo.co.uk/Wii/Wii-94559.html>): The Wii console uses motion-sensing technology to provide an immersive gaming experience. The sound in games often corresponds to the movements of the player, enhancing the interactive experience.
  - Functionality:
    - Motion-Sensing Technology: The Nintendo Wii console is equipped with motion-sensing technology through its wireless motion controllers, known as the Wii Remote (or Wiimote). These controllers contain accelerometers and infrared sensors that detect movements and positions in three-dimensional space.

- Immersive Gaming: The primary functionality of motion-sensing technology in the Wii is to translate real-world movements into in-game actions. Players can swing, point, and gesture with the Wii Remote to control characters and interact with the game environment.
- Sound Integration: Sound in Wii games is closely integrated with the player's movements. When players perform actions like swinging a virtual tennis racket or bowling a ball, the sound effects correspond to these movements. For example, the sound of a tennis ball hitting the racket aligns with the player's swing.
- Feedback and Audiovisual Synchronisation: The sound effects are synchronised with the player's actions, providing immediate feedback. This synchronisation enhances the sense of immersion by making the game world respond audibly to the player's gestures.
- Features:
  - Dynamic Sound Effects: Wii games often feature dynamic sound effects that change in response to the intensity and speed of the player's movements. For example, the sound of a sword swing in a sword-fighting game may vary based on the force applied by the player.
  - Spatial Audio: The Wii console supports spatial audio, allowing players to perceive sound sources from different directions. This adds to the immersive experience, as players can hear objects or enemies approaching from specific directions.
  - Wireless Audio: Players can use wireless audio devices, such as Bluetooth headsets or speakers, to enhance their gaming experience. This allows for a more immersive and customizable audio experience.
  - Voice Chat: Some Wii games support voice chat, enabling players to communicate with each other during multiplayer gaming sessions. Voice chat adds a social and collaborative dimension to the gaming experience.
- Impact:
  - The Nintendo Wii revolutionised gaming by introducing motion-sensing technology to a mainstream audience. It made gaming more physically engaging and accessible to players of all ages.
  - The integration of sound with motion in Wii games created a unique and immersive gaming experience. Players felt like their actions had a direct impact on the in-game world, enhancing their sense of agency and enjoyment.

- The success of the Nintendo Wii paved the way for further developments in motion control gaming and influenced other gaming platforms to explore similar technologies.
- Virtual Reality Systems: VR platforms like Oculus Rift and HTC Vive use movement sonification to increase immersion. Actions performed by the user in the virtual space are often accompanied by corresponding sounds, enhancing the realism of the experience.
  - Oculus Rift (<https://www.oculus.com/rift-s/>):
    - Functionality:
      - Immersive VR Experience: The Oculus Rift is designed to provide users with an immersive virtual reality experience. It accomplishes this through a combination of high-resolution displays and precise head tracking. Users feel as though they are inside a virtual world.
      - Head Tracking: The Rift uses sensors and infrared LEDs to track the movements of the user's head with exceptional accuracy. This tracking ensures that the virtual environment responds to the user's head movements in real-time, enhancing the sense of presence.
      - Motion Controllers: Some versions of the Oculus Rift come with motion controllers that enable users to interact with virtual objects and environments. These controllers provide haptic feedback for a more tactile experience.
      - Spatial Audio: Oculus Rift features spatial audio technology, which means that sound sources in the virtual environment are positioned in 3D space. Users can locate and identify sounds based on their direction and distance.
      - PC Connectivity: Oculus Rift connects to a high-end gaming PC to deliver a premium VR experience. This connectivity allows for graphically intensive VR applications and games.
    - Features:
      - High-Resolution Displays: Oculus Rift typically features high-resolution OLED displays that provide clear and sharp visuals, reducing the screen door effect that can be present in lower-resolution headsets.
      - Ergonomic Design: The headset is designed for comfort, with adjustable straps and cushioning. It's lightweight and balanced to reduce strain during extended VR sessions.
      - Content Library: Oculus has a vast library of VR content available

through the Oculus Store, including games, experiences, and applications. Some content is exclusive to Oculus platforms.

- Room-Scale VR: With the addition of extra sensors, Oculus Rift supports room-scale VR experiences, allowing users to move around in physical space while interacting with the virtual world.
  - Cross-Platform Compatibility: Oculus Rift can be used with various VR platforms and can run some VR content from sources outside the Oculus ecosystem.
- HTC Vive (<https://www.vive.com/us/>):
    - Functionality:
      - Room-Scale VR: HTC Vive was one of the pioneers of room-scale VR, allowing users to move freely within a defined physical space while wearing the headset. Multiple sensors track the headset and controllers, providing precise spatial awareness.
      - Motion Controllers: HTC Vive includes motion controllers that offer 6-degree-of-freedom tracking. These controllers enable natural and interactive interactions within VR environments.
      - Precise Tracking: The HTC Vive system relies on external base stations that emit infrared signals to track the headset and controllers with high precision. This tracking technology minimises latency and enhances the overall VR experience.
      - Front-Facing Camera: Some HTC Vive models feature a front-facing camera that allows users to see their real-world surroundings without removing the headset. This is useful for avoiding obstacles and interacting with the physical environment.
    - Features:
      - High-Quality Visuals: HTC Vive typically offers high-resolution displays with low persistence, reducing motion blur and improving visual clarity. The headset's optics are designed to minimise distortion.
      - Viveport Store: HTC Vive has its own content platform called Viveport, which offers a wide range of VR experiences, games, and applications.
      - Collaborative VR: HTC Vive has been used for collaborative and social VR experiences, where users from different locations can meet and interact in virtual spaces.

- Enterprise Solutions: HTC Vive has ventured into the enterprise market with solutions for training, simulations, and professional applications. This includes specialised software and hardware for business use.
- Learning and Training: In sports and physical training, movement sonification can provide athletes with immediate auditory feedback on their performance. For instance, a change in sound can indicate the accuracy of a golf swing or the form of a yoga pose. This immediate feedback can accelerate learning and help in perfecting techniques. Examples:
  - Sports Training: Technologies like “MotionMatch” use movement sonification to provide feedback to athletes. For example, the sound of a swoosh in a perfect tennis serve or the sound of wind during a well-executed ski slalom can provide instant feedback to the performer (<https://info.wondercise.com/>).
  - Dance Education: Systems like “Sound of Movement” are used in dance schools where dancers' movements are captured and translated into sound, providing immediate auditory feedback that can help in understanding and improving dance movements.

## 9. Self and other whole-body perception and interaction

Technologies for body perception and interaction are pivotal in a range of fields such as virtual reality, gaming, and interactive art installations. Tools like Microsoft Kinect are renowned for body tracking and facilitating interactive installations. Moreover, the domain of whole-body interaction has seen significant advancements, particularly in VR and gaming contexts. Systems that combine VR headsets with sophisticated tracking systems, such as the Oculus Rift and HTC Vive, offer immersive experiences by enabling detailed whole-body interactions. These technologies collectively underscore the growing integration of physical movement with digital environments, enhancing user engagement and offering more natural, intuitive ways to interact with virtual spaces.

- Microsoft Kinect (<https://learn.microsoft.com/en-us/windows/apps/design/devices/kinect-for-windows>): Kinect is a notable example of a body tracking technology that gained prominence in gaming and interactive installations. It tracks body movements and gestures without the need for controllers.
  - Functionality:
    - Body Tracking: Kinect is designed to track the movements and gestures of the human body. It uses depth-sensing technology, including an infrared sensor and a colour camera, to capture the positions of a user's joints and create a skeletal representation in real-time.

- Gesture Recognition: One of its standout features is its ability to recognise specific gestures made by users. This allows for intuitive control of games and interactive applications without the need for traditional controllers.
- Voice Recognition: Kinect is often equipped with a microphone array for voice recognition. Users can issue voice commands, enhancing the overall interactivity and control options.
- Depth Sensing: Kinect's depth-sensing capabilities enable it to perceive the 3D structure of the environment, making it possible to distinguish between objects and users. This is crucial for immersive experiences and accurate tracking.
- Real-time Processing: It excels in real-time data processing, ensuring low latency between user movements and on-screen responses.
- Features:
  - Full-Body Tracking: Kinect provides full-body tracking, capturing the positions and movements of the head, shoulders, arms, hands, hips, legs, and feet. This comprehensive tracking enables users to engage with digital content using their entire body.
  - Facial Recognition: In some iterations, Kinect incorporates facial recognition technology, allowing it to identify and track facial features, further enhancing the interactivity and personalisation of experiences.
  - Multi-User Support: Kinect is capable of tracking multiple users simultaneously, making it suitable for multiplayer gaming and collaborative interactive installations.
  - Development Tools: Microsoft provides development kits and software tools for developers to create Kinect-powered applications, games, and experiences. This has fostered a vibrant developer community.
  - Integration with Gaming Consoles: Kinect is often integrated with gaming consoles like Xbox, enabling a seamless and user-friendly gaming experience. It has been utilised in a wide range of games, from sports simulations to dance and fitness titles.
  - Interactive Installations: Beyond gaming, Kinect has found applications in interactive art installations, museums, education, and healthcare. It offers a novel way for users to engage with digital content in physical spaces.
  - Accessibility: Kinect has been praised for its potential in accessibility

applications, assisting individuals with mobility challenges in controlling digital devices and interfaces.

- VR Headsets with Tracking Systems: VR headsets like Oculus Rift and HTC Vive are equipped with advanced tracking systems that allow for precise tracking of head movements and, in some cases, full-body tracking. This enhances the realism of VR experiences.
- Motion Capture Systems: In the context of animation and filmmaking, motion capture systems use similar principles to capture and translate real-world movements into digital characters or animations. Some examples of motion capture systems are:
  - Vicon (<https://www.vicon.com/>): Vicon is a well-known provider of motion capture technology. Their systems use high-resolution cameras to track the movement of reflective markers placed on actors or objects. Vicon systems are commonly used in the film and video game industry for character animation and special effects.
  - OptiTrack (<https://optitrack.com/>): OptiTrack offers motion capture solutions for various industries, including entertainment, virtual reality, and biomechanics. Their systems use high-speed cameras and markers to capture precise movement data. OptiTrack technology has been used in films, video games, and scientific research.
  - Xsens (<https://www.movella.com/products/xsens>): Xsens specialises in inertial motion capture technology. They offer wearable motion capture suits that use sensors to track the movement of the body. Xsens suits are used in animation, sports analysis, and healthcare applications.
  - Rokoko (<https://www.rokoko.com/>): Rokoko provides motion capture solutions, including affordable markerless motion capture systems. Their technology is used by independent filmmakers, game developers, and animators to create character animations.
  - Qualisys (<https://www.qualisys.com/>): Qualisys offers high-precision motion capture systems that use cameras and markers to track movement. Their systems are used in various fields, including sports analysis, biomechanics research, and entertainment.
  - Synertial (<https://www.synertial.com/>): Synertial specializes in inertial motion capture technology and provides full-body motion capture suits. Their solutions are used in animation, VR development, and biomechanics research.
  - PhaseSpace (<https://www.phasespace.com/>): PhaseSpace provides motion capture systems with active LED markers. These systems are used in animation, research, and game development.

These motion capture systems vary in terms of technology, accuracy, and cost, allowing users

to choose the one that best suits their specific needs. They play a crucial role in bringing realistic and natural movement to digital characters and animations in various media and industries.

## 5.4 Exploitable Results

The following section describes the initially identified exploitable results from the technological development. This section focuses on the digital assets created during the project and identifies the knowledge needed to exploit them. We plan to also exploit the know-how created during the project, although this will be identified and recorded in the future iterations of this deliverable.

### Overview of Developed Tools and Technologies

The ReSilence project has given rise to an array of innovative tools and technologies, each designed to address specific accessibility challenges and enhance the overall quality of life for stakeholders. These tools encompass a broad spectrum, including but not limited to:

- **Crawling and Scraping Service:** A versatile data collection and analysis tool widely applicable in various sectors.
- **Audio to Image Techniques:** Capable of converting audio waveforms into visual representations, enabling novel ways of perceiving sound.
- **Image to Audio Techniques:** Experimental tools for transforming images into sound, offering innovative artistic and accessibility solutions.
- **Tactile Sound:** Technologies that convert sound into tactile sensations, facilitating accessibility for individuals with visual impairments.
- **Multilingual Language Analysis Pipeline:** Advanced language analysis tools capable of understanding and analysing multiple languages.
- **Multilingual Natural Language Generation Workbench:** Utilizing sophisticated language generation models for contextually relevant text generation in multiple languages.
- **EyesWeb Platform and Libraries:** A platform for developing interactive multimedia systems, with applications in dance, music, and therapy.
- **Interactive Movement Sonification:** Systems for converting movement into sound, contributing to performance art, rehabilitation, and gaming.
- **Self and Other Whole-Body Perception and Interaction:** Technologies pivotal in virtual reality, gaming, and interactive art installations.

### Accessibility Impact

Central to the ReSilence project is the commitment to improving accessibility for individuals with disabilities. The tools and technologies have the capacity to transform lives by making urban environments more navigable, information more accessible, and artistic expressions more inclusive. The impact of these tools extends to individuals with various disabilities, including visual and hearing impairments, as well as those with mobility challenges.

## **Integration into Urban Planning**

The ReSilence toolkit is not limited to individual tools; it also extends its reach into urban planning. By optimizing sound environments and addressing the needs of visually impaired individuals, the toolkit contributes to the creation of safer and more accessible urban spaces. Notably, areas with complex soundscapes, such as vegetable/open-space markets, bus stops, and hospitals, stand to benefit significantly from the integration of these tools.

## **Collaborative Opportunities**

Collaborative opportunities abound for organisations, institutions, and businesses interested in leveraging the ReSilence project's results. Partnerships and collaborations can play a pivotal role in furthering the goals of accessibility and inclusivity.

## **Intellectual Property Considerations**

The exploitable results may encompass intellectual property considerations such as patents, copyrights, or licensing agreements. Ensuring the protection of intellectual property is crucial to maintain the integrity of these results and enable their responsible utilisation.

## **5.5 Roadmap to exploitation**

For successful exploitation of the ReSilence, in the upcoming months, based on the market analysis and the exploitable components, various business models will be developed. Several collaboration possibilities will be evaluated between partners to successfully exploit the result of the project.

### **5.5.1 Exploitation Models**

The first major objective in the upcoming months for the ReSilence exploitation planning, will be development of Business Model Canvas for various stakeholders. Business Model Canvas (BMC) is a strategic planning tool, used by managers to illustrate and develop their business model. The Business Model Canvas template clearly identifies the key elements that make up a business. Additionally, it simplifies a business plan into a condensed form; in this way, the Business Model Canvas template acts like an executive summary for a business plan (Corporate Finance Institute, n.d.). It consists of various columns and rows which help identify different aspects for a business scenario. Figure 31 represents a sample Business Model Canvas which will be filled in for each component and for different business models based on different value propositions.

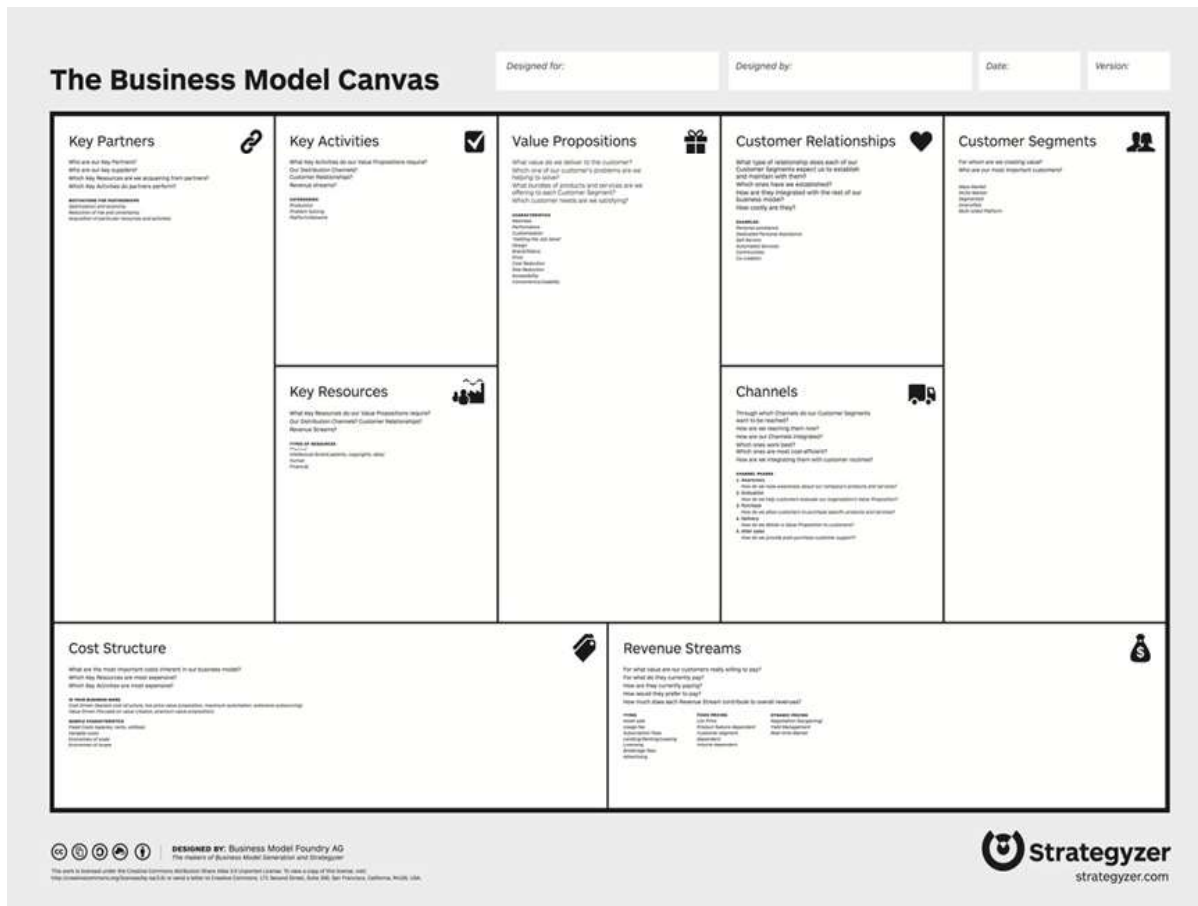


Figure 31: Business Model Canvas

A Business Model Canvas (BMC) consists of 9 different sections, which are:

- **Customer Segment:** This section of the BMC will identify various customer segments that can be targeted, as well as those for whom value is created through business.
- **Value Proposition:** This is the most important section in the BMC and usually the starting point for the completion of the BMC. It highlights what value the business model will provide to customers, stakeholders and parties involved in the development of the business.
- **Channels:** This section should define various channels that will be used to reach the customers and engage with them; it should also highlight the best channel to raise awareness in relevant communities of customers.
- **Customer Relationships:** This section should highlight what kind of relationships will be developed with the customers (direct, indirect) and how in the planning these relationships are managed.
- **Key Activities:** This section describes the key activities that will happen in the business model to successfully develop the value proposition identified.
- **Key Resources:** This section highlights the key resources (physical, intellectual, financial, human) that are required to fulfil the value proposition of the business model.

- Key Partners: This section describes various key suppliers/buyers or partners for the business model which help in securing resources of services for the success of the business model.
- Revenue Streams: This section of the business model will determine the revenue streams from the customers identified and what are the customers willing to pay for the value generated.
- Cost Structure: This section of the business model canvas identifies various costs that need to be kept in mind from the starting that will incur and how they change during the runtime of the business.

Business Model Canvas gives a competitive edge to launch a profitable business not only through product innovation but also through correct design; it is useful for easy communication with team members, investors, partners as well as employees, providing a transparent reference, while it can easily get modified as a project goes along. Moreover, it can help the project team with the execution steps requirement to bring its ideas to market. Finally, since BMC is focused on value proposition, it guides the rest of the business model and how people should approach each section.

This is the reason why Value Proposition Canvas is planned to be used as an exploitation model as well. According to Osterwalder et. Al (2014) is a framework which can help ensure that a product or service is positioned around what the customer values and needs; it is a detailed tool for modelling the relationship between the two parts of Business Model Canvas, customer segments and value propositions. The Value Proposition Canvas is built on a strong base of thorough customer research and provides a clear sense of what it is the customers want; therefore, if it's done right, the application of this method ensures that partners do something that responds to a genuine problem the customer has. An additional step is to investigate the extent to which a project team has a competitive advantage, to ensure that the value proposition is unique and sufficiently differentiated.

Figure 32, the Value Proposition Canvas has 2 main sections with a total of 6 sub-sections:

- Customer Segment side:
  - Gains: the gains for the customer segment that project can provide.
  - Pains: the pains of the customers that the project can solve.
  - Customer jobs: the jobs of the customer.
- Value Proposition side:
  - Products and Services: all the products and services for a customer segment.
  - Gain creators: all the gain creators for the users, meaning the part of the product that will create gain to the users.
  - Pain relievers: all the pain relievers for the users.

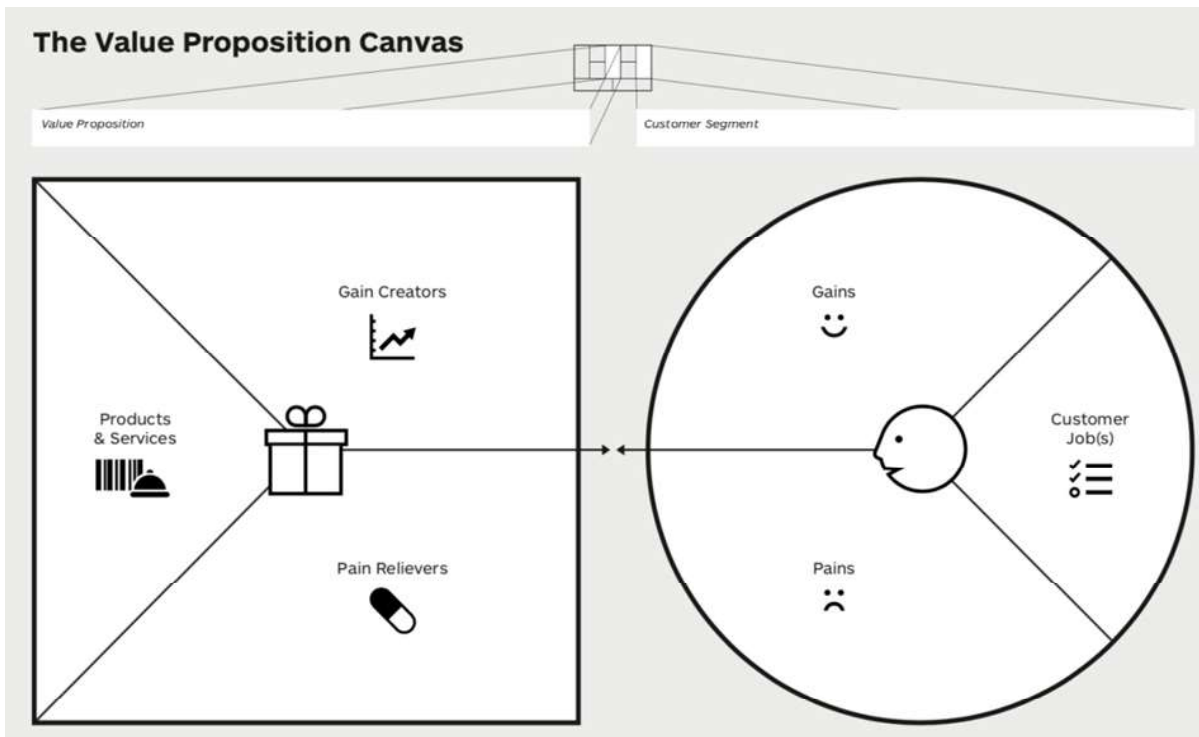


Figure 32: Value Proposition Canvas

## 6. CONCLUSIONS

In this deliverable the dissemination principles, strategies and plan and material of ReSilence were presented accompanied by dissemination activities realised during the first sixteen months of the project as well as the dissemination actions planned for the immediate future. The project website and social media accounts will support the ReSilence contact with the surrounding research, artists, creatives, and technology experts in the field. Its success relies on the quality of the content and that it is constantly updated. It is therefore necessary to continuously provide status updates on the project's progress but also news and current topics discussed in the community. Even though it will be only one of the several tools to inform people about ReSilence, the website will play a very important role in disseminating the project's news.

Additionally, this deliverable outlines the initial analysis of the market requirements and the tools that exist, relevant for the exploitation of the ReSilence project. It provides a detailed elaboration of the stakeholder analysis and outlines the initially identified stakeholders along with their importance, highlighting strengths and weaknesses, both of each stakeholder and each module that the ReSilence toolkit includes. This will help in developing a future strategy for business models in compliance with legal and ethical aspects for the exploitation of components individually and within partnerships.

It is evident that sound-producing activities contribute to the vitality of cities, including tourism, transportation, festivals, and other cultural events. In this scope sound is reframed as a resource, shifting the field of environmental noise into one intersectoral field, where "city-makers" collaborate with stakeholders (local communities, artists, etc.), in order to shape the memories of places. Such an approach perceives soundscape as an opportunity that reshapes everyday life by optimising the urban spatial layout in several aspects such as urban mobility, concert settings and urban soundscapes amongst others.

By leveraging the ReSilence toolkit, more inclusive spatial sound experiences can be created, accessible to all individuals. Thus, it is crucial to ensure that modules are being developed with a focus on accessibility, inclusivity, and a deep understanding of the diverse needs of the ReSilence stakeholders, incorporating collaboration among researchers, artists, developers, and experts during the project's outcomes exploitation.

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