

**S+T+ARTS**  
in the City

**LEGACIES OF  
TRANSDISCIPLINARY  
COLLABORATIONS**

**A PRACTICE BASED ANALYSIS  
OF THE S+T+ARTS IN THE CITY  
RESIDENCIES PROGRAMME**



Co-funded by  
the European Union

In the framework of:



With the support of:



### **Credits**

**Authors: Ona Anglada, Pau Alsina and Elisenda Ardèvol (UOC), Tere Badia and Anna Pinotti (HacTe)**

**Reviewers: Aurélie Delater (GLUON) and Alba Colombo (UOC)**

**Layout: MEET Digital Culture Centre**

For more information on this report please contact: [projectes@hactebcn.org](mailto:projectes@hactebcn.org)

Barcelona, October 2024

[www.starts.eu](http://www.starts.eu)

S+T+ARTS in the City is funded by the European Union under grant agreement LC-01984766 under the S+T+ARTS – Science, Technology and Arts initiative of DG CNECT. Views and opinions expressed are those of the author(s) only and do not necessarily reflect those of the European Union or DG CNECT. Neither the European Union nor the granting authority can be held responsible for them.

## TABLE OF CONTENTS

1. EXECUTIVE SUMMARY	3
2. RESIDENCIES PROGRAMME	6
3. MEASUREMENT IMPACT PLAN	7
3.1. Key Performance Indicators	7
3.1.1. Dimensions	8
3.1.2. Aspects	8
3.1.3. Stakeholder Perspectives	9
3.1.4. Analytical framework	9
3.2. Methodology	10
3.2.1. Quantitative data	10
3.2.2. Qualitative data	10
4. QUANTITATIVE ANALYSIS	12
4.1. Quantitative analysis research question	12
4.2. Quantitative KPI definition	13
4.4. A knowledge ecosystem for creativity and innovation	15
4.5. Public engagement opportunities	17
5. QUALITATIVE ANALYSIS	18
5.1. Qualitative analysis research questions	18
5.2. Qualitative KPI definition	19
5.3. The dynamics of interdisciplinary collaboration	23
5.3.1. Cooperation between the stakeholders	23
5.3.2. Innovation and interdisciplinary collaboration	26
5.4. Delving into the Residency Challenge	29
5.4.1. Synergistic Impacts	29
5.4.2. Encompassing the residency journey	33
5.5. Long-term Sustainability and community impact	35
5.5.1. Legacy by actors and dimensions	35
5.5.2. Legacy and community engagement	37
5.6. Stakeholders feedback	39
5.6.1. Learnings by actors	39
5.6.2. Good practices and actionable insights	41
6. CONCLUSIONS AND WAY FORWARD	44
6.1. From KPI to KTI	45
6.2. Enhancing collaboration	47
6.3. Improving S+T+ARTS	51

## **I. EXECUTIVE SUMMARY**

The current report presents the main findings of the assessment plan implemented within the S+T+ARTS in the City residency programme, a set of 11 artistic residencies that, over the course of 9 months, addressed eleven regional challenges in collaboration with scientific, academic and technological institutions. The assessment, conducted by Barcelona's Hub of Arts, Science and Technology (HacTe) and Universitat oberta de Catalunya (UOC), has the objective of demonstrating the transformative potential of interdisciplinary collaboration across the arts, science and technology.

The analytical framework devised for this assessment is based on three fundamental descriptors: dimensions, aspects and perspectives. These descriptors enabled us to evaluate the complex and multifaceted nature of cross-disciplinary collaborations through a multi-method approach combining qualitative and quantitative data.

The term "dimensions" serves as a foundational descriptor for the development of a set of indicators for measuring interdisciplinary collaboration, innovation and creativity, residency processes, public engagement and dissemination, and long-term sustainability.

The "aspects" allowed us to code and interpret the data collected from the participants' perceptions, actions, and programme conditions. Furthermore, aspects permitted the evaluation of the transformative legacies, both tangible and intangible, resulting from the programme.

Ultimately, the input from the stakeholder perspective enabled the acquisition of feedback and insights from the principal participants in the residency programme, namely artists, scientists and innovation catalysts.

The analytical model served as the nexus of these performative dimensions, analytical aspects and stakeholder perspectives, linking them through qualitative and quantitative indicators, thereby facilitating a comprehensive and nuanced assessment of the residency programme.

The analysis of the S+T+ARTS in the City residencies has revealed the necessity for improvements to be made to the way in which ASTS collaborations are conducted throughout S+T+ARTS projects. The success of such endeavours is contingent upon the establishment of a mutually beneficial learning environment, the undertaking of transformative processes, and the emergence of a reframed comprehension of the interrelationship between art, science, and technology.

The main findings of this report highlights specific issues regarding transdisciplinary residencies. While artists benefit from scientific insights and support, scientists appear to gain in terms of creative disruption and novel perspectives. However, an imbalance is also identified with regard to the perception of peripheral scientific contributions and the limited engagement of artists with their scientific counterparts.

These challenges, when considered alongside the necessity for tangible results and the sometimes ambiguous definitions of residency, can act as a barrier to innovation and sustainability. This emphasises the necessity for a more accurate definition of roles, expectations and support structures. By establishing an environment conducive to dynamic experimentation, the residencies can facilitate the realization of greater transformative potential and foster genuinely innovative results.

The role of the Innovation Catalysts in facilitating communication and fostering collaboration remains of critical importance. It is similarly crucial to provide opportunities for engagement

with a diverse range of stakeholders, including those without specialised expertise, at different stages of the process. This will serve to enhance public engagement and facilitate the introduction of innovative approaches.

Notwithstanding the time constraints and the highly specialised nature of the residencies, which frequently limit opportunities for broader citizen involvement, public engagement has been demonstrated to be beneficial when effectively implemented. This fosters a sense of shared ownership and the development of solutions that are centred on human needs. It is essential to implement a more strategic integration of public engagement initiatives in order to fully realise the potential of these projects and to promote meaningful societal impact.

In addition, with regard to long-term sustainability, scientists frequently perceive a sense of disconnection, citing the limited reciprocal influence and the challenges associated with integrating artistic projects into scientific frameworks. While scientists frequently perceive themselves to be relegated to the role of mere "suppliers", artists often encounter pressure to adhere to deadlines. Even though the aforementioned challenges, participants consistently emphasise the value of mutual learning, the acquisition of diverse skills, the fostering of cross-cultural understanding, and the inspiration of new approaches to the generation and dissemination of knowledge.

The key challenges identified from the analysis include communication barriers, different worldviews and languages, and the need for immediate tangible results. There is therefore an urgent need to develop strategies that facilitate open communication, foster trust, align objectives and create common languages to overcome semantic friction. It is essential to provide training and support for those acting as facilitators, who play a crucial role in promoting dialogue between different disciplines and facilitating genuine collaboration. Conversely, there needs to be a shift towards programmes that prioritise the quality of processes that facilitate open-ended research, without a focus on predetermined outcomes that often limit the exploratory potential of interdisciplinary research and collaboration.

Time constraints were also identified as a significant factor affecting the building of trust, the adoption of experimental practices and the level of public participation. This highlights the need for longer timeframes and adaptable processes to achieve meaningful and sustainable outcomes. Consequently, institutions and funding agencies need to support more flexible frameworks, creative experimentation and unconventional outcomes. This should be achieved by balancing short-term funding with long-term structural support, which would facilitate the development of more inclusive and diverse innovation ecosystems.

In order to enhance the transformative potential of interdisciplinary residencies, the report makes a number of recommendations for the future of the S+T+ARTS initiative. These include:

- The implementation of a multi-stage matchmaking process to reinforce transdisciplinary collaboration and guarantee robust partnerships prior to the allocation of funding,
- The establishment of a coherent conceptual framework for residencies. This framework should set out the material and temporal conditions that facilitate the implementation of transformative projects that integrate artists, scientists and local contexts in an effective manner.
- Reinforce the pivotal role of Innovation Catalysts through the implementation of targeted training programmes designed to develop the skills that facilitate interdisciplinary cooperation.
- Achieve a balance between exploration time and production time, given that transformational projects require flexibility and extended timelines for experimentation

and iteration. One potential solution is the introduction of multiannual grants or permanent open calls, which could help alleviate time constraints.

- Addressing funding constraints, it is vital to explore alternative remuneration channels to ensure equal recognition and genuine commitment for all stakeholders involved, not only artists through the grants.
- The S+T+ARTS initiative should place an emphasis on the value of learning, recognising the importance of process and transformation in addition to tangible outputs. The report emphasises the necessity of cultivating novel forms of interdisciplinary knowledge, methodologies and research practices to expand the scope of outcomes and encompass a diverse array of transdisciplinary research results, thereby ensuring a more comprehensive and impactful approach.
- The long-term impact of the residencies can be observed in their capacity to foster the creation of new collaborative platforms, interdisciplinary research centres, and mentorship networks, which provide invaluable guidance.
- The identification of a set of structures that can sustain innovation ecosystems, foster knowledge exchange, and promote the continuity of transformative work that can be supported in the Regional S+T+ARTS Centres (RSCs) has led to the conclusion that these centres represent a critical hub for fostering localised experimentation and driving long-term impact. Serving as dynamic platforms for cross-regional collaboration, knowledge dissemination, and community engagement, the RSCs are positioned to facilitate the advancement of transdisciplinary research and innovation.

A paradigm shift in evaluation metrics is required, moving beyond traditional quantitative key performance indicators (KPIs) that fail to capture the full complexity and dynamics of the Arts, Science, Technology and Society (ASTS) practices. Instead, further exploration and implementation of key transformative indicators (KTIs) should be pursued, integrating qualitative insights to provide a deeper understanding of collaboration quality, medium and long-term transformative potential, and the systemic changes catalysed by cross-disciplinary collaborations. The proposed framework draws attention to the emergence of new paradigms, pathways, and innovation models that extend far beyond immediate outputs and foster long-term societal impact.

In conclusion, the S+T+ARTS initiative, through its artistic residency pillar, provides an optimal context for demonstrating the transformative potential of interdisciplinary collaboration, exemplifying a model for integrating art, science and technology with the objective of driving innovation. The incorporation of Key Transformative Indicators (KTI) into evaluation frameworks can facilitate a more comprehensive understanding of the impacts and legacies of art-driven innovation. By addressing structural challenges, enhancing collaborative strategies and fostering open and flexible approaches, the programme can offer greater transformative potential and inspire meaningful change that contributes to social, cultural and technological advancement.

## 2. RESIDENCIES PROGRAMME

The S+T+ARTS in the City project, which was conducted from 2023 to 2024, hosted a residency programme that provided support for 11 artists over a nine-month period. The programme's

objective was to facilitate collaboration between the artists and academic, scientific, and technological institutions in addressing some of the challenges currently facing European regions. It aimed to produce artworks or prototypes offering solutions to real-life problems in various sectors, including green manufacturing, sustainable urban development, biotechnology, security, health issues, digital literacy, and more.

Take a look to the S+T+ARTS in the City outcomes: <https://starts.eu/starts-in-the-city-artists/>

The following table provides an overview of the residencies programme, the challenges addressed and the agents that took part of them on each Regional S+T+ARTS Centre:

Challenge	Artist	Research or Technological Centres	Innovation Catalyst
<b>Challenge 01: Going Wild in the City</b>	Adrien Lucca	The National Lottery Innoviris Vrije Universiteit Brussels	Ramona Gansbeke (GLUON)      Van
<b>Challenge 02: Reclaiming Our Agency</b>	David Claerbout	Proximus ADA	Willie Hermans (GLUON)      Marie
<b>Challenge 03: Where Our Food Comes From</b>	Futurefarmers	EIT Food Ghent University Innoviris Good Food Brussels	Willie Hermans (GLUON)      Marie
<b>Challenge 04: The Value of Care</b>	Roel Heremans	Innoviris Jules Bordet Hospital IMEC Flemish Institute for Biotechnology Ritcs School of Arts Sirris	Ramona Gansbeke (GLUON)      Van
<b>Challenge 05: Machine Sapiens and the City</b>	Stanza	Regione Lombardia – ARIA	Rosanna Dinuzzo (MEET)
<b>Challenge 06: Regenerative AI for Urban Mining</b>	Studio Above&Below	Area Science Park	Rosanna Dinuzzo (MEET)
<b>Challenge 07: The Future of Computing</b>	Where dogs run	Kersnikova Institute	Jana Putrl (Kersnikova)
<b>Challenge 08: Driving Agricultural Sustainability: Empowering Smallholder Farmers with Digital Transformation</b>	Samuel Ransbeeck van	Lusíada University (UL-VNF)	Rita (Inova+)      Sousa
<b>Challenge 09: Understanding and</b>	Disnovation.org	ICFO, Institute of Photonic Sciences	Anna (HacTe)      Pinotti

<b>Engineering Photosynthesis for a More Sustainable Future</b>			
<b>Challenge 10: Designing the Robots of the Future</b>	Mónica Rikić	Institut de Robòtica i Informàtica Industrial (IRI, CSIC-UPC)	Anna (HacTe) Pinotti
<b>Challenge 11: Immersive and Digital Narratives for Climate Change</b>	Mark Farid	Universitat Oberta de Catalunya (UOC)	Anna (HacTe) Pinotti

Table 01. Challenges and agents involved in the S+T+ARTS in the City residency programme

## 3. MEASUREMENT IMPACT PLAN

The evaluation plan implemented aims to provide a comprehensive understanding of the impact of the S+T+ARTS in the City residencies programme, fostering continuous improvement and deeper integration of the arts into science, technology and society.

The impact measurement involves the development of quantitative and qualitative indicators to assess how effectively the residency programme has achieved its goals and to gain insights for refining future iterations of the programme and improving its overall effectiveness. While KPIs are often associated with quantitative data, qualitative KPIs provide valuable insights that numbers alone cannot capture.

Qualitative Key Performance Indicators (KPIs) measure non-numerical data but reflect the perceptions of stakeholders about the process, actions taken, material conditions, successes and failures; descriptive characteristics and subjective interpretations that provide valuable insights into the residency programme development process and offer a more comprehensive view of performance and progress.

Qualitative KPIs complement quantitative KPIs by adding context and depth to the data, helping to provide more accurate descriptions. In this report we include the assessment of both quantitative and qualitative KPIs and their key findings.

### + 3.1. Key Performance Indicators

The analytical framework for KPIs consists of three descriptors: dimensions (the different areas of performance that are important to the residency program), aspects (the aspects from which indicators are evaluated) and perspectives (the point of view of the stakeholders).

#### + 3.1.1. Dimensions

In order to assess the complexity and multifaceted nature of an artistic residency in scientific and technological research centres, five key dimensions have been identified as a starting point from which to develop a specific set of indicators. These five dimensions are:

##### 1. Interdisciplinary Collaboration:

This dimension refers to the cooperation between artists, technologists and scientists from different disciplines. The evaluation focuses on how effectively these different groups work



together, share ideas and influence each other's perspectives and methodologies. Evaluates the effectiveness and extent of collaboration between different disciplines.

#### **2. Innovation and Creativity:**

This concept is central to the project and assesses how the residency promotes new creative approaches in art, science and technology. It looks at the novelty and originality of the artistic outputs and any innovative shifts in technological application/scientific research prompted by the artistic perspectives. Evaluates the level of innovative practices and outcomes generated during the residency.

#### **3. Residency Process:**

This refers to assessing the effectiveness of the structure and implementation of the residency. It examines the selection process of artists, the integration of participants into research environments, and the role of innovation catalysts and LEGs in facilitating the residency. This dimension can provide valuable insights into how the programme is structured and managed. It can help to evaluate the effectiveness of the residency structure and identify areas for improvement.

#### **4. Public Engagement and Dissemination:**

This dimension evaluates how the project engages with the wider public. It includes an assessment of the reach and effectiveness of exhibitions, presentations and digital platforms in conveying the work undertaken to a wider audience. It assesses the degree of interaction and involvement with the public and local communities.

#### **5. Long-term Sustainability:**

This dimension seeks to assess the lasting effects of the residency programme. It looks at ongoing collaborations, enduring impacts on participants' future work, and any lasting contributions to the fields of art, technology and science. Looking at the sustainability practices and their long-term impact.

### **+ 3.1.2. Aspects**

In order to provide a comprehensive assessment of the five dimensions, we have added three critical aspects regarding perceptions, actions and conditions and legacy. These aspects provide the analytical framework for coding and interpreting our data. The qualitative data collected encapsulates the perceptions of the participants, encompassing their experiences, expectations, emotions and aspirations throughout the residency process. These aspects, which cut across the five dimensions and three perspectives, are:

- + **Perceptions:** this aspect focuses on how the participants explain their own conceptions, attitudes, beliefs, experiences, emotions and expectations regarding different issues of the residency programme and the anticipated results. For example, the different conceptions that participants express about the interplay between art, science and technology.
- + **Actions and conditions:** this aspect identifies how the participants explained the actions undertaken during the residency to achieve the desired objectives. It also looks at how participants dealt with the material conditions and the collaborative process.
- + **Legacy:** this aspect explores the transformations experienced by participants during the process and their future prospects. It also encompasses their values, memories, and lessons learned, as well as the tangible and intangible contributions they valorate as outcomes of the residency.

### **+ 3.1.3. Stakeholder Perspectives**

When evaluating the impact of the Artists-in-Residency Programme in Science and Technology Research Centres, it's crucial to understand and assess the objectives of each group of stakeholders involved. Gathering and analysing feedback from all stakeholders - artists, researchers or other representatives of the associated scientific or technological centres, and

Innovation Catalysts (staff of the consortium partners) - provides different perspectives on the programme's effectiveness and areas for improvement. Here's a breakdown of the objectives for each actor:

**A. Artists:**

- + Aim: to explore and integrate scientific and technological concepts and processes into their artistic practice, fostering innovation and creativity to contribute to a contemporary challenge.
- + Evaluation focus: to assess how effectively artists have incorporated scientific themes into their artistic practice and research, the development of their creative skills and methodologies, and the extent of their engagement with scientific concepts.

**B. Science, Technology and Society Researchers (from now on Scientists):**

- + Aim: to collaborate with artists to gain new perspectives and potentially innovative approaches to their research.
- + Evaluation focus: to assess the influence of artistic perspectives on their research or methodology, any new insights gained, and the extent of productive interdisciplinary collaboration.

**C. Innovation Catalysts (ICs):**

- + Aim: to facilitate effective communication and collaboration between artists and scientists, ensuring a fruitful exchange of ideas and methodologies.
- + Evaluation focus: to assess their effectiveness in bridging the gap between art and science, the smoothness of the collaboration they foster, and their role in solving any interdisciplinary challenges.

### + 3.1.4. Analytical framework

The analytical framework is the intersection between dimensions, aspects and perspectives:

- + **Dimension:** correspond to the broad categories of indicators we used for the assessment (collaboration, innovation, residency performance and sustainability).
- + **Aspect:** define the feature from which the indicators are assessed (perceptions, actions and conditions, legacy).
- + **Perspective:** the different subject points of view of the actors involved (artists, scientists, innovation catalysts).

The analysis model below allows us to visualise how each indicator relates to the dimensions, aspects and perspectives of the stakeholders, facilitating the qualitative and quantitative analysis of the data.

Dimensions	Aspects	Perspectives
1. Interdisciplinary Collaboration 2. Innovation and Creativity 3. Residency Process 4. Public Engagement and Dissemination 5. Long-Term Sustainability	Perceptions Actions Legacy	Artists Scientists Innovation Catalysts

Table 02. Analysis model

### + 3.2. Methodology

In order to effectively evaluate the impact and the value generated by the S+T+ARTS in the City residencies programme, this report incorporates both qualitative and quantitative data

collection methods to ensure a holistic analysis and understanding of the programme's outcomes. The next sections unpack the data collection methods that have been applied; first, regarding quantitative data, and secondly, qualitative data gathering procedures.

### + 3.2.1. Quantitative data

Quantitative data was collected using monitoring sheets and Innovation Catalysts and Artists written diaries (see qualitative data methods). The quantitative data collection feeds into the five dimensions regarding the action and conditions aspect. However, Long-Term Sustainability dimension and Perception and Legacy aspects are addressed and developed through qualitative analysis. Although the legacy aspect, closely linked to the dimension of Long-Term Sustainability, could be measured quantitatively, it is not considered in this report due to the time constraints for actual data collection regarding this dimension. Consequently, the full impact and sustainability of the initiatives cannot be accurately measured at this stage in quantitative terms. Future evaluations should consider extending the data collection period to capture post-residency outcomes, which would provide a more comprehensive understanding of the long-term effects and legacy of the projects.

### + 3.2.2. Qualitative data

To develop the qualitative key performance indicators, we used a range of qualitative data collection methods, including interviews, written diaries and focus groups. These methods were carefully designed to gather valuable insights from the three key stakeholders involved in the residency process - artists, scientists, and ICs - at different stages of the process.

#### Qualitative methods:

##### + Written Diaries

Innovation catalysts and artists were asked to submit standardised reports that provided insights into the different residency processes from a participant observation perspective. These reports included a series of closed-ended questions designed to cover specific aspects of the residency phases, interactions, outputs and overall satisfaction. The diaries were submitted in two main stages: at the beginning of the residency in March 2024 and at the end of each residency in July 2024. These reports have also informed the quantitative data collection.

##### + Interviews

A total of 27 semi-structured interviews were conducted with artists, scientists and ICs. The interviews with artists and researchers were conducted via videoconference in June 2024, while the interviews with innovation catalysts took place at MEET Milan in April 2024. All interviews were audio-recorded and transcribed. Some interviews involved more than one participant, as the artists or researchers were part of a team.

Participants	Number of interviews	Number of participants interviewed
Artists	11	13
Scientists	11	13
Innovation Catalysts	5	5
Total	27	29

Table 03. Number of interviews conducted by profile and number of participants interviewed.

The interview script was designed to cover the five key dimensions of the evaluation. The questionnaire for the artists and scientists focused on their roles within the project and institution, their previous experience with ASTS (Arts, Science, Technology and Society) projects, their expectations of the S+T+ARTS In the City programme, the development of the residency, future steps for the collaboration, the main advantages and disadvantages of the experience. The questionnaire for the Innovation Catalysts covered the definition of their roles and institutions, their expectations regarding their contributions to the programme and the main challenges related to impact assessment.

**+ Focus group with Innovation Catalysts.**

In June 2024, we conducted a focus group with all the ICs via video conferencing. The one-hour session was recorded and later transcribed. The primary aim was to gather their experiences, visions and feedback towards the end of the residencies, as their initial interviews were conducted earlier in the process. The discussion covered topics such as the definition of their roles, their experiences during the different phases (the call, the residency, the public exhibitions), the S+T+ARTS In the City methodology, the challenges they faced and recommendations for future programmes.

Participants	Written diaries	Interviews	Focus Group
Artists	22	11	-
Scientists	-	11	-
Innovation Catalysts	22	5	1
Total	44	27	1

*Table 04. Total qualitative data collected, categorised by method.*

**Data treatment and analysis**

Once the qualitative data had been collected, we imported all the interviews, diaries and focus group transcripts into Atlas.ti<sup>1</sup>, a qualitative data analysis software, to derive actionable insights. The graphs in the analysis report are also elaborated with this QDA software.

All data, including quoted extracts from interviews, focus groups and diaries, are anonymised to protect the identity of participants. However, the report identifies the source of the information (interview, focus group or diary) and the role of the participant (artist, scientist or ICs), collecting their individual experiences in different stakeholder profiles. This approach ensures the protection of participants and fosters a climate of trust that allows participants to freely express their opinions and share their experiences as well as an accurate report of their points of view as stakeholders.

The coding of the data using ATLAS.ti followed the established analytical framework, which involved coding based on the five predefined dimensions and aspects (deductive analysis). Throughout the coding process, emergent categories were identified and incorporated into the code library (inductive process). The emergent categories have been refined and codified in new indicators. As coding progressed, codes were systematically organised into code groups based on themes or categories. These code groups served as the basis for defining specific indicators and further analysis.

Ensuring rigour in qualitative data analysis is crucial to producing reliable and valid results. Here are the three main steps we took to ensure rigour in our analysis:

---

<sup>1</sup> . <https://www.atlasti.com>

- + **Triangulation:** we used multiple data sources and methods (interviews, diaries and focus groups) to cross-check the findings. This helped to identify consistent patterns and themes, and increased the credibility of the findings.
- + **Inter-coder reliability:** different researchers independently coded the data to ensure consistency and reliability. We then compared and discussed the coding to resolve any discrepancies and reach a consensus. We kept a comprehensive record of all data collection and analysis procedures, including coding decisions and changes. This transparency allows others to follow the research process and verify the findings.
- + **Peer debriefing:** we regularly discussed the analysis with colleagues and experts in the field to gain external perspectives and challenge our interpretations. This process helped to refine the analysis and ensure its rigour.

*All the graphics included in the Qualitative Analysis section have been done through the Atlas.ti software.*

## 4. QUANTITATIVE ANALYSIS

This chapter delineates the research questions that guided the formulation of quantitative key performance indicators (KPIs). It also presents an analysis of the results obtained from the quantitative data. By establishing clear research questions, specific KPIs were defined to measure the effectiveness and impact of the S+T+ARTS residency program. The subsequent results provide numerical insights into how the program has facilitated interdisciplinary collaboration, fostered creativity and innovation, and enhanced public engagement and diffusion.

### + 4.1. Quantitative analysis research question

In order to focus the quantitative analysis and present the results, this section is structured around a main research question that examines the quantitative impact of the residency programme on the relationship between Arts, Technology, Science, and Society. This main question has been unpacked into three sub questions that have guided the definition of the quantitative indicators and their subsequent analysis:

- + **Facilitation of Interdisciplinary Collaboration:**
  - What specific actions and conditions have been implemented to promote interdisciplinary collaboration within the residency program?
- + **Knowledge Ecosystem for Creativity and Innovation:**
  - What initiatives and support structures have been established to create an ecosystem that fosters creativity and innovation?
  - Which and how many tangible outcomes have been produced?
- + **Public Engagement and diffusion:**
  - Which and how many activities have been employed to engage the community and encourage public participation in the residency programme?
  - How have these strategies and activities impacted the dissemination of the programme?

### + 4.2. Quantitative KPI definition

The quantitative analysis employed specific indicators corresponding to each proposed dimension. These indicators were selected to quantitatively measure the impact and effectiveness of the program across various facets, ensuring a data-driven evaluation.

**Dimension 1: Interdisciplinary collaboration**

Tracks the number and frequency of meetings held between the different stakeholders involved in the residencies programme in order to assess the extent of interaction and cooperation between them. It is measured through these quantitative KPI:

- + Number of meetings between artists and scientists
- + Number of meetings between artists and local expert group
- + Number of meetings between ICs-Artist
- + Number of meetings between ICs-Scientists

**Dimension 2: Innovation and creativity**

In order to assess productivity, it tracks the number of tangible outcomes generated and their potential industrial applications. However, it should be noted that currently available quantitative data is lacking in terms of measuring and assessing the impact of acceleration and innovation degree of the outcomes produced. We used the following quantitative KPI:

- + Number of artworks produced
- + Number of potential industry applications or prototypes

**Dimension 3. Residency process:**

Assesses the effectiveness of the selection process by challenges, number of applications received, artists supported and the overall number of stakeholders involved in the residencies programme through these KPI:

- + Number of applications received
- + Number of challenges
- + Number of artists supported
- + Number of Labs involved in the residency
- + Number of researchers involved in the residency
- + Number of local experts participating in the residency
- + Number of entities that form the local expert group of the residency

**Dimension 4. Public engagement**

Assesses the number and impact of public live activities (e.g., exhibitions, workshops) to determine the effectiveness of the residencies programme in disseminating the processes and results and engaging with a wider audience.

- + Number of events linked to artists
- + Number of general events linked to project
- + Number of attendees (in all events)

**Dimension 5: Long-term sustainability**

Due to the time constraints of this report, this dimension is not included in the quantitative analysis. Understanding the enduring impact of the program on the relationship between Art, Technology, Science and Society requires a longer timeframe. At the time of writing, there is no updated data available to accurately measure this impact. Future evaluations should extend the data collection period to capture post-residency outcomes, providing a more comprehensive assessment of the program's long-term effects.

**4.3. Organising interdisciplinary collaboration**

Organising formal meetings within the different stakeholders is essential for ensuring coordination between artists and scientists in order to properly address the different challenges. The interactions between the artists and the scientific and technological community were facilitated by setting up a diverse variety of encounters. These meetings facilitate alignment, communication, resource allocation, collaboration, monitoring,

engagement, risk management, and accountability, all of which are critical for the project's success and can be quantitatively measured to assess its impact.

In consideration of the interdisciplinary collaboration dimension, the quantitative indicators predominantly pertain to the frequency of online or offline meetings held between the various stakeholders involved in the residency programme. This is illustrated in the following table:

QUANTITATIVE INDICATORS (considering total numbers)	Expected (if applicable)	Done
Number of meetings between artists and scientists	-	110
Number of meetings between artists and local expert group	-	35
Number of meetings between ICs-Artist	-	111
Number of meetings between ICs-Scientists	-	21*

*Table 05. Number of meetings between the agents involved in the residency programme*

The role of the Innovation Catalyst was crucial to initiate and oversee the collaboration, ensuring it stayed aligned with the project's goals and, more broadly, with the S+T+ARTS in the City project, with a focus on mutual cross-fertilization.

The average number of meetings between artists and the Innovation Catalyst is 10 per residency (110 in total numbers), the same average as for meetings between artists and scientists. This is equivalent to one formal meeting per month, taking into account the average 9 months of each residency, and not taking into account any informal meetings that may have taken place between the teams. The importance of conversations between the different parties to foster collaboration, beyond formal meetings, will be seen in the qualitative analysis.

This means that both scientists and Innovation Catalyst, carry out 86% of the encounters with artists, in contrast to the 14% carried out by 3 local experts, whose average number per residency is 3 formal meetings. From these data we can deduce that the role of scientists and Innovation Catalyst is highly relevant in the continuous follow-up of the entire residency process, while the role of the local experts (LEGs) seems to be more punctual at specific moments in the process, according to their role as external advisors.

Overall, these data provide valuable insights into the planning and management control of the residencies' development. In total, 256 meetings were held among the various stakeholders involved in the 11 residencies, averaging 23.3 meetings per residency, or roughly 3 meetings per month. This indicator demonstrates that sufficient actions have been taken to ensure coordination. Complementary qualitative data will offer additional perspectives to this analysis.

## + 4.4. A knowledge ecosystem for creativity and innovation

A knowledge ecosystem for creativity and innovation within the S+T+ARTS initiative is a holistic framework that supports the collaborative efforts of artists, scientists and technologists. Such a knowledge ecosystem is crucial for addressing complex global challenges to the development of sustainable solutions that can be implemented across various sectors. It has to provide the necessary infrastructure, resources, and community engagement to drive forward creative and innovative projects that have a meaningful impact on society. In this section we analyse the residencies process in terms of the challenges addressed and the interest aroused by each of them in the open call to artists, as well as the results obtained, and the configuration of a collaborative ecosystem around each one of the projects developed.

The S+T+ARTS in the City open call for artists-in-residency (launched in June 2023) received a total of 175 applications, distributed as follows according to each of the 11 proposed challenges:

Challenge	Number of applications
Challenge n° 1: Going Wild in the City	42
Challenge n° 2: Reclaiming our Agency	21
Challenge n° 3: Where Our Food Comes From	11
Challenge n° 4: The Value of Care	8
Challenge n° 5: Machine Sapiens and the City	19
Challenge n° 6: Regenerative AI for Urban Mining	9
Challenge n° 7: The Future of Computing	10
Challenge n° 8: Driving Agricultural Sustainability – Empowering Smallholder Farmers with Digital Transformation	4
Challenge n° 9: Understanding and Engineering Photosynthesis for a More Sustainable Future	11
Challenge n° 10: Designing the Robots of the Future	10
Challenge n° 11: Immersive and Digital Narratives for Climate Change	30

*Table 06. Number of applications received by challenge*

As the table above shows, the challenges linked on how to reimagine and reconfigure the relationship with nature in the urban areas within what is called ‘symbiotic’ thinking (Challenge 1: Being wild in the city), as well as the one linked on how to address climate change through immersive and digital narratives (Challenge 11), were the ones that attracted the most interest among the applications received.

The residency programme has supported 11 artists who have developed their art practice based-research projects in collaboration with 14 scientific, technological or academical laboratories. The knowledge ecosystem created around each of the residency processes is mainly based on the figures of the scientists and the group of local experts (LEG’s) that orbit around each of the projects.

A total of 34 scientists (32%) and 72 local experts (68%), representing 52 different organisations, have participated in the programme. The number of organisations involved is far greater than initially expected, which suggests the need to create broad support contexts that nourish each of the specific areas addressed in the residencies from a different range of fields of knowledge and specialisation.

The average participation per residency is 3 collaborating scientists and 6.5 local experts (corresponding to the involvement of an average of 4.7 local organisations per residency).



QUANTITATIVE INDICATORS (considering total numbers)	Expected (if applicable)	Done
Number of applications received	-	175
Number of artists supported	11	11
Number of Labs involved in the residencies	10	14
Number of researchers involved in the residencies	-	34
Number of local experts participating in the residencies	-	72
Number of entities taking part of the local expert group	15	52

Table 07. Overview of quantitative data related to Dimension 3

The residency programme has led to the creation of 11 new artworks that have responded to each of the 11 challenges posed and have been shown at high visibility festivals (such as Ars Electronica, Manifesta15, I love Science and Sonar) and other local artistic venues. Six of these results are participating in the S+T+ARTS in the City Acceleration programme, showing potential for innovative industrial application or prototyping.

QUANTITATIVE INDICATORS (considering total numbers)	Expected (if applicable)	Done
Number of artworks produced	11	11
Number of potential industry applications or prototypes	8	6

Table 08. Overview of quantitative data related to Dimension 2

At the time of writing this report, no conclusive data are available on the continuation of industrial collaborations, as the Acceleration programme is still ongoing. A specific report on this will be presented at a later stage.

The indicators show that the program’s objectives regarding the enrollment of scientists in defining and addressing the challenges have been exceeded significantly. The active participation and contributions of scientists have not only met but surpassed initial expectations, demonstrating a high level of engagement and commitment. This success is reflected in the innovative artwork outcomes developed, highlighting the program’s effectiveness in fostering an artistic product. The qualitative section will further elaborate on these artistic achievements and address the nuances and challenges related to scientific innovation.

## + 4.5. Public engagement opportunities

The quantitative indicators presented in this section highlight the significant impact of the S+T+ARTS in the City project in terms of live public engagement through events such as exhibitions, presentations, educational activities or workshops. A total of 48 outreach events were organised, with 22 directly linked to the individual artists-in-residence and 24 as part of broader project events. These figures exceed initial expectations and underscore the Consortium’s dedicated efforts towards dissemination and social engagement. The high number of events and the substantial audience of attendees reflect the project’s success in fostering public interest and participation.

QUANTITATIVE INDICATORS (considering total numbers)	Expected (if applicable)	Done
Number of events linked to artists (implemented and in progress)	-	22
Number of broader events linked to project	8	24
Number of attendees (in all events) <sup>2</sup>	-	1.600

Table 09. Overview of quantitative data related to Dimension 4

Overall, the data demonstrates a strong commitment to public outreach and highlights the effectiveness of the S+T+ARTS in the City project in promoting the public diffusion of the intersection of arts, technology, and science. However, one significant challenge encountered in this project was the absence of data collection on citizen engagement during the research and production phases. This gap presents a limitation in fully understanding the extent and nature of public involvement throughout the entire lifecycle of the residencies. While the quantitative indicators provide valuable insights into public engagement during events such as exhibitions and workshops, they do not capture the potentially rich interactions and contributions of citizens during the earlier stages of the project. This lack of quantitative data makes it difficult to assess how effectively the project engaged the community in the research and creative processes, which are crucial for fostering a deeper connection between the public and the interdisciplinary work being conducted. The qualitative section will further explore these challenges and provide additional insights into the nuances of public and community engagement.

The quantitative indicators used in this assessment highlight the significant achievements of the S+T+ARTS in the City project in terms of public engagement and outreach. While the project has excelled in organising events and attracting audiences, future efforts should focus on capturing data on citizen engagement during the research and production phases to provide a more complete picture of the project’s impact.

Overall, the indicators demonstrate a successful and impactful initiative that has effectively engaged the stakeholders and promoted the intersection of Arts, Technology, Science and Society. However, although interdisciplinary coordination was successfully achieved, the project encountered some challenges in fostering effective interdisciplinary collaboration. Creating an effective knowledge ecosystem that fosters innovation and creativity as an ongoing process, rather than merely focusing on artwork outputs, is essential to ensure that the collaborative efforts lead to sustainable and impactful innovations across disciplines. These challenges will be analysed in greater detail in the qualitative section.

## 5. QUALITATIVE ANALYSIS

This chapter presents a detailed examination of qualitative analysis, offering a comprehensive definition of qualitative dimensions, aspects, and perspectives that emphasises their importance in capturing the intricate and multifaceted nature of social phenomena involved in the S+T+ARTS residency program. These indicators encompass a wide range of data sources, including interviews, diaries, and focus groups, thereby facilitating a comprehensive and detailed understanding of the insights captured by the qualitative key performance indicators.

---

<sup>2</sup> Data collected at the time of writing this report.

Furthermore, we present an analytical framework designed to facilitate the systematic organisation and interpretation of qualitative data. This framework integrates a variety of methodological approaches, including thematic analysis and content analysis using Atlas.Ti software, in order to guarantee a rigorous examination of the data. The utilisation of this framework enables the identification of patterns, themes and relationships, thereby facilitating the acquisition of valuable insights for answering the research questions.

After these methodological clarifications, the analysis results are discussed, with the key findings and their implications highlighted. The results sections (5.3 to 5.6) provide a detailed account of how the qualitative indicators were applied within the analytical framework, illustrating the process of data interpretation and the emergence of significant themes. Through this analysis, the underlying dynamics and contextual factors that shape the phenomena under study are uncovered, offering a holistic and nuanced perspective.

The aim of this chapter is to demonstrate the power and potential of qualitative indicators in generating meaningful and actionable insights.

## + 5.1. Qualitative analysis research questions

In order to focus our analysis and present the results, this section is structured around three main research questions that emerge from the objectives of the S+T+ARTS residency program and the analytical framework:

- + **Perception:** How do the different disciplines collaborate and exchange knowledge during the residency programme?

This question aims to explore the dynamics of interdisciplinary collaboration. By analysing the interactions between artists, scientists and technologists, we can gain insights into the mechanisms of knowledge exchange and the value placed on interdisciplinary work. This analysis will help identify the strengths and challenges of collaboration efforts within the residency.

- + **Actions and Conditions:** What effects have the residencies had on the researchers and artists who have collaborated with them? What was the role of the Innovation Catalysts?

This question aims to evaluate the tangible and intangible impact of the residency on its participants. We will assess how the residency has influenced the professional and personal development of the researchers and artists involved. Furthermore, we will examine the role of the Innovation Catalysts and the LEGS in facilitating and enhancing these collaborations, identifying key actions and conditions that contributed to the success of the residency.

- + **Legacy and Sustainability:** How has the S+T+ARTS project contributed to the ASTS relationship within the residency program?

This question assesses the long-term impact and sustainability of the residency programme. In order to evaluate the S+T+ARTS project, we will examine how it has fostered ongoing relationships between art, science and technology (ACTS). This will include an assessment of the lasting impact on participants' future work, ongoing collaborations and the broader societal contributions of the residency.

To provide a comprehensive analysis, the results are presented below from the perspective of the stakeholders, with stakeholder perspectives employed as an independent variable. It is of the utmost importance to gain an understanding of the points of view of the various stakeholders in order to gain insight into the different appraisals of the five dimensions that have been analysed: interdisciplinary collaboration, innovation, public engagement, long-term

sustainability and the residency process. By focusing on the perspectives of the stakeholders, it is possible to highlight the different experiences and insights that contribute to a comprehensive understanding of the impact of the residency programme.

However, we also seek to identify significant correlations between the five dimensions in order to ascertain the factors that exert the greatest influence on the overall success and sustainability of the residency programme provided by qualitative data. By examining these correlations, we can discern patterns and relationships that may not be immediately apparent through the perspective analysis alone. This dual approach, combining stakeholder perspectives with dimensions correlation analysis, ensures a robust and nuanced understanding of the programme's impact. Ultimately, this comprehensive analysis will inform future improvements and strategic decisions, increasing the effectiveness and reach of the residency programme.

## + 5.2. Qualitative KPI definition

Following the codification process, we have carefully defined a set of specific indicators for each dimension defined in the analytical framework for qualitative impact measurement. The indicators have been devised in order to capture the subtle effects and outcomes of the residency programme, and to provide a comprehensive understanding of its impact, taking into account a variety of aspects involved from the perspectives of the stakeholders.

The comprehensive indicators for each dimension are delineated below, thereby providing a transparent framework for the qualitative evaluation of the programme's efficacy and sustainability.

### 1. Interdisciplinary collaboration

A set of specific indicators has been developed to identify and measure participants' expectations and practices regarding the relationship and intersection between art, technology, science and society. These indicators are designed to break down and challenge traditional boundaries between these fields. They are coded in two main indicators:

- + **Collaborative Dynamics:**
  - **Cooperation:** how the actors involved explain the joint collaboration during the residency process in order to achieve the expected goals of the residency either in the shape of an outcome (artwork or prototype) or a collaboration research or production process (and actions taken).
  - **Disconnection:** difficulties in collaboration, communication or coordination; perceived limitations in working together.
  - **Transformations:** the ability to influence, disrupt or change the ideas, conceptions, ways of doing things, outcomes... of either party.
  - **Mutual influence:** the perceived reciprocal effects during the residency.
- + **Mindset and methods:**
  - **Experience:** previous participation in other processes linking Art, Science, Technology and Society.
  - **Expectations:** assumptions about what is likely to happen in the residency process and the outcome.
  - **Preconceptions:** previous beliefs about science, art and technology and the different skills and methodologies of scientists, artists and technologists.

### 2. Innovation and Creativity

A set of indicators designed to identify the perceptions and actions associated with artistic, technological and/or scientific outcomes, as well as the role of creativity in achieving them.

- + **Innovation in the artistic project:** exploring and experimenting with new methods, ideas or technologies, understanding artistic processes and outcomes as a form of research.
- + **Innovation in scientific research:** generation of new ideas or transformation of existing concepts, methods or technologies.
- + **Innovation limitations:** the constraints or barriers that participants explain hinder the development, implementation, or success of innovative ideas, processes, or outcomes.

### 3. Residency process

A set of indicators for identifying participants' appreciation of the adequacy of the residency process to the challenges proposed, perceived difficulties during the process and also the roles of the different actors involved in the residencies.

- + **Challenge Relevance:**
  - **Call and selection process:** considerations regarding the public call and the selection process of artists and projects.
  - **Challenge definition:** considerations concerning the definition of the challenge
  - **Challenge adequacy:** considerations on how the artist project or research team addressed the challenge
- + **Residency performance:**
  - **Integration:** incorporation, reception and adaptation of the artist in the host centre.
  - **Setting:** production and research, infrastructural and human conditions and resources involved in the residency programme.
  - **Funding:** economic conditions linked to the residency programme.
  - **Temporality:** considerations about the length of the residency adequacy.
  - **Emplacement:** relationship between the origin or place of residence of the artists in relation to the location of the host centre (travels, language, and cultural idiosyncrasies).
- + **Accompaniment:**
  - **Mediation:** role and contributions of the Innovation Catalysts (facilitator).
  - **Mentorship:** role and contributions of the participants in the residencies as representatives of the Local Expert Groups.
  - **Methodologies:** set of procedures and skills related to the residence management and implementation.

### 4. Public engagement

A set of indicators designed to facilitate the assessment of success in reaching and influencing wider communities, identifying actions related to the artist in residence's interactions with the local or regional context, and promoting community engagement.

- + **Exhibitions:** showcase and visibility of the residency outcomes.
- + **Community:** relationship between the participants of the residency process with the local communities, citizens or other relevant local stakeholders. The term public engagement refers here to mean the active participation and involvement of individuals or communities in the research process. Engagement refers here to building relationships, fostering dialogue and encouraging collaboration.

### 5. Long-term sustainability

A set of indicators is employed to assess the lasting impact of the residency programme, including ongoing collaborations and the impact on participants' future work. This provides valuable insights and cross-cutting learning that promote sustainability. This information is essential for planning future iterations of the programme and ensuring its continued relevance and effectiveness. It is important to note that these evaluations are based on stakeholders' perceptions while the residency is still ongoing.

- + **Legacy of the Interdisciplinary Collaboration:**

- **Ongoing and/or Future Collaborations:** continuity in the collaboration across disciplines after the residency. It includes the number and quality of ongoing projects and any new collaborative initiatives that emerge.
- **Future Engagements with STA:** likelihood and frequency of participants engaging with the Science, Technology, and Art (STA) community in future projects or events. It reflects the sustained interest and involvement in interdisciplinary work.
- **Changes in Mutual Perception:** how participants' perceptions of each other's disciplines have evolved. It looks at increased understanding, respect, and appreciation for the methodologies and contributions of different fields.
- + **Legacy of the Innovation process:**
  - **Outcome:** tangible results of the innovative efforts during the residency. It includes new products, processes, or solutions developed and their effectiveness.
  - **Acceleration:** how innovative ideas are developed and implemented, looking at how the residency has accelerated the innovation process and reduced time-to-market for new solutions.
  - **Community Impact:** broader societal effects of the residency engagement with the local community and the visibility of the outcomes. It includes improvements in quality of life, environmental benefits, and contributions to social well-being.
- + **Legacy of the Residency Process:**
  - **Future Developments in Artistic or Scientific projects:** the extent to which the residency has influenced participants' future work. It includes new projects initiated, advancements in existing projects, and the integration of new ideas and techniques.
- + **Learnings:**
  - **Setbacks:** the challenges, obstacles, or issues encountered during the residence program.
  - **Good Practices:** the effective and efficient methods, strategies, or processes that have been identified to yield positive results and can be replicated or adapted in similar contexts.
  - **Actionable Insights:** recommendations, suggestions, advice and guidance provided by the stakeholders for future programme improvements.

Dimension	Indicator	Sub-indicator
Interdisciplinary collaboration	Collaborative Dynamics	Cooperation
		Disconnection
		Transformations
		Mutual Influence
	Mindset and Methods	Experience
		Expectations
		Preconceptions

Innovation and Creativity	Innovation in the Artistic Project	
	Innovation in Scientific Research	
	Innovation Limitations	
Residency process	Challenge Relevance	Call and selection Process
		Challenge Definition
		Challenge Adequacy
	Residence Performance	Integration
		Setting
		Funding
		Temporality
		Emplacement
	Accompaniment	Mediation
		Mentorship
		Methodologies
	Public engagement	Exhibitions
Community Participation		
Long-term sustainability	Legacy of the Interdisciplinary Collaboration	Ongoing and/or Future Collaborations
		Future Engagements with STA
		Changes in Mutual Perception
	Legacy of the Innovation Process	Outcome
		Acceleration





A06<sup>3</sup>: "Like the scientists are really helpful, really nice. I mean, they have always been nice, but they actually really like helping us in the sense of developing something together. I think to add to that, yeah, I think the science organisation that we collaborated with, they've been really generous from day one. So like, being on site, yeah, we weren't just partnered with like, one department in a way, we were really, they were really open for us to speak into a lot of departments".

On the other hand, scientists view collaboration with artists as a source of inspiration, facilitating the generation of novel ideas for innovation and enhancing their capacity to disseminate findings to a broader audience. The residency programme is perceived as a collaborative space for innovation.

SC04: "One of the reasons for working with artists is to get inspired and to think about certain ideas or concepts in a different way. Artists typically think in a different way than we scientists do. So by connecting them, you open this new potential insight".

Scientists highlight the distinct worldview, mindset, and methodology of artists, which can act as a catalyst for creative disruption and facilitate the achievement of significant social impact. Nevertheless, scientists express greater reservations and a sense of ambiguity. Some have even proposed that "researchers have to feed the artists," yet they perceive a lack of tangible recognition, academic acknowledgment, or secure funding for their own projects. Despite these challenges, they maintain a positive outlook and believe that collaboration with artists has reshaped their preconceptions about artistic practice.

For the Innovation Catalysts, working together as intermediaries between artists, scientists and LEGs is crucial. They share with scientists the concept of art as a communicative tool and the potential of artists' creativity to lead to innovation. Their role in the residency process emphasises collaboration as a work of translating languages, connecting people and developing a 'collaborative culture'.

IC02: "Engaging with the artistic process introduced the scientists to new ways of thinking about and visualising data, which enhanced their ability to communicate complex scientific concepts in more accessible and creative ways".

IC01: "From this experience, one lesson learned is the importance of aligning expectations early in the residency process. Ensuring that the hosting organisation, Local Expert Group (LEG) partners, and the artist are all aligned on the expected outcomes from the outset. This initial clarity helps set a solid foundation for collaboration".

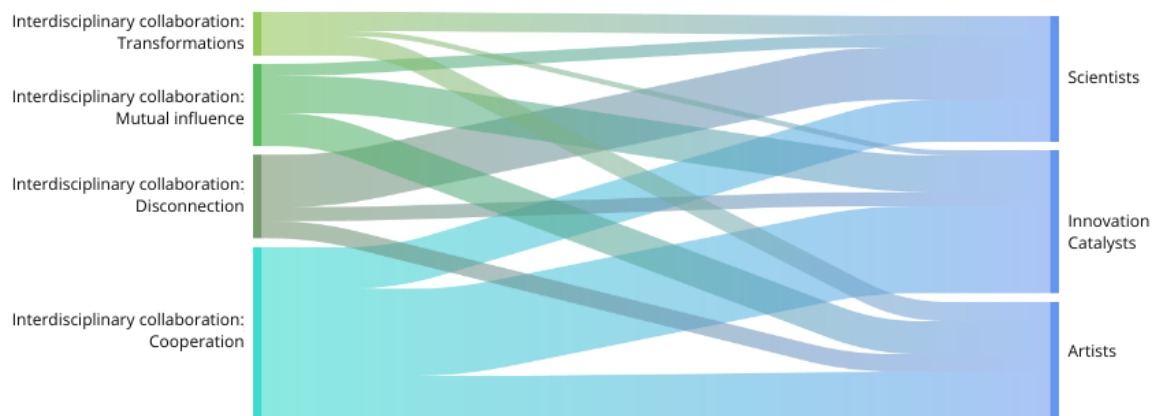
FG: In our country, we don't have this collaborative culture between artists and entrepreneurs. No, we still need it to establish it. And at the end, it comes out that you bring this artist that don't really understand what the companies are there.

While the quantitative data (see section 4.3) indicate effective coordination and a positive dynamic of formal meetings, the qualitative data reveal that artists and scientists place a high value on "conversations" as a trigger for the exchange of ideas and the establishment of trust. To facilitate productive conversations, it is essential that artists and scientists have a common space where they can meet, not only in formal meetings, but also in informal encounters and daily interactions in the laboratory. For them, conversations are the foundation of "real interdisciplinary collaboration," as they facilitate the exchange of ideas, the transformation of their initial points of view, and the mutual influence. The power of conversations is instrumental in enabling interdisciplinary collaboration to flourish.

A06: "There were conversations which are still ongoing with specialists in fields of neurology, AI technology, but also people who work in the industry. And those were live conversations and the live conversation is a very different thing than Zoom, but if you sit together... I realised you really do progress much faster, because you really confront your ideas and your findings with those of others".

---

<sup>3</sup> Code correspondence: A, Artist; SC, Scientist; IC, Innovation Catalyst. FG: Focus Group and D corresponds to Diary.



Graphic 02. Interdisciplinary Collaboration and Perspectives

The graph shows that artists, scientists and innovation catalysts work together during the residency programme to achieve the expected goals. The **Interdisciplinary Collaboration** dimension shows the actions taken by the participants to facilitate the exchange of ideas in the context of their respective challenges. '**Cooperation**' indicator refers to the actions taken by the actors to collaborate in the pursuit of the project success, while the '**Transformation**' and '**Mutual Influence**' indicators identify the two key perceptual aspects that point to the experience that the 'interdisciplinary collaboration' has 'really' happened beyond the cooperation. The indicator '**Disconnection**' refers to the perceived failure to reach a level of cooperation that leads to true "interdisciplinary collaboration". So, the scientists are the group that felt more moments or situations of disconnection (61%), the artists also were experiencing these situations to a lesser but significant degree (22%), while the catalysts are not so receptive (16%) as they are not directly involved in the project research process. The factors identified by the participants as making 'interdisciplinary collaboration' challenging are related to the disparate ways of thinking and working, the pressure to complete the artistic outcomes, and the difficulties experienced during the residency programme in integrating the artist into the scientific research teams. The difficulties of 'speaking different languages' were anticipated by all, but expectations of bridging this gap were also high.

A04: "The main challenge of working with scientists and technologists lies in bridging the gap between disciplines and navigating differing perspectives and methodologies. As an artist, I often approach problems from a creative and intuitive standpoint, while scientists and technologists typically rely on empirical evidence and systematic inquiry".

SC10: "But we are used to the scientific method, which has always worked the same way, I mean, all scientists work the same way in this sense, don't they? Then maybe it's the part with a little more difference. (...) Uncertainty, let's put it this way, that maybe there is a lot of uncertainty, and artists are used to that... We also have uncertainties in our world, but it's a different kind."

IC05: "There is a perception of a certain sense of difficulty within some part of the research team in working with artists. It conveys the perception that there are many barriers to break in the art-science relationship or in how artists are perceived, nearer to the idea of the artist-creator (someone who paints, etc..) and far from the idea of artist-researcher".

IC01: "Maybe, yeah, at how each of these disciplines work and the preconceptions they had about it when they started maybe at the project, and that if we are able to take that away a little bit, I'm already happy. Because that's something you carry on maybe and I think that eventually makes this change. It's like these very tiny seeds".

It is noteworthy to say that the artist showed a greater perception of having been engaged in a mutual interchange of ideas that has transformed their point of view and their artwork (62%)

than scientific's experiences in changing their mindset regarding art and incorporated new ideas in their work (38%). As one Innovator Catalyst observes:

IC04: "the relationship between the artists and the scientists is developing in a challenging yet dynamic way. Navigating the different interests and ambitions of each partner, each eager to see their research, technologies or organisational values reflected in the artwork, presented some challenges for the artist".

The challenges also relate to the artists' and scientists' previous experience of interdisciplinary collaboration and the manner in which the artists employ scientific data and methods in their work.

SC05: "And we discovered literally another world. It's the first time, but we are, I can say that it's a great opportunity to open the data for other use, other types of usage".

**+ 5.3.2. Innovation and interdisciplinary collaboration**

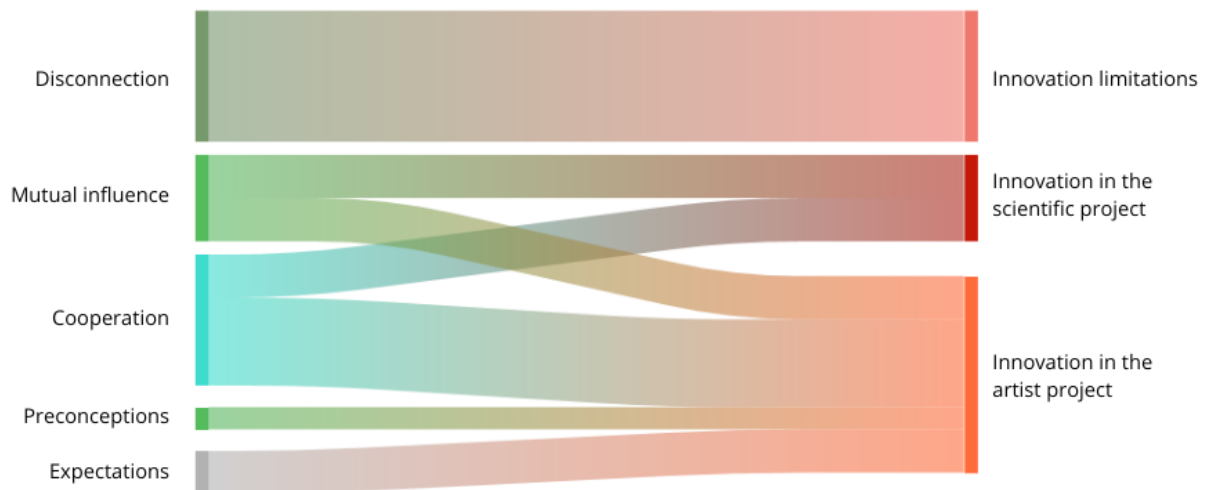
As has been demonstrated, interdisciplinary collaboration is significantly correlated with creativity and innovation. The graph below illustrates that the majority of the innovative effort associated with the residency programme was directed towards the artistic project. This emphasis on innovation within the artistic product demonstrates a comparatively reduced impact of the interdisciplinary collaboration on the scientific outcomes. Scientists and artists perceive their contribution to innovation within the scientific domain to be limited, while scientists indicate that their input to the artistic project was slight.

SC03: "I was naive in saying this artist in residence, there will be challenges in you and providing wild ideas and you have to, I don't know, I should try to feed some ideas to them. That didn't really happen. It was more like a guidance committee of the type of project I am in. You select a project, it has a plan, you'll try to deliver. So now I'm not sure if my added value is really significant".



Graphic 03. Innovation and creativity indicator by perspectives

The data reveals an imbalance in expectations regarding the innovation outcomes of interdisciplinary collaboration between scientists and artists. And, as shown, scientists perceive a greater sense of disconnection compared to artists and innovation catalysts and this is reflected in their impressions that the Challenge has scarcely contributed to their scientific research. Additionally, there is a correlation between the innovation and creativity indicators and interdisciplinary collaboration (see graphic below).



The graphic above illustrates clearly the impact of the sentiment of "disconnection" on the perception of innovation breakthroughs. Furthermore, the data indicates that innovation within the scientific domain is more closely associated with expectations and preconceptions than innovation within the artistic domain. Furthermore, the data indicates that the collaborative efforts were primarily concentrated on the artistic aspect of the project, with less emphasis on the scientific side. It can be observed that artistic innovation is more evidently associated with the resolution of the challenge than in the scientific research acceleration. Conversely, there is the matter of disparate modes of thought, methodologies, and practices. Artists bear responsibility for outcomes and adhere to their work, incorporating elements from scientists to achieve success. Consequently, some scientists perceive a lack of involvement in the artistic endeavour or a lack of influence from the artist on their own work.

IC05: "The artistic project has not been opened up enough at this point which led to a feeling of not developing a collaborative project at all".

SC10: "In this case it's a black box, I mean. We do not know what is happening, we explain many things, many meetings, but there is no feedback back, and well, we invest time that we do not know exactly where it goes, that I do not know exactly if all artists work like this, and they , I mean, they're picking up things, they're formulating the result in their head, and then they show it to you at the end".

SC09: "I don't know. But we missed the very first part of getting to know each other and discussing the project and what we do and how they can incorporate in what they wanted to do, what we do".

SC03: "the way it is designed now, very little new can happen. A lot of new things probably happen within the artist when they conceive the project. And they will do their project and we'll be discussing how to do next, but also this is already scheduled".

SC09: "no, this is not okay", "this is not okay". And then whatever was left was still something not related at all with what we do. So we still tried to fit in a bit, helping them to make it a bit more scientifically relevant, but still there was nothing that we were just trying to understand what they do and how to help them make it more scientifically solid".

Misunderstandings emerge from disparate mindsets and methodologies, where scientific rigour and ethics are juxtaposed against creativity and audacity. Most important, however, is the integration of the residency challenge into the scientific framework. If the artist' project is 'closed' to the scientists, they feel that they are only 'giving' but not really contributing to the outcome. The artists, on the other hand, are under pressure to complete their work on time and to follow their own agenda.

A01: "Well, actually, I did all that alone. I did meet some people and discussed with the team. We discussed with different people. And I also tried to discuss it with the author of the paper that I'm participating in. Somehow they don't, they're not very responsive right now. But I'm a person who's been doing this kind of multi-disciplinary work for more than 10 years".

A04: "And of course, if you find that, and then you have to open the concept up again, and I tried, I tried to incorporate some different techniques and different things that came from the other organisations. But it was just hard. And again, like on paper, I wish, I wish that I would have been able to do it. But if I want to stay true to myself, it was not possible".

A09: "because we're artists, we want to see the aesthetics of it. And they don't have any of that. They I mean, they do visualise it, but very abstractly using their own conventions. So, yeah, I mean, it's interesting, but I don't know to what extent our interests will converge in terms of what kind of projects we can do with them".

Nevertheless, the legacy of the collaborative experience leads us to conclude that the achievements of interdisciplinary collaboration outweigh its possible pitfalls. Moreover, it can be seen that mutual influence has been achieved in several cases, which has resulted in an interdisciplinary "wow!" effect.

SC07: "I am always fascinated by the way artists think. I am a scientist and I simply do not have the same world view. Their world view and their questions broaden my worldview, open new doors and give me a different perspective. Of course I will continue to work with artists".

A04: "When we actually saw that this is possible, that it is not just our assumption, but we can actually do it in real life, it brought joy to everyone, everyone was like "wow, this is actually possible!" And it was also great because now we found out that this is something that we can work with and stably develop a technical part of the project around it. And this result was not predicted and this result was a very large and qualitative work, so we were very happy".

In conclusion, the various disciplines cooperate during the residency programme in order to successfully meet the challenge of the artistic project. The 'interdisciplinary collaboration' depends on the management of different ways of thinking and working to create a 'collaborative space' where conversations can flourish. Furthermore, the pressure on the artistic outcome of the challenges can make the partnership between stakeholders and innovation on the scientific side difficult.

## + 5.4. Delving into the Residency Challenge

### + 5.4.1. Synergistic Impacts

This section will examine the impact of the residencies on the researchers and artists who participated in them, as well as the role of the Innovation Catalysts in the process.

The **residency process** is a key indicator that refers to the assessment of the effectiveness of the structure and implementation of the residency. We examine the aspects of actions and conditions related to the residency phase that are crossed by the participants' perspective: the selection process of artists, and the conditions (tangible and intangible) that facilitate the integration of participants into research environments. In this dimension, the role of innovation catalysts in managing and mediating the ongoing residency is fundamental.

The principal indicators for this dimension are Residency performance and Accompaniment. The graph below illustrates the significance of the Innovation Catalyst in this dimension, particularly in its role as an intermediary between the scientists and the artists. It also demonstrates the influence of the Residency Performance indicator on all stakeholders.

Furthermore, the graph demonstrates that the Accompaniment indicator is particularly pertinent for artists in residence and for innovation catalysts, who have been instrumental in assisting artists with the transition from everyday life to integration within the host community.



Graphic 05. Residence process by Stakeholders perspective

The **Residency Performance** sub-indicators refer to activities related to the reception and integration of artists in the scientific and technological centres, including working conditions and local contexts. For example, the nuances arising from travel and stay in the residency centre (when international artists are not resident in the country of the host institution), the time spent in the residency (some artists combine the residency and the project with other professional projects and family responsibilities), etc. Placement signals these contextual adaptations. For example, not being able to speak the local language can be a barrier to communication between artists and scientists in the day-to-day life of the residency, and can affect the relationship between artists and local community partners.

In relation to the Residency Performance, **Setting** indicators provide crucial insights. It refers to the working conditions and facilities provided by the host institutions for interdisciplinary collaboration with the artist. Artists express their satisfaction with the working conditions, the flexibility to organise their work and the conditions set by the scientific community, such as a desk in the laboratory, access to research facilities and technicians, etc. Scientists also express how they have provided the artist with an inspiring environment and access to their resources.

A06: "There weren't too many rules of how we can use software and like resources that we really had an idea and then like technically they allowed that to happen. I think there's this trust factor as well like when you feel that as well between people that's really nice".

A07: "In this sense, we were really lucky to have a place where we can work in the needed conditions. So, this was really special to have this opportunity. It also changes up the process really well, considering how complicated it is".

SC09: "Even before proposing the challenge we were prepared to have one space for them to come here. She said, I am not able to meet with them every single day, but they can come here. They can install something here. And I think basically become part of the group".

SC07: "We have a very well-developed support system for artists. We have a tissue culture lab, a microbiology lab and a makerspace with lots of useful machines. In this case we used the microbiology lab and of course the makerspace".

Another issue raised by all stakeholders was the definition of the open call. Its nature implied the presentation of a very well-defined project that was able to address the challenge.

However, having to present a developed project meant that it was difficult to change or modify later, also due to time constraints:

SC03: "The way it's designed is they come with a project, you select it, they do it. And then we try to discuss things, but new things can't happen the way it is designed now, very little new can happen. A lot of new things probably happen within the artist when they conceive the project".

FG: "Concerning the call, I think that one thing to think about is to what extent are calls to projects conditioning the whole process, the whole research and production process. We have received artistic projects. The idea is that these projects evolve in collaboration with scientific or technological centres or professionals, but at least for our experience in STARTS in the City, when projects are so closed or are very well defined, in fact, sometimes we are dealing with some difficulties on opening these projects during the process".

Thus, the main difficulties regarding the dimension of the residency process have to do with **Temporality**. Some artists and scientists pointed out that, in some cases, the time frame of the residencies made it difficult for artists and scientists to engage in deep and meaningful collaboration.

Time is important, but time does not pass equally for all. Artists pointed out questions related with the temporality of the residence more emphatically (44%) than scientists (27%) and innovator catalysts (27%). Temporality intersects with the conditions of setting in a way that creates difficulties for the development of the residency programme. It should be noted that for all the artists interviewed, one year is a reasonable period of time, but "de facto" is too short if you have to combine project development and residency. The common feeling of the artists is that a one-year project plus residency is feasible, but if some obstacles arise, the result is a shorter residency than expected.

A01: "So it's also a good timing after one year, if you see it's not gonna work, well then it's not gonna work. That's it. But so one year is quite short, but it's not super short. I'd say that it's not short if you can continue".

A05: "Well, I would have liked to have finished longer. I would have liked to have... expanded the time parameter, because it allows you to think about the gaps in between as you're doing. I mean, I was encouraged quite quickly to get into a production phase. Specifically around the questions all the time, "what are you doing?", "What are you making?" Rather than "what are you thinking?"

A08: "I also only really started in January. So it would have been good if I had another three months, but we pushed back a few things towards September and so on. So I can deal with it. It's not ideal, but it's something I can work around and we can all work around with".

A11: "My expectations, different expectations, but the truth is that this was a nine-month residency, supposed to start in October. And in my case, it didn't actually start until January. So, we already lost two or three months within that. So what was already quite a short residency, became an even shorter residency".

A02: "For my personal way of working, it's too fast. I am unfortunately very, I'm like a snail compared to a butterfly. It goes much faster. So for my way of working, it's too fast. But for, I think for, let's say an average project when you have experts working together with an artist, I think it's okay. It's okay to have a period of six months to eight months residency. Usually my rule of thumb is when you really want to be transformed, you have to use about a year. A year is more when you really become familiar with the whole residency and where you come out transformed. So it's a little bit on the edge".

A03: "I think the time frame is okay. I think if it was framed differently in terms of the relationships it would be better. I mean it's an incredibly dense thing to organise. I see it. It's sometimes overwhelming, like wow, how do they organise all of this? So that's why I wish it was a bit more optimised to make the relations better. I think another framework, but it's very different. If it was longer, it would be a different framework, but maybe it would be about having a period of research and development before production. But in the same frame of the same experts and maybe being embedded in one of their realities more directly".

This last quote addresses a common understanding that the residency period is crucial for 'real' interdisciplinary collaboration, and that there is a tension between two different aims of

the programme: to deliver a product to a wide audience and to engage in partnership to experience interdisciplinary collaboration: product versus process.

A11: "This is a production project and residency. The grant is already very clearly specified.(...) So that means we have to complete the project to a point where it's fully functioning for audience engagement and it works. (...) That is not possible, it's not possible to do interdisciplinary research within the time frame and delivery for an outcome. But there's a very clear tension to me between delivering a product and collaboration and sharing ideas and developing things together and knowledge exchange".

A04: "If there's anything that I would like to see more flexibility, more flexibility, I would say. More flexibility, more time and actually more importance is given to the end result instead of the process".

The scientists agree that a year is a reasonable time to develop the project and, unlike the artists, they feel that the pressure of time is beneficial in terms of maintaining interest and focus. At the same time, however, they agree with the artists that spending time together is essential for engaging in 'real' interdisciplinary collaboration. And some of the 'disconnection' they express comes from not taking more time to share their thoughts with each other, and this undermines innovation. This tension between project and residency, creativity and innovation, was also noted by the Innovation Catalysts.

SC04: "Sometimes to deliver the maximum, it's also good to be under time pressure. So in general, I think we're not at the end yet. And I think it will work out within the time that we have. And maybe then it's just fine. On the other hand, I also think if you take more time, then maybe it could have been a little bit more not necessarily creative, but more innovative".

SC09: "we thought it would be more of a real residency. It didn't have to necessarily mean to have them here for six months locked in a room, but definitely more longish periods of times, and also more ongoing communication, which if they would have been here physically, that's easier because just even if it's one moment you meet, getting some coffee and then you talk because that's how it works here at the end of the day. You often end up talking with colleagues about joint projects or joint things when you cross them in the corridor and say "look, have you seen the email, what do you think?"

IC04: "So I think this residency period might be too short if you expect them to interact, develop like each other and then produce an artwork. So maybe in that case it's more focused on the research itself than the outcome. But in our case, because they already had some connections and lines of work established with scientists, it was a bit easier to begin".

Many participants felt that not being in the same place could affect the collaborative dynamic. For artists, not spending much time in the host institution also meant not having access to certain materials and conditions necessary for their artistic research and project. In addition, collaborative research was a way of fostering interactions between artists and researchers:

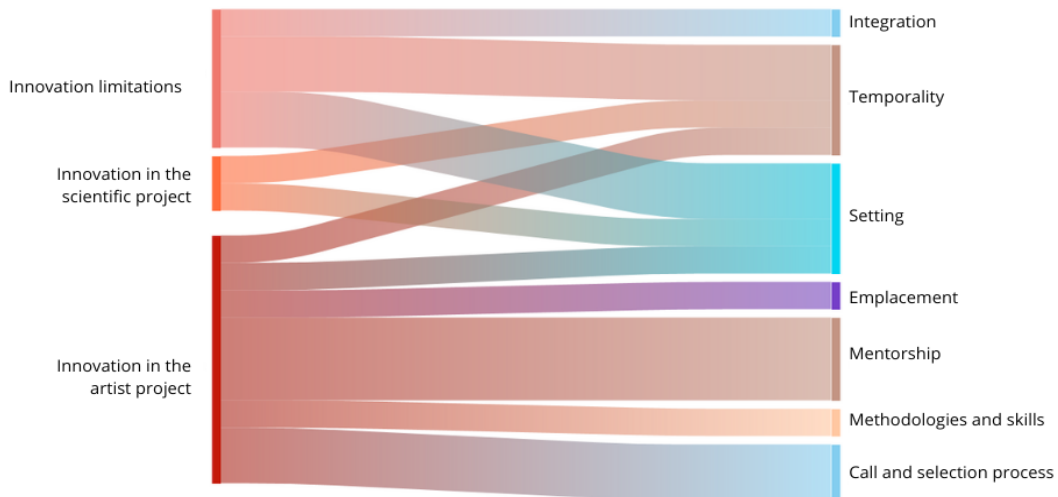
IC05: "Most of the interactions between the artists and the scientific team have taken place via email or online meetings. The same has happened between the IC and the artists, the relationship has been mainly through digital channels. I think this has been determined by the fact that the artists are from abroad, and because their physical presence in the research center's facilities has been minimal [...] which has not facilitated the relationship nor the process of cross-disciplinary and collaborative work".

A08: "The only thing that bothers me is that I don't have the equipment [when I'm not at the host institution]. I don't need a lot of equipment. I have my computer, I have a sound card and I need a screen and these controllers. But it would be really fun or useful if I could buy that for myself and have it here in storage so I can do everything myself".

The graphic below shows the synergies between the innovation and creativity indicators and the residency process. We can see the indicators that facilitate or limit scientific and artistic innovation. Difficulties in the correct timing of the residency and shortcomings in the framework conditions, together with problems in the integration of the artists, are the most relevant factors affecting innovation on the scientific side. On the contrary, the stimulation of innovation in scientific research clearly depends on a well-established framework and a continuous and fruitful time at the residency.



Artistic creativity and innovation emerge as the most significant benefits of the residency program, albeit the most complex and influenced by multiple factors. Notably, mentorship stands out as a critical element that artists attribute to facilitate artistic innovation. A deeper analysis of the data reveals that artists hold high expectations for the Local Expert Group (LEG), viewing it as essential for enhancing their projects. They heavily rely on both the Innovation Catalyst and the LEGs to achieve their objectives, which will be further explored in the subsequent section.



Graphic 06. Innovation and Creativity by Residence Process Indicators

+ 5.4.2. Encompassing the residency journey

In this section, we conduct a comprehensive analysis of the critical role of accompaniment during the residency process, focusing on the Indicator **Residency Process** and its three sub-indicators: mediation, mentorship, and methodologies and skills. Mediation refers to the role of Innovation Catalysts, who facilitate communication and collaboration among all parties involved. Mentorship encompasses the expert guidance provided by the LEG, which is crucial for the development and success of the artists' projects. Lastly, methodologies and skills pertain to the specific procedures and competencies applied to foster effective relationships between scientists and artists, ensuring a productive and integrative residency experience.



Graphic 07. Residency Process by Actors Perspective

The graphic highlights mentorship as the most crucial factor from the artists' perspective, emphasising the significant impact of the Local Expert Group's (LEG) guidance and advice on project development. From the total mentions to LEG, the 39% corresponds to artists and the

36% to the Innovation Catalysts, only the 6% of the researchers mention this role of mentorship, and sometimes, problematically. Artists value their interactions with the LEG for the diverse perspectives and insights they provide, which challenge and enrich the artists' understanding of the intersection of art, technology, and science. Consequently, the LEG's feedback is instrumental in shaping the project's direction.

AD03: "Our engagement with this diverse group of practitioners has shaped the project seminally. We have been moved by our expert's input and critical questions. The residency provides the support to test this idea out and gain the visibility and trust needed for the project to go on".

The various meetings with the LEGs have provided the artists with crucial feedback to focus on the key elements of their artworks and narrow down their research. Their objective was to establish a framework for interaction with LEGs and the scientific partners, thus facilitating the further conceptualisation and development of their artwork.

AD05: "I have met with the 11+ members of the LEG team, who all offered different suggestions and opinions of the developing ideas based around the challenge. Which in itself was interesting that it seemed to be shaping into a sort of committee, and all had completely different opinions based on the challenge which seems more like a brief. Suggestions that resonated with me about critical versus observational manifestations and uses of AI are what I took away from all these meetings".

Artists acknowledge that the interaction with LEGs has also been highly formative in terms of the interdisciplinary collaborative experience. However, some artists point out some pitfalls that can hinder this rich mentorship and exchange of ideas. On the one hand, the meetings can be very formal, and some artists perceived these sessions as being like a conference or being in front of a jury, difficulting the feed-back. On the other hand, working together is seen as essential for developing innovative ideas.

A05: "The LEG meetings, the first one was fantastic, and there were 10 people. I did suggest to trim it down because there were too many. I'm better in smaller groups, but there was even more in the second LEG meeting. There were 14, 16 people in the room. I felt more like I was giving them a lecture and repeating things that I'd said rather than exploring new ideas".

A04: "And I just have the feeling that if everything is so rigidly categorised and you have to deliver this and that, a lot of these informal moments just get lost. Because I just felt it also with the experts in the beginning. Most of them were there, but then they saw, oh, it's so formal near the end. Everybody was online. And then it's even more detached".

Innovation Catalysts often had to help both artists and scientists resolve the tension between the production of artworks and the process of collaborative research. Finding a balance between the two sometimes felt like an obstacle. In this sense, the mentoring provided by the LEGs was sometimes too focused on the outcome and made the artists feel that they had to defend their project rather than find ways to collaborate and research together. As one ICs reflected:

IC05: "One of the main goals of the facilitation was to find a balance between the production of the artwork, the pressure that the exhibition was supposed to put on the artists, and the common research interests".

Mediation implies different kinds of tasks in coordination (meetings, events). This role of "making things happen" is highly valued by artists and scientists and is also linked to ICS concern in developing methodologies for "translating languages" and promoting innovative collaboration. During the focus group discussion, the Innovation Catalysts reflected on the need to facilitate a rich experience and to develop methodologies that help participants to create a collaborative climate. Additionally, they emphasised the importance of flexibility and adaptation on the part of the Local Expert Group (LEG) in order to align with the evolving needs of the project. Furthermore, they underscored the necessity of developing methodological tools to provide guidance to local experts, as "it's part of the accompanying process but it feels more like monitoring".

## + 5.5. Long-term Sustainability and community impact

### + 5.5.1. Legacy by actors and dimensions

Assessing the long-term sustainability of the outcomes of the residency programme is a complex and challenging task. One of the main reasons for this difficulty is the extended time frame required to evaluate such outcomes. The true impact of the residency may not become apparent until years after the programme has ended, making it difficult to track and measure lasting effects.

Moreover, the outcomes of residency programmes are often multifaceted, encompassing both tangible outcomes, such as completed projects and exhibitions, and intangible outcomes, such as changes in perceptions, skills and relationships. Measuring the sustainability of these diverse outcomes requires comprehensive and nuanced evaluation methods.

The continued involvement and commitment of different stakeholders, including artists, researchers and community members, is crucial to the sustainability of the outcomes. However, changes in stakeholder engagement or priorities can affect the long-term success of residency outcomes.

In this section we present the results of the qualitative analysis of how the residency programme contributed to the S+T+ARTS general aim to foster innovation at the intersection of science, technology and the arts, with a focus on addressing social, environmental and economic challenges. We also include the public engagement indicator, as community participation and public dissemination of the project might have long-term effects.

Here we will refer to the long-term sustainability of the residency's outcomes. Specifically, we compare the perspectives of the stakeholders with the legacies in relation to three main indicators: Interdisciplinary Collaboration, Residency Process, and Innovation and Creativity.

The legacy of the collaboration process is perceived comparatively highly by Innovation Catalysts (64%) and less so by artists (27%) and just mentioned by the scientists collective (6%). While the legacy of the innovation is perceived equally by artists and scientists (24 and 27% respectively) and is a matter of concern for the innovation catalysts (50%). The residence process legacy shows similar results as the innovation legacy indicator.



Graphic 08. Legacies in Residence Process, Interdisciplinary Collaboration and Innovation and Creativity by Perspectives.

While the quantitative data demonstrate the success of the residencies through tangible results, such as the artworks produced or completed by the end of the residency (see section 4.4), the qualitative data reveal that the intangible outcomes depend on the long-term impact of interdisciplinary collaboration. These intangible outcomes include the sustained innovation,

creativity, and knowledge exchange that continue to evolve beyond the immediate completion of the residency projects.

The graphic below illustrates the significance of interdisciplinary collaboration as a crucial indicator for fostering future engagement within partners and further development of the artistic project. It emphasises that the long-term impact on the community is only realised when there is a collaborative effort or when there are changes in mutual perceptions.



Graphic 09. Interdisciplinary Collaboration by Long-Term Sustainability

As an Innovation Catalyst noted, the relationship between the artist and the scientist evolved from initial curiosity and cautious exploration to a deeper mutual understanding and respect.

ICD05 The scientists were initially sceptical, as they had never worked with an artist before. However, they became fascinated by the project’s poetics and discovered new possibilities for utilising the data.

From the artists’ point of view, collaborating with local and international research groups has been particularly enriching, allowing for the integration of various disciplinary influences. Working alongside scientists has been instrumental in exploring new perspectives and expanding the impact of the artists’ work, aligning with the aims of the S+T+ARTS initiative.

A11: “So really, the approach that I’ve been taking is let’s foster this relationship closer to when this residency ends. Because in reality, it takes a year to develop that time. It’s really short on time. It takes a while.(...) For me, that becomes a more meaningful approach to taking a residency than what happens in a very soon start. [Now] we can use that for a further research collaboration. So we’re using this as a really nice groundwork that’s ready for a real collaboration post residency”.

Scientists tend to highlight legacy in terms of the impact of the artist mindset in their worldview:

SC03: “yeah, to some extent it did so looking at how artists look at it and some ideas on there are definitely some ideas that I will try to keep that I’ve learned from this”.

SC07: “Like all artistic projects, it has reached the point of realisation, which marks the end of a period of work. My expectations have been fully met and I am very proud of our collaboration and the results. (...) I am always fascinated by the way artists think. I am a scientist and I simply do not have the same world view. Their world view and their questions broaden my worldview, open new doors and give me a different perspective. Of course I will continue to work with artists”.

### + 5.5.2. Legacy and community engagement

Public engagement is a core aspect of the S+T+ARTS initiative. The programme encourages public participation in its projects through exhibitions, events and other outreach activities. By engaging with the community, S+T+ARTS aims to raise awareness of the role of art in technological and scientific innovation and to foster a deeper understanding of the societal impact of these advances. The local community helps to amplify the impact of the residency projects by spreading awareness and promoting the outcomes. Their involvement ensures that the benefits of the projects extend beyond the residency and leave a lasting legacy.

The graphic below illustrates that the most substantial legacies are associated with the residency programme outcomes and societal impacts. Notably, acceleration is scarcely mentioned overall, due to the fact that the S+T+ARTS in the City Acceleration Programme has been developed only within residency projects directly linked to the promotion of competitive products and it is less pronounced in university or scientific research centres.



Graphic 10. Long-term sustainability by perspectives

By engaging the local community, the S+T+ARTS programme aims to create a more inclusive, collaborative, and impactful environment for innovation and creativity. Innovation Catalysts have been working diligently to ensure community participation and achieve long-term impact. However, it is important to recognize that working with local communities takes time, especially for international artists who may arrive with limited knowledge of the local context and their own interests. These artists can sometimes be seen as parachutists, arriving on site with little understanding of the local reality. Despite these challenges, the engagement of the local community and public participation in organised events has generally been satisfactory. Nonetheless, it must be acknowledged that efforts to achieve societal impact through community participation in the artwork design process did not always yield uniformly expected results across all residencies.

A06: "I also think it has an impact. On like a general audience, on the scientist, on cultural institutions, reaching other audiences through re-exhibiting it. So there's definitely reach in that sense. It's just not that it's like product driven in the end".

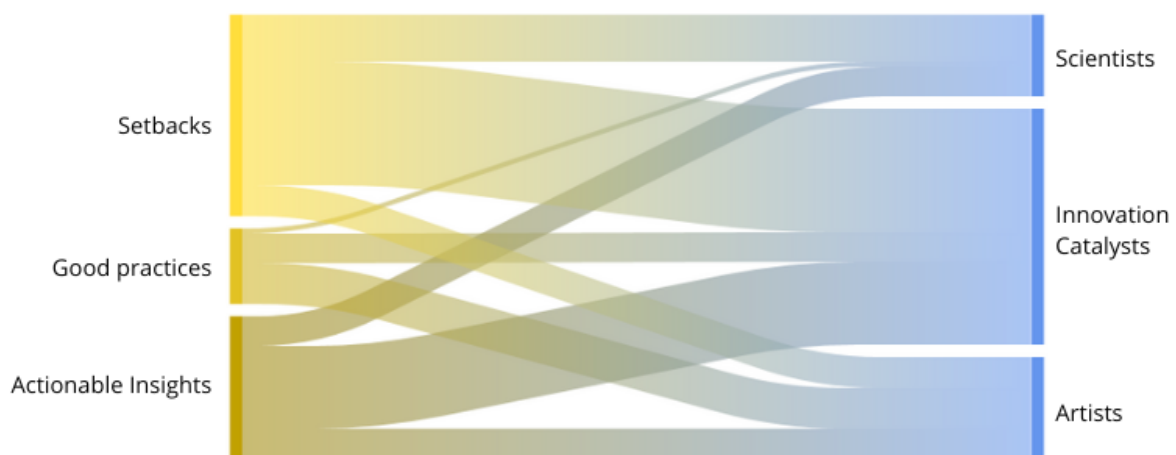
SC02: "So, for me the project is successful when the engagement of the participants is high enough to make it successful. It is conceptual, but in art, that's not an issue. I think with art, conceptual art".

A08: "Yeah, actually that workshop we did in March, so we went to the allotments. So it's like the public gardens, like where people have a small piece of land. And a professor and innovation agent, they were saying, we'll be not too many people, maybe five, six or something. But then we came there, it was on a Friday and then on Saturday. On Friday, there were 30 people and everybody was interested. And on Saturday, there were also some 30 people, but also people who had been there on Friday, they wanted to see it again. (...) And they already could see the data, so they could scan the code and they were watching it on their phone. And they were really enthusiastic about it".



Scientists predominantly concentrated on the challenges they encountered, with 58% of their feedback highlighting difficulties. This aligns with findings from the interdisciplinary collaboration dimension and the perceived issues in engaging with artists' work (section 5.3). Notably, only 8% of their feedback mentioned successes, suggesting that achievements in their areas of interest have been less frequent or less emphasised. On the other hand, artists presented a more balanced perspective. While 30% of their feedback pointed to difficulties, a substantial 39% celebrated successes. This balance suggests that artists are equally aware of the challenges and the positive outcomes in their work. Additionally, 31% of their feedback included recommendations, showing their proactive approach to improving practices. Interdisciplinary collaborators (IC) fell somewhere in between. They reported difficulties in 52% of their feedback, which is closer to the scientists' perspective. However, they also provided a fair amount of recommendations (33%) and acknowledged successes in 15% of their feedback. This indicates that while they face significant challenges, they also see room for improvement and recognize achievements.

In summary, scientists tend to focus more on the difficulties they encounter, artists maintain a balanced view of both challenges and successes, and interdisciplinary collaborators provide a mix of all three aspects. This diverse feedback highlights the different experiences and perspectives each group brings to their work.



Graphic 12. Learnings by Perspectives

A detailed analysis of stakeholder feedback indicates that the Innovation Catalysts provided the most comprehensive insights. Their dual perspective and involvement in daily management allowed them to offer a thorough understanding of the process. As a result, their unique viewpoint sheds light on the main challenges and successes of the residency process, as well as potential areas for improvement.

ICD06: "What I have learned from this residency is the importance of continuing to cultivate relationships with major research institutions, creating awareness and culture about the potential of art/science collaborations. We have already started working in this direction, particularly by involving local policymakers in co-design meetings aimed at stimulating relationships and collaborations. During these meetings, we have presented concrete examples of success where artists and scientists have produced innovation together".

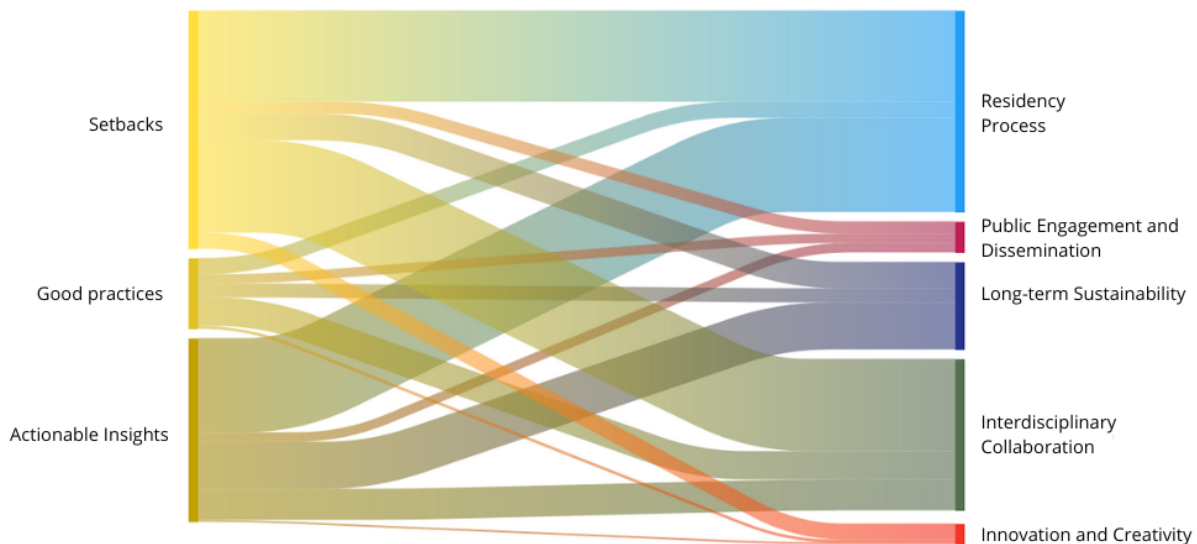
IC06D: "several valuable lessons emerged that can be applied to future residencies cross-fertilization based: It is crucial to establish clear communication and set expectations from the outset. This involves outlining the challenges and benefits of collaboration, ensuring that all parties understand the process and their roles within it. Initiating relationships and sharing results early in the process helps build trust and understanding. This is particularly important when working with public institutions or new partners who may not be familiar with interdisciplinary collaborations. Being open to adjusting methods and approaches based on the needs and feedback of all participants can lead to more effective and satisfying

collaborations. Flexibility allows for the accommodation of different working styles and the integration of diverse perspectives. Maintaining a constant exchange of ideas and feedback is essential. Regular meetings and discussions help to keep the project aligned with its goals and ensure that any issues are addressed promptly. Understanding and working within the local cultural and structural context is vital. Engaging local stakeholders and leveraging local scientific resources can create a supportive environment for the residency. Ensuring that the collaboration is intellectually stimulating for all parties can sustain enthusiasm and commitment throughout the project.”

Scientists and artists, however, tend to provide fewer insights overall. This can be attributed, in part, to the nature of their involvement in the project, the timing of the collection of information, and the different approaches they bring to the residency. Nevertheless, as will be seen in the following section, the three groups contribute valuable perspectives.

## + 5.6.2. Good practices and actionable insights

In this section, we will focus on the **good practices and actionable insights** provided by the different stakeholders, as the difficulties have already been discussed in the previous sections of analysis regarding the different dimensions. The good practices indicator allows us to identify the successes and effective strategies implemented during the residency programme, and highlights the positive outcomes of interdisciplinary collaboration and integration within the residency. The actionable insights indicator gathers all the recommendations made by the participants based on their experiences.

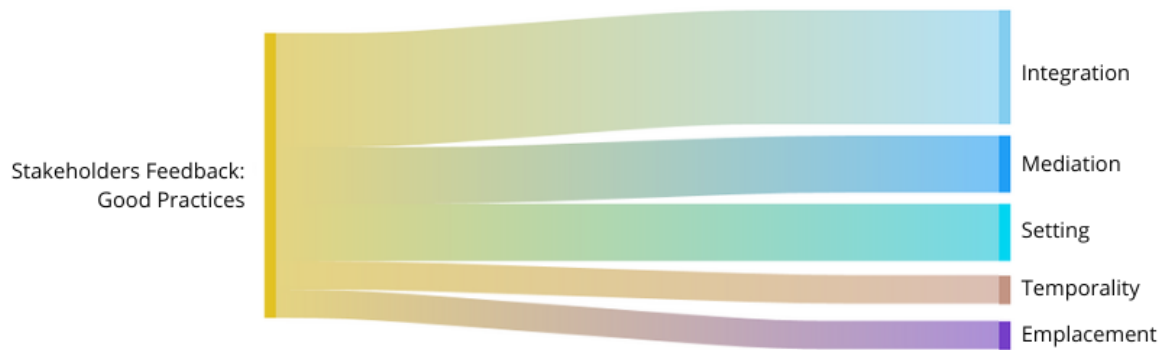


Graphic 13. Stakeholders Feedback by Dimensions

In terms of good practices, we will initially examine the dimension of the residency process and subsequently the interdisciplinary collaboration, as these are the two dimensions in which participants have identified positive outcomes.

The most positive aspects highlighted in relation to the performance of the residencies relate to the successful completion of the residency (integration, setting and placement) and the significant role of mediation (mostly provided by Innovation Catalysts).





Graphic 14. Good practices by Residency Process

The **integration** indicator and the opportunity to work within the facilities of the host institution and its researchers is a key factor in the success of the collaboration. For numerous artists, access to laboratories, materials or spaces was pivotal for their artistic research and the development of their artworks. For scientists, sharing a space with artists streamlined the process of identifying collaborative opportunities and influencing each other's work, fostering a convergence of artistic and scientific research interests. The shared physical environment also fostered interpersonal connections between individuals, which emerged as key practice for successful collaboration.

A07: "In this sense, we were really lucky to have a place where we can work both the sterile place, where we can work with bacteria, and also a workshop also at the same place where we can work with computers and build these machines. It was really special to have this opportunity".

Furthermore, this integration allowed for interactions with other actors and the local community. This included, reaching out to other departments, connecting with university students and fostering relationships with citizens and local organisations:

A06: "The science organisation that we collaborated with, they've been really generous from day one. Being on site we weren't just partnered with like, one department in a way, they were really open for us to speak into a lot of departments".

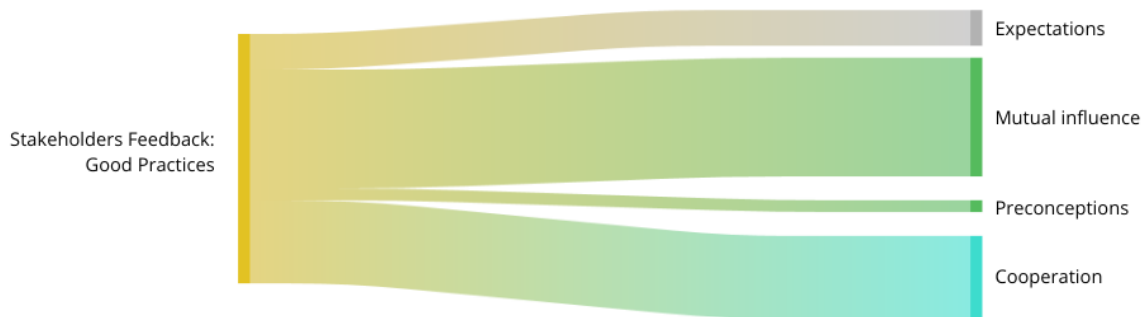
A11: [Being on-site] "has been unbelievably useful. Meeting researchers, NGOs, charities and non-profit associations, even learning associations.... That has been, in many ways, the best learning that I've ever had. Meeting such diverse different voices who are working on different but really similar things has also been really amazing".

In this regard, the **mediation** provided by the Innovation Catalysts was perceived as a pivotal element in facilitating integration (both within the host institution and within the local community) and in achieving a shared common language between artists and scientists.

A08: "The Innovation Catalyst, they really help in facilitating things. For example, they organised the public events, the first one that we had at the farm where we could show our project. So they are really useful in facilitating stuff".

SC09: "The Innovation Catalyst is very good at really trying to understand the needs and the ways of working from both sides. And I think they're really trying and they're good at trying to, as we said, kind of almost translating".

In terms of **interdisciplinary collaboration**, participants highly valued the mutual influence and cooperation achieved by the different actors involved in the residency.

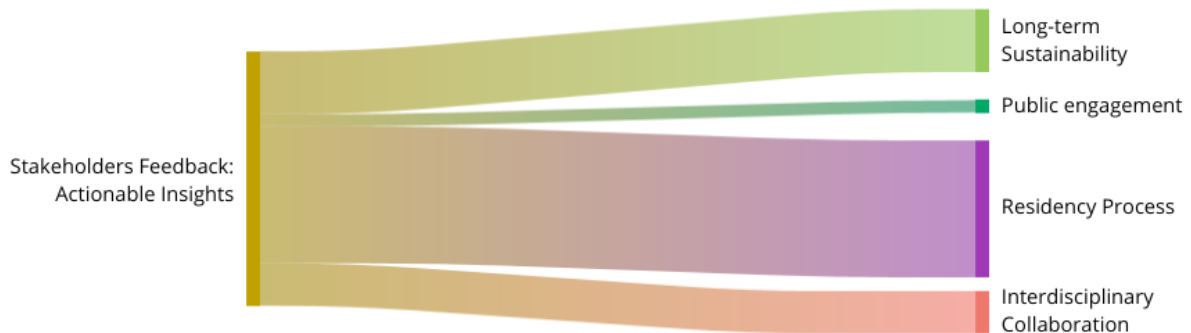


Graphic 15. Good practices by Interdisciplinary Collaboration

Participants highlighted good practices related to the possibility of working together and influencing each other. They also emphasised the importance of discussing expectations at the outset of the residency, which they perceived as a crucial step in fostering alignment between the scientists and artists involved. This process helped to establish a common understanding, align goals, and build a foundation for trust. In this way, the sense of imbalance pointed out earlier in this report was reduced in the residencies where more time was dedicated to initial discussions, and the artists and scientists involved reported positive outcomes of the residency. In the following quote we can see how the Innovation Catalyst organised a meeting with the artists and scientists to share their expectations and ambitions, which later led to feelings of satisfaction and reciprocity:

IC01: “We had also asked them [research centre] beforehand to think about how they see their involvement in the residency and how they could contribute to this collaboration, which they also included in their presentations. This way the artist got a clear view on who he will be collaborating with, while at the same time it was a nice way for the experts to get to know each other and understand their respective ambitions for the project”.

Looking at the **actionable insights**, most of the recommendations relate to the residency process, followed by the long-term sustainability of the project.



Graphic 16. Actionable insights by dimensions.

In general, the recommendations made by the participants in the dimension of the residency process related to the setbacks in terms of time, methods and skills. Therefore, participants felt that a longer **timeframe** for the residency would be beneficial for future projects, as it would facilitate collective research time and foster interdisciplinary collaboration.

IC01: “The residency is quite short, it would be nice to give the artists more time to develop their projects, to dive deeper in the research and have more time for production”.

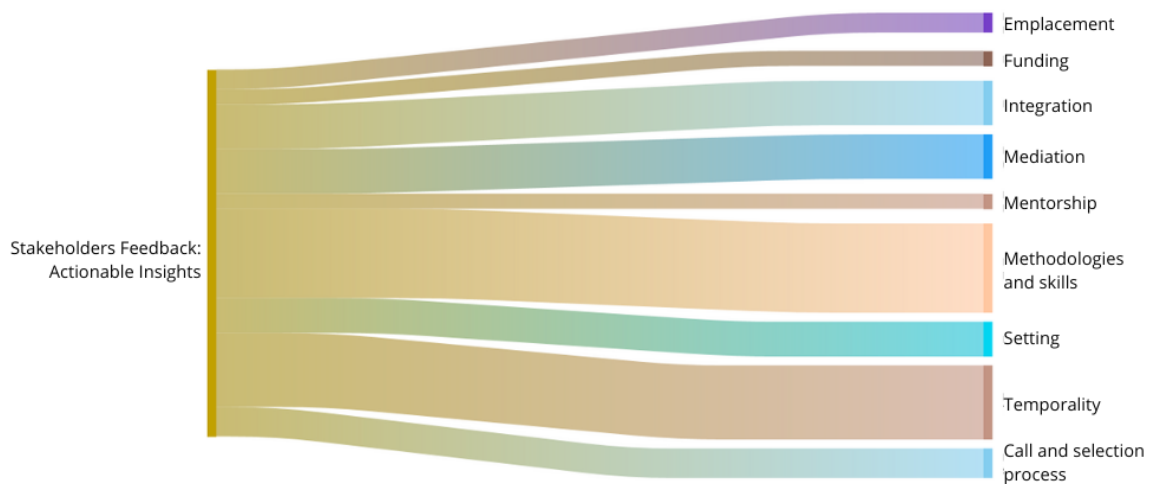
In terms of **methodology and skills**, artists, scientists and Innovation Catalysts felt that the residency programme could be improved by providing a framework or training to help artists and scientists get to know each other and develop a common language:

A10: “One thing I’d change is providing a sort of training to the researchers and lab staff, and also to the artists [...] Some sort of workshops to help break the ice, spending time together”.

IC02: “It could be also interesting to design these kinds of guidelines, “how to”, these kinds of recommendations, on how to foster these kinds of collaborations, sort of steps or tools”.

Similarly, Innovation Catalysts felt that training in specific areas, such as mediation, could also improve the development of the residencies by facilitating their role.

IC05: “It would be really meaningful and helpful to have some kind of tools and learning programs that capacitates this kind of mediation profiles in this process. Because in fact, for example, one of the processes has been more difficult than the others in terms of understanding between the parties. And in fact, I felt like I had to become a kind of professional mediator, social mediator, or even a conflict mediator”.



Graphic 17. Actionable Insights x residency process

Finally, in terms of **long-term sustainability**, one of the most important actionable insights that emerged from the interviews and diaries was necessity to establish robust connections with the local community in order to guarantee the project’s continuity and innovation beyond the residency period:

IC02: “It is necessary to work on the local context, both structurally and culturally. This means engaging with local stakeholders to activate research centres and industries for this type of collaboration, including through local funding programs and initiatives. This approach aims to create a conducive environment that supports interdisciplinary collaborations with a win-win perspective”.

In conclusion, the comprehensive collection of good practices and actionable insights provides a deep and nuanced understanding of the success aspects of the residency. It does not only highlight the effective strategies that emerged during the collaboration, but also outlines specific, actionable proposals that can be implemented in the future.

## 6. CONCLUSIONS AND WAY FORWARD

The objective of this document is to provide a synthesis of the experience gained from the residencies conducted as part of the S+T+ARTS in the City project. This synthesis is intended to inform the development of a set of indicators that could serve as a model for the evaluation and diagnosis of the S+T+ARTS programme as a whole.

The multifaceted nature of the projects, the diversity of topics, methodologies and actors involved, and the interplay between the perceptual aspects and the actions undertaken have shaped the process of developing the indicators included in this document.

In light of the aforementioned complexity, it was not feasible to adhere to a conventional methodology. For this reason, and in order to move beyond the conventional approach of evaluating a process or project over a specified period using a standard set of indicators measuring the efficiency of investments, the proposed analysis combines the distinctive features of the projects developed within the S+T+ARTS in the City framework with a forward-thinking perspective, a multidirectional approach that reflects the reality of the whole S+T+ARTS programme through the lens of its transformative power.

We propose a novel paradigm shift, one that expands the quantitative indicators traditionally associated with project performance. In its place, we propose a set of complementary markers that will enable us to focus on the transformative capacity of art-science-technology-driven innovation, while awaiting further work that will allow us to elaborate a comprehensive set of indicators. This conclusion contains this twofold approach.

## + 6.1. From KPI to KTI

The codification has been instrumental in measuring performative indicators, yet it also points out the necessity of evaluating transformative processes, which could be regarded as a foundational output of the S+T+ARTS residencies.

Nevertheless, a specific challenge emerges when attempting to quantify the productivity of transdisciplinary projects, which is frequently oriented towards particular outputs such as artistic works, patents, or prototypes. This stands in contrast to the necessity of evaluating the transformational impact of these collaborative, cross-disciplinary residencies.

This dilemma between productivity and transformation in transdisciplinary projects arises from the conflicting priorities and objectives that the different disciplines and the different actors involved bring to the project. Productivity is concerned with the efficiency of a project in meeting its targets, whereas transformation involves deeper and often more long-lasting effects, such as paradigm shifts, disruption of existing models or the emergence of new collaborative fields. In this context, transdisciplinarity can be defined as the creation of a position that transcends the boundaries of conventional disciplinary categories, goals and methodologies. This concept was previously articulated by Roland Barthes<sup>4</sup>, who observed that to engage in interdisciplinary work, it is not sufficient to simply select a 'subject' (a theme) and to situate two or three sciences around it. Rather, interdisciplinary study entails the formation of a novel object that is not solely attributable to any single discipline.

To encourage innovation, it is essential to cultivate transformative processes across a range of disciplines, including the arts, sciences and technologies. A comprehensive evaluation of both qualitative and quantitative indicators, including Key Transformative Indicators (KTIs), can assist in identifying and assessing the potential of residencies to bring about long-term impacts in society. The incorporation of KTIs into the S+T+ARTS residency programme would facilitate a more expansive and nuanced assessment of cross-disciplinary outcomes, enabling a transition towards a greater emphasis on long-term transformations over short-term performance metrics. This would allow for a more comprehensive evaluation of systemic changes, interdisciplinary collaboration, and societal influence, which are often challenging to quantify with performance data alone.

---

<sup>4</sup> Roland Barthes, "Research: The Young" in "The Rustle of Language", University of California Press, 1989.

The following section will present the reasons why the mixing of quantitative and qualitative measurement to create KTI is needed:

**1. The limitation of quantitative data in capturing the nuances of complex interactions.**

The focus of quantitative data on isolated, measurable outputs (e.g., number of artworks, number of exhibitions, number of papers, patents, etc.) has been identified as a potential shortcoming in fully capturing the intricate dynamics of interdisciplinary collaboration, creativity, and transformation. Qualitative data, such as that obtained from interviews, case studies or observations, provides insight into the underlying processes at work, for example, how partnerships between artists and technologists give rise to new innovation pathways. It is of the utmost importance to assess the quality of cross-disciplinary exchanges in order to ascertain their capacity to foster new ideas or problem-solving approaches.

**2. Evaluating Long-term Impacts**

Transformation initiatives, such as those driven by S+T+ARTS, frequently seek to achieve long-term cultural, scientific, technological, or social shifts. These changes are frequently subjective and rooted in perceptions, which makes it challenging to measure them with numbers alone. Qualitative methods, such as focus groups, interviews, and surveys, provide more detailed and nuanced information.

**3. The concept of transformation is closely related to the concept of the innovation ecosystem.**

This transformation involves systemic changes in innovation ecosystems, which can be observed in a number of ways. For example, new patterns of collaboration are emerging, mindsets are shifting, and new approaches to contemporary challenges are being developed. These factors are not readily quantifiable; however, they can be observed through qualitative metrics, such as the nature and quality of interdisciplinary partnerships and the openness to new approaches. These factors have an impact on innovation schemes and make the disciplines more flexible to adapt to challenges.

**4. The measurement of creativity and innovation processes.**

The inherent non-linearity and difficulty in quantifying creativity and open innovation make them challenging to assess. Processes that are driven by the convergence of science, technology and the arts should result in outcomes that are both unanticipated and emerge over time. A methodology based on purely quantitative approaches may fail to capture the essence of these processes. Qualitative assessments can be used to capture the manner in which ideas evolve, the nature of creativity that is at play, and the innovative thinking that emerges from collaborations between artists and scientists.

**5. The measurement of transdisciplinary research processes frequently encounters challenges related to intangible and unpredictable qualities.**

These include the building of trust, mutual recognition and appropriate credit; a balanced and open participation of actors from various sectors; and possibilities for renegotiating at least some of the established rules, norms and demands according to new participants and shifting needs. In order to properly evaluate these processes, a transformative measurement assessment is required.

Qualitative measurement facilitates a more profound comprehension of the mechanisms underlying transformation, particularly in the case of intricate, interdisciplinary processes. While quantitative data is crucial for monitoring outputs, qualitative insights are invaluable for understanding the performative process itself. However, to further examine the transformative impact of transdisciplinary encounters, Key Transformative Indicators need to be developed

and added to the evaluation process as they could better assess the dynamics, and systemic changes that drive long-term innovation.

## + 6.2. Enhancing collaboration

In examining the most effective strategies for promoting transdisciplinary collaboration within the S+T+ARTS in the City residencies, in which artists form partnerships with scientists and innovation catalysts, we will focus on the findings of the analysis conducted on all five dimensions - interdisciplinary collaboration, innovation and creativity, residency process, public engagement and long-term sustainability-, regarding the prerequisites for optimal transdisciplinary collaboration.

**Transdisciplinary collaboration** is a process that unfolds between individuals from disparate skill sets, knowledge disciplines, semantic backgrounds, social contexts and cultural legacies when tackling common challenges. In this context, collaboration is then displayed as a framework in which the individuals involved have to be regarded as agents who can learn from and are subject to social dynamics, and who are situated within cultural environments.

This partnership is mutually beneficial for both artists and scientists. Artists gain valuable support and inspiration from their scientific counterparts, while scientists benefit from unique perspectives and creative disruption brought forth by artists. Furthermore, the pivotal function of innovation catalysts in facilitating communication between the two groups is underscored.

The results of the analysis demonstrate the positive impact that transdisciplinary collaboration has on the realms of art and science. Furthermore, the analysis underscores the **significance of cooperation, transformation, and mutual influence as indispensable factors in determining the success of interdisciplinary collaboration**, meaning that a good collaboration involves a shift in the way we think about the relationship between art, science and technology (not just long-term collaborations, but a new way of understanding the relationships and feedbacks between these areas).

The significance of interdisciplinary collaboration in **cultivating creativity and innovation** is a crucial topic in the field of research. It draws attention to a perceived imbalance between scientists and artists in terms of their contributions to innovation and creativity. The available evidence indicates that scientists perceive their influence on artistic innovation to be constrained, whereas artists express that they have not engaged with scientists to the extent that they would have liked. The findings of the analysis indicate that the discrepancy between scientists and artists may impede innovation in scientific pursuits. Furthermore, it draws attention to the difficulty of integrating disparate mindsets and methodologies between the two disciplines, thereby reiterating the old dilemma between the “two cultures” that has frequently been perceived as an impediment to interdisciplinary collaboration and implementation. The objective to bridge this gap is to foster collaboration and holistic understanding across disciplines, recognising the value each brings to the broader pursuit of knowledge.

Furthermore, the **perception of imbalance** is also reflected in the current approach of the residency programme, which does not make it clear from the outset what scientists will receive in terms of remuneration or results. In this sense, the lack of definition of this 'return' may lead to the urgency of achieving immediate tangible results to ensure progress in the process. This may also be related to the specific professional context and processes of scientific research, where progress in some direction is necessary.

With regard to the collaboration during the **residency process**, the role of the Innovation Catalyst has been notably proactive, an aspect that we believe holds great significance. Moving forward, this must be maintained and, potentially, improved upon. The role primarily entails the ability to foster networking and collaborative events, elevate peer awareness, and acquire the necessary knowledge for the development of such initiatives.

Furthermore, there is a **discrepancy in the concept of residency itself**, with varying models employed depending on the characteristics of the host and the flexibility of the artist to travel and spend time at the host centre. This ambiguous definition of residency, while facilitating a broad range of residency modalities and intensities, has an impact on both the quality of the collaboration and its sustainability.

The analysis also yielded insights into the **potential advantages of engaging new specialised stakeholders** (LEG members) at different stages of the residency, with the involvement tailored to the specific needs of the project. This strategy has the potential to augment the project's overall value. However, in line with some findings, it is necessary to address the involvement and the role of the LEG to ensure their optimal effects on the project.

On the dimension of **public engagement**, in the majority of cases analysed, the pressure of the calendar and the necessity of obtaining tangible results have meant that the opening of the collaboration process with a larger audience has not been feasible. The role of citizens in the aforementioned processes is, in most cases, not clearly defined. As they involve highly specialised approaches (such as those of artists, scientists and other experts), there are only a few instances where a strategy for citizen involvement has been established. Nevertheless, in instances where such involvement has been possible, it has been evidenced that engaging an interested audience in collaborative research cultivates a sense of co-ownership and co-responsibility, facilitating both the development of more human-centric approaches and finding better solutions for applied technologies and broadening the scope of research.

In terms of **long-term sustainability**, the evidence suggests that scientists perceive a greater degree of disconnection in comparison to artists or innovation catalysts. Moreover, there is a perception of a smaller degree of reciprocal influence and lasting transformation in their mutual perceptions. This discrepancy can be attributed primarily to differing mindsets and methodologies, particularly in terms of scientific rigour and ethics. Additionally, there is a challenge in fully integrating the artistic project within the scientific framework. Scientists frequently express that they are merely "supplying" to the artist's project without genuinely contributing to its outcome. In contrast, artists often feel compelled to adhere to deadlines and meet their own agenda.

Despite anticipating potential difficulties due to diverse skills and the multiplicity of individual goals, the participants remain optimistic in successfully navigating the collaboration obstacles. All of them emphasise the importance of individuals from different backgrounds learning from each other, developing a diverse skill set and acquiring new competencies.

### **Key Challenges:**

Further challenges are recognised, including communication issues, differences in mindset and methodology, the pressure to produce artistic outcomes, and the integration of artists into scientific research teams:

#### **Communication**

The findings emphasise the importance of open and transparent communication and setting clear expectations when collaborating with others. It highlights the need to communicate both the challenges and benefits of working together and to ensure that all parties involved

understand their roles and stresses the importance of building trust through actively sharing information and results.

Language misunderstandings and disputes between artists and scientists are usual, as they must communicate effectively and understand each other's perspectives and expectations. Different disciplinary jargons and professional cultural contexts lead to communication problems.

Nevertheless, in such cases, these misunderstandings become valuable sources of insight. A transformative approach is to guarantee that the collaboration is intellectually stimulating for all parties involved, by highlighting the cross-fertilisation approach and the innovative potential and broader impact of the work. It is therefore important for all actors involved to address and learn from these misinterpretations rather than dismissing them.

To effectively tackle these necessary frictions, the collaboration could be improved if a) is provided by a framework or training that can help artists and scientists create a shared language and build upon the semantic frictions; b) recognises the significance of being flexible and open to feedback; and c) is accompanied by a mediator/innovation catalyst capable of building a context of mutual understanding and supporting consistent exchange of ideas. Regular meetings and discussions serve to keep the project aligned with its objectives and ensure prompt resolution of any issues that may arise.

### **Openness degree**

Maintaining a willingness to adapt methods and strategies in accordance with the needs and feedback of all actors involved in the project can guide more effective and gratifying collaborations. The ability to be flexible allows for the incorporation of divergent working styles and the integration of diverse perspectives. Openness requires a dynamic project development to allow artists the freedom to pivot their projects as they gain insights during their residency. This adaptability encourages innovation and the exploration of new concepts that may emerge during the discussions with researchers.

Nevertheless, there is a concern that open-ended objectives and an exploratory mindset, which allow artists and scientists to pursue curiosity-driven projects that may evolve in unexpected ways, may be perceived as a threat to the focus on fixed outputs that characterised such collaborations.

### **Predetermined outcomes**

One important output of this analysis is on the research process and the nature of the collaboration in relation to the outcome. It also highlights the value of establishing aligned expectations early in the residency process to establish a strong foundation for cooperation. The analysis has demonstrated that the orientation of the collaboration programme towards the achievement of a tangible result conditions the collaboration processes in various ways.

In relation to the call for proposals, it was observed that the majority of projects selected by the residency hosts (science and technology centres) were chosen on the basis of the clarity of their proposals and the tangible nature of their outcomes.

In the case of the scientific centres, the pre-eminence of the tangibility was identified as the element in the path to be followed, without delving into the "experimental" field of the collaboration on the one hand.

The primary challenge is to transfer the dominance of the result and transfer the weight in the collaboration to achieve a greater quality of process. This may be accomplished through an extension in temporality and a focus on open-ended research, or through the identification of artistic projects that have already commenced but lack a clearly defined outcome.

Such a shift would need a reconfiguration of the high visibility events and a rethinking of the conditions of communication of the results and the knowledge transfer.

### **The role of the Innovation Catalysts**



The necessity of achieving collaboration is the main objective of the Innovation Catalyst. It is essential to provide facilitators with methodologies that facilitate the creation of conducive conditions and the use of effective communication tools. Additionally, it is vital to ensure that they perceive themselves as catalysts, rather than merely facilitators, in their managerial roles. Their work is less constrained by disciplinary knowledge and methodologies. Rather, it could be described as an itinerant way of thinking to encourage a dialogue between different disciplines.

## **Institutions and funding**

Bodies seeking to provide support for transdisciplinary research must address a number of challenges that require a shift in traditional research frameworks: it is imperative that they facilitate opportunities for open-ended creative experimentation, even in the absence of an immediate market application. Furthermore, it is essential that investment extend beyond technical infrastructure to encompass media projects that facilitate access and participation. It is recommended that small-scale, short-term funding be provided in conjunction with long-term structural support, and that methodological flexibility be given greater priority than rigid subject-based structures. It is also essential to acknowledge non-traditional research outputs. There is a pressing need to incentivise interdisciplinary work by providing specific support by applied science laboratories in universities and offering accreditation and financial rewards for interdisciplinary contributions. Finally, funding bodies should encourage and support research conducted in non-traditional settings, or "in the wild", in order to embrace diverse approaches and outcomes.

## **Innovation process**

Effective management of interdisciplinary collaboration is crucial for fostering an environment conducive to productive discourse, particularly in addressing complex artistic challenges. By establishing transparent communication channels, promoting mutual respect and trust, and aligning objectives across the residency, management can facilitate the bridging of differences in perspectives and methodologies, thereby creating an environment conducive to creativity and innovation. Structured coordination also ensures that all voices are heard and that the collaboration progresses smoothly, facilitating the successful integration of ideas and ultimately leading to the completion of shared artistic objectives.

## **Social and open innovation**

The S+T+ARTS framework represents an optimal context for the coexistence of diverse innovation models, which should be encouraged in a balanced manner. In addition to the advancement of innovation in technological or productive terms, with a clear orientation towards potential industrial or market applications, there is a need to encourage an open innovation of research and production processes towards a broader range of agents and organisations. The creation of rich, plural and diverse innovation ecosystems is linked to the incorporation of professional or expert profiles, as well as non-expert (citizen) profiles, in the search for joint solutions to the challenges posed. Furthermore, the promotion of social innovation must be linked to a positive and sustainable impact of the processes themselves, as well as their outcomes, on society as a whole.

## **Temporality**

The restricted time frame for research, production and exhibition influences the trajectory of collaboration and affects public engagement, particularly when working in unfamiliar contexts or with new partners. The establishment of trust and mutual understanding is an incremental process that necessitates sufficient time. Furthermore, evolving outcomes require ongoing reassessment, which may require flexibility in the implementation timeline of the residency.

### + 6.3. Improving S+T+ARTS

**Ensure a matchmaking process to establish a solid basis for transdisciplinary/trans-actor collaboration:** facilitate a multi-stage selection process to consolidate cooperation before the project is funded. This could be promoted through a variety of measures, such as:

- + A pre-selection of artists, before the final decision, who will enter into a proposal development process with scientists and core experts from the consortium to ensure a fit between artistic interests, scientific interests and real challenges facing society;
- + a proposal of the methods that the artists will use to ensure collaboration in the project included in the call.

**Ensure a clear definition of an interdisciplinary residency:** the material and temporal conditions of the residencies are of crucial importance for the promotion of transdisciplinary projects with a transformative impact, both between scientists and artists and between the development of the project and the local context. It is therefore recommended that a common conceptual framework for the residencies is developed, taking into account a range of characteristics:

- + A residency should enable trust between the different participants
- + A residency should begin with a session in which participants share their expectations and viewpoints.
- + A residency should ensure the smooth running of the collaborative process and allow the different disciplines to feed into and be fed by the residency.
- + The residency should provide a safe environment and a skilled mediator to support the project and facilitate conflict resolution.
- + The residency should be able to provide and open up spaces for connection and exchange that facilitate the continuity of the collaboration by becoming part of a wider community

**Enhance the skills of the Innovation Catalysts:** the findings of this report show that the Innovation Catalyst is a crucial figure in fostering interdisciplinary collaborations between scientists and artists. The findings gathered during the focus group with the ICs organised within S+T+ARTS in the City showed that, in order for the IC to be able to promote the expected transformation and innovation, the S+T+ARTS programme should facilitate specific training for the acquisition of skills such as:

- + Communication and facilitation skills, with a focus on translational skills to be able to transfer scientific concepts into a language that resonates with artists and vice versa, without diluting the complexity.
- + Deeper knowledge in scientific and artistic research methodologies and constraints.
- + Active listening to understand the nuances of both parties.
- + Conflict resolution skills to manage potential mismatches.
- + A leadership style that encourages collaboration and equal participation, enabling both scientists and artists to contribute fully.
- + Community building to promote public engagement and social innovation.

Moreover, the S+T+ARTS programme could include regular peer learning sessions where Innovation Catalysts share best practices, challenges and insights from different S+T+ARTS projects.

**Exploration Time vs. Production Time:** the necessity for high productivity often results in the implementation of a rigorous schedule, which can restrict the amount of time allocated to exploration and experimentation. On the contrary, transformational projects may need a greater investment of time to facilitate experimentation, iteration, and the nurturing of creativity, which could result in a postponement of discernible outcomes. The introduction of

multiannual grant schemes or the establishment of a permanent open call based on challenges could serve to mitigate the constraints on experimentation.

**Funding Constraints:** the funding bodies that comprise the S+T+ARTS initiative tend to favour projects that can demonstrate clear and immediate outcomes, such as the exhibition of artworks during high-visibility events. This approach may inadvertently stifle the development of transformative initiatives that require a longer timeframe to bring results.

Also, alternative remuneration channels should be explored to provide incentives for scientists and other collectives involved in the development of the residencies. Such a move would not only facilitate the establishment of genuine interest on the part of all collaborating parties, but it would also help to ensure the principle of equal conditions for the work done.

**Emphasise Learning:** ensure that the framework of S+T+ARTS reflects that both productivity and transformation are valuable, emphasising that learning from the process, even when outputs are not as expected, is an essential component of successful collaboration.

**Recognise academic and scientific research contribution:** academic institutions and research centres should facilitate the recognition of scientists' commitment to the collaborative project through academic credits, recognition of the time dedicated to the project in the academic Knowledge Exchange system, recognition of the value of interdisciplinary research in the arts and sciences and its inclusion in the ERA (European Research Area) scope.

**Outcomes:** the results of this study demonstrate that the primary outcome of the S+T+ARTS transdisciplinary residencies is the creation of artistic artefacts, with other potential outcomes being given less consideration and limiting a wide range of transdisciplinary research results. Below, we propose a different set of possible outcomes that could be included in the outputs of future programmes:

- a) Academic outputs:
  - + Publications and research papers.
  - + Development of new theoretical frameworks or models that bridge different academic disciplines.
  - + Creation of new research methods that can be applied across disciplines, advancing the way data is collected, analysed or interpreted.
  - + Academic recognition: awards or recognition of interdisciplinary research within academic institutions or conferences.
- b) Non-academic, non-textual (performative) outcomes:
  - + Material artefacts.
  - + Technological prototypes and innovations
  - + Artworks, installations, exhibitions.
  - + Community projects
  - + Citizen mobilisation, civic participation initiatives and grassroots movements.
- c) Collective practices, creating lasting (transformative) bonds between researchers:
  - + New knowledge: new interdisciplinary knowledge and new research insights arising from the collaboration of different research practices.
  - + New critical and analytical approaches and new cross-disciplinary methodologies.
  - + New disciplines (emerging fields of practices) and new interdisciplinary fields
  - + New interdisciplinary research centres that facilitate ongoing interdisciplinary collaboration.
  - + Collaborative platforms to support interdisciplinary work..

**Legacy:** it is evident that a considerable amount of expertise has been accumulated by previous grant holders. This could be optimised through the implementation of a system of mentors or 'critical friends', who could provide support mechanisms for emerging or high-risk collaborations between the arts and sciences. By leveraging the insights and experiences of artists, scientists, and innovation coordinators from past residencies, this network would enhance:

- + Enhance knowledge transfer;
- + Foster trust;
- + Help navigate interdisciplinary challenges;
- + Ensure more robust and innovative outcomes;
- + Promote continuity and legacy, creating a collaborative ecosystem that can adapt and grow across future projects.

One potential point of reference is the existing European Expert Network on Culture (EENC), a well-established platform that brings together cultural experts to provide analysis and advice on cultural policies within the EU. The EENC's principal function is that of a policy advisory body, addressing cultural dynamics at the macro level and working in close collaboration with policymakers.

In contrast, the proposed mentorship network for S+T+ARTS projects would operate as a practitioner-oriented support system, specifically geared towards facilitating collaborations between artists and scientists within the context of innovative, interdisciplinary projects. The proposed S+T+ARTS mentors network would adopt a hands-on approach, providing guidance and mentorship to participants in real-time, addressing the challenges of transdisciplinary research and production, while also informing European policies that enable and sustain these practices in the long term.

**Define the role of the Regional S+T+ARTS Centres (RSC):** a fundamental consideration for the long term impact of the S+T+ARTS residencies is understanding and operating within the local cultural and structural context. Engaging local stakeholders and capitalising on regional scientific resources can establish a conducive environment for the S+T+ARTS residencies. The RSC could serve as localised hubs for fostering interdisciplinary collaboration between artists, scientists, and technologists. The centres built expertise upon previous experiences, would provide hands-on assistance, would serve as regional knowledge hubs, documenting best practices and methodologies while facilitating public engagement through workshops, exhibitions, and outreach activities that connect communities to cutting-edge projects.

As incubators for regional art-driven innovation, the centres would:

- + Provide a permanent context for transdisciplinary experimentation and innovation.
- + Support research conducted in non-traditional environments, thereby fostering new, context-driven approaches and challenges.
- + Foster cross-regional collaboration, facilitating the integration of local outcomes in wider European regions with similar challenges.
- + Collect and disseminate knowledge and learnings among European regions.
- + Establish a dynamic ecosystem for innovation, ensuring long-term support and growth for S+T+ARTS projects

# S + T + ARTS

<https://starts.eu>