MindSpaces

Art-driven adaptive outdoors and indoors design

H2020- 825079

D2.1

Arts in society

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Abstract

D 2.1. Description of the scientific background supporting emotional and behavioural effects of art in society, and related ethical issues.

This report will examine the connection between arts and emotion, by examining the relevant literature, from various perspectives, including psychological, neurological, philosophical, aesthetical. This will provide a solid foundation for interpreting the effects of

art and discovering how emotional and behavioural responses can be invoked by art and will define a novel working model between artists and technology-oriented partners and users. The potential for resulting societal benefits will be investigated, to understand how they should be used within the context of MindSpaces.

By this way, solid foundations are going to build that will enable the technical partners to implement their tasks on the relevant Work-Packages (WP3, WP4, WP5).

WP3. Sensor data collection. It will acquire the data that are required so as to inspire artists and architects to deploy their installations.

WP4. Analysis of emotional, cognitive and environmental sensing. It will analyse the offline data and build a Knowledge Base (KB) of the acquired digital data.

WP5. MindSpaces adaptive environment development. It will concern the development of environments adapting online to integrated emotional, physiological, visual, textual measurements, to produce emotionally-relevant and functional design.

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History

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Executive Summary

The deliverable Arts in Society has the objective of establishing the conceptual bases for Art driven research/ innovation of the project MindSpaces / STARTS Lighthouse that wish to solve social problems and increase the wellbeing of the citizens associate with their perception of the public space, experience in working venues or improvement of private interior homes. The deliverable goes from more holistic knowledge to specific information of research to be used in MindSpaces project through the three uses cases described in the DoA. Also, the document offers relevant case studies that could inspire the trans-disciplinary work, research and innovation that is expected between artists, architects, engineers and other professionals and citizens in this STARTS Lighthouse project.

Additionally, this deliverable wish to offer to all the partners of the Consortium (multiple backgrounds from architecture, ICT engineering, neuroscience, cultural management, etc) an update overview of the current knowledge of the influence of Art in society and in human emotions, and also what are doing the contemporary artists in relationship with the new emerging technologies, not only as new media of expression, also about critical thinking of their impact in society.

The deliverable is divided in three sections:

1) **Art and Society** will explore conceptually the philosophical approach to the influence of Art (under their different expressions: visual arts, performance arts, music, theatre, poetry, literature, etc) from an historical point of view to our contemporary era.

Followed by subtopics closer to MindSpaces project objectives: Art and Public spaces, Art and Designin professional environments and Art and domestic environments.

2) **Art and emotions**, this part is focusing in giving a strong conceptual approach to the key issue in MindSpaces project, how to produce **environments that are emotionally connected** with the users: citizens, workers and the elderly. An academic overview of the recent research projects will offer to the partners of MindSpaces a scientific background and it will improve the testing prototype procedures that will be develop during the project.

3) **Art and Technology in MindSpaces**, this section wish to offer a more practical guideline of the trans-disciplinary research to develop through the MindSpaces project, analysing through current artistic projects how the technologies presents in MindSpaces are used by them, and their conceptual approach. Additionally, it will be a documentation of the more successful methodologies in trans-disciplinary work art, science and technology, and how it could be successfully applied to MindSpaces.

Finally, the deliverable is a Compendium of sources of knowledge that will allow partners of MindSpaces project, other researchers and public in general to go further in their research and approach to the topics in study.

Abbreviations and Acronyms

DoA	Description of Actions
AI	Artificial Intelligence
VR	Virtual Reality
STEAM	Science, technology, engineering, arts and maths
EEG	Electroencephalogram
PUC	Pilot Uses Case

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1 INTRODUCTION

Contemporary urban design and interior design addresses an ever-changing set of needs that arise in expanding cities, workplaces and homes requiring new functionalities and emotionally-relevant aesthetics. In recent years, advances in cognitive science, sensory technologies and the arts have been facilitating embodied knowledge through the senses which can inform engineers and architects about the way citizens experience their surroundings.

In MindSpaces innovative design, ideas will be introduced through art practices, their ability to imagine futures that do not just reflect the current consensus in mathematics, logic and engineering, setting into motion new ways of seeing, hearing, touching, feeling, transforming and experiencing spaces, places and communities.

In the conclusion of the *think tank*, Contemporary Research Intensive, 2017, organized in the context of the 57th Venice Art Biennale, they mentioned: "**It is a basic assumption that art can operate as an advance laboratory for investigating processes of meaning-making and for understanding wider developments within culture and society."**

The goal of this event was to define accurately the concept of Contemporaneity, and they defined it as:

"Contemporaneity refers to the temporal complexity that follows from coming together in the same cultural space of heterogeneous clusters generated along different historical trajectories, across different scales, and in different localities". (The Contemporary Condition 10, 2018)

These thoughts expressed in this important *think tank* are aligned with the main goals of **STARTS program** and MindSpacesproject which is about **thinking outside-of-the-box** and **building bridges between Science, Technology and Arts**. STARTS is a European initiative based on the conviction that collaborations between artists, researchers and engineers lead to **innovation** and **mind-openness**, generating **more inclusive and sustainable innovation**.

MindSpaces' visions and goals refers to the most urgent problems to solve in our contemporary society. In Luca D'Acci's recent paper, *New type of cities for liveable futures. Isobenefit Urbanism morphogenesis*, 2019, he points out that most **planetary problems** such as climate change, biodiversity loss, ecological degradation, pollution, as well as humans' psychological and physical well-being are linked with **degenerative urban design**. He continues to indicate that we need to imagine ways to make cities habitable, and that a better city will offer a better life to millions of citizens. (D'Acci 2019).

On the other hand, we have an **increasing potential of creative people** with artistic practices. Recent studies in Canada, Germany and UK are demonstrating that art practices, and its studies, are becoming highly popular in young people, and at the same time, institutions such as the United Nations, reported in 2010, recognise the influence of culture in economic growth and development. (Sholette 2018)

Ars Electronica is promoting "**Art thinking**", a key factor in envisioning wellbeing society, questioning the "reality" and the systems and behaviours that society is using nowadays. In a recent interview with **Hidaeki Ogawa**, the director of Art Thinking School, he said: "we want to use art to foster dialogue and emotions. Art can be very effective in helping to create your own compass and envision the future. Art Thinking allows us to have our own compass, to see society from a critical perspective, in different ways."

Authors like Holer are pointing this relationship between art and society as interdependent, and the interactions of Art need to play a major role with knowledge and scientific methodologies. (Holer 2009)

This proposal has the objective of establishing the conceptual bases for art-driven research and innovation of MindSpaces project and STARTS Lighthouse who wish to solve social problems and increase the wellbeing of the citizens associated with 1) their perception of the public space, 2) experience in professional environments and 3) improvement of domestic environments.

2 METHODOLOGY

The methodology for creating this deliverable is described in the following steps:

a) Initial research of relevant literature: academic paper publications, book publications, public interviews, conference content, art exhibition visits and its catalogues, etc, was done following a first criteria suggested by an index of related topics. Each partner involved in the task sent an abstract of his initial research of the topic assigned, and then produced a selected list of bibliography and references.

b) A second round of research happened after a brain-storming workshop of key words that could define the report, those ideas were coming from the initial research and readings and also for the potential needs of the project in wp3, wp4 and wp5. This process of brainstorming was done in the Plennary meeting of MindSpaces Consortium.

c) A final table of contents was agreed by the Coordinator of the project, and the document was written under a process of several authors to bring to document many different approaches and professional experiences (artist, architect, cultural manager, social entrepreneur, educator, etc) from the partners of MindSpaces.

d) The resulting document was revised by peers, from the Consortium, arriving to a final agreement and publication.

3. ART AND SOCIETY

3.1 Aesthetics, Arts and Society. A philosophical approach

Since the Antiquityphilosophers analysed the social impact of artistic expression in Europe and in other millenary cultures from other parts of the world such as China, India, Arabic countries and more.

In Europe, the Arts that were in question have evolved throughout history, from Greece to Rome where theatre and poetry were the most prestigious of the arts, until the 18th century where visual arts has been accepted by the intellectuals.

The philosophers and thinkers were attributing to the **Arts' diverse functions, influences** and **relationship with Society**, from educational purposes and cultural identity to moral and civil values and, or just, pleasure effects. Art was associated with aesthetics until conceptual Art appears in the second half of the 20th century, where the objective is no longer just the artwork, it is the artistic idea that replaces it.

Analysing all the contributions that philosophy has done in the interrelation between Art, Aesthetics and Society, it could be very extensive if we consider all the cultures around the world, that's why the following text will mainly discuss the historical evolution and the contemporary situation in the European and Western framework. Nevertheless, we will dedicate the last part in analysing the contribution of this discussion from the philosophical approach of one of the most ancient cultures in the world, the Chinese Taoism.

The relationship between Art and Aesthetics has been widely looked at by philosophers as concepts that are separated.For example, from the first arguments of Kant and his definition of artistic beauty (Osborne 2004) to the contemporary philosopher Adornowho wrote about the autonomy of Art and the absence of a transcendent and inalterable aesthetic criteria (Harding 2001). Aesthetics is defined as more of a sensitive or perceptual capacity of humans, and Kant introduces that the existence of only aesthetic appreciation should not be compared between Art and a pure appreciation of the nature of the objects. The art experience also involves an ontological experience marked by functions that are metaphysical, cognitive and politico ideological. The current situation of contemporary art is defined as post-conceptual art, following the proposed transition, between the 20th and 21st century, to modernism, conceptual art and post-conceptual art. Contemporaneity is not accepting just aesthetic objects as art objects. By the definition of the cultural industries, many other creative practices has been considered cultural such as design, publicity and media, but not Art. (Osborne 2004).

Going back to the origins of this debate between the role of art in society and its relationship with aesthetics, we would need to review literature in philosophy on ancient Greco-Roman culture. In *The Social Impact of the Arts* | *An Intellectual History*, the authors,

EleonoraBelfioreand Oliver Benett, explain that it was the ideas of the most prestigious philosophers in the Classical Greece:

"Plato's suspicion of the arts – poetry and theatre – derived from his belief in the strong hold they have on the human psyche. By affecting the irrational part of the psyche, the arts can affect both the ethical sphere and human behaviour ".“Aristotle was the first who attempted to separate the theory of the aesthetics from that of morals. He maintains that the end of the poetry is a refined pleasure. If the poet fails to produce the proper pleasure, he fails in the specific function of his art." (Belfiore, Bennet 2010)

We could see that the most prestigious Greek philosophers attribute to the Arts, mainly in theatre and poetry, as a social impact and influence. They recognise that human thoughts and emotions could be modified by Arts and also introduce the concept of pleasure that will be a continuous argument during centuries. In Rome, those ideas were supported by Cicero. Horace also included the concept of usefulness to the delightful. (Belfiore, Bennet 2010).

During the middle ages in Europe, literature from priests went against poetry as they believed that it was immoral art. Those arguments changed substantially in the Renaissance, 15th-16th century, where authors like Bernardino Daniello argue that poetry is the art of life and could teach better than philosophy. (Belfiore, Bennet 2010)

Leading to the 18th century, during the French enlightenment, other arguments about the influence and functions of the Arts are written by philosophers such as Diderot, Marmontel, d'Alembert, Condillac and Voltaire. Moral and Civil values are the main objectives of arts which impact society. Similar ideas are expressed by Kant in his Critique of Judgement where art is described in a moral direction. (Belfiore , Bennet 2010)

Kant's ideas will be very influential in the following centuries because it is the start of seeing Art as an independent concept from Aesthetics. Nevertheless, Hegel's theories argue that Art needs to be placed in the same level as philosophy and religion, introducing the concept of *beautiful art* that corresponds with the Ideal, but also recognising that Art could be not beautiful (Tarozzi Goldsmiths 1999). In the 18th century, philosophers conceptualized Art as independent of any functionality, being a different direction that other cultures in other part of the world. (Zaidel and 2013)

Contemporary processes of intellectualization produces the idea that Art is more intertwined with other disciplines like philosophy. The loss of the objective of art could lead to nihilism, which is why interaction with science is used by the artist to give meaning to their concepts (Tarozzi Goldsmiths 1999). In the words of conceptual artist, Joseph Kosuth, art is a question of intellectual searching and thinking, not just a question of beauty and aesthetic pleasure or whether the work of art has materiality or if it remains as an idea when it doesn't have form (Ihringova 2018). Thus, we lead to Danto's definition of *work of art* not as a physical object, but as a materiality that transmits meaning. (Foster 2011).

Other contemporary thinkers like Gadamerdon't agree to the idea of beauty, and they concentrate their attention in the anthropological bases of Art, defining three concepts:

play, symbol and *festival*. *Play* brings the social purpose to the Art debate again and *festival* introduces the flexibility and multidimensionality of time. (Foster 2011).

Exploring philosophic ideas in other parts of the world, we also need to consider the Chinese culture of Tao. In Wengao Huang's study, *New Media Art as Embodiment of Tao*, he says: "Western culture, rooted in Hellenism, must be radically revised to deal with the **complexity of our digital age**. The resonance between natural sciences and Eastern mystical traditions can contribute to the formation of **a new worldview that is holistic and ecological with enhanced spirituality**." (Alexemberg ed. 2008)

The concepts based in Chinese Taoism are bringing awareness and aesthetic experiences, based on intuition and imagination, to the new media working in generative and interactive art. (Alexenberg ed. 2018)

Concluding this overview, the relationship between Art, Aesthetic and Society, under the philosophical point of view has evolved throughout the centuries.

Some of the concepts of philosophers argue that connecting Art and Aesthetics are always in the mind of a big part of society, that's why it continues to be difficult for the general public to understand works that are based in ready-made or conceptual art where the object itself is not the artwork. The moral and ethical mission of art is again in question due to a part of society considering some art expressions as immoral or unethical. Also, algorithms that manage social media censor art that exhibit nudity or other "immorally" scandalous issues.

Gadamer's theory, connecting art with *play, symbol* and *festival,* opens new approaches in engaging society with Art.

The research that will be carried out in MindSpaces Project could explore those fields artistically, because digital society behaviour is surrounded by playfulness in social media, symbology and global trends in our changing society (climate change, democracy, etc) and the concept of *festival* (time that is breaking our routine) which is a social tendency to feel the reality of life and anthropological needs to be in a community in front of a digital world where people are more isolated and more in contact with screen and not with material objects and subjects.

Additionally, the visions coming from other cultures in the world could improve the philosophy that is embedded in research between Art, Science, Technology and Society. The interconnection between the mind and body, which is the basis of Tao culture, brings in the designs of new technologies, the importance to understand the concepts of awareness and "thinking with the body" that it will be key in developing all technologies related with immersion.

3.2 Art and urban space

The first pilot use case of MindSpaces (PUC1) concerns an outdoor urban setting of important cultural interest. MindSpaces architects and artist will use advanced technologies to propose new urban design schemes that showcase its cultural importance, generate new types of social interaction, and draw attention to social, environmental pollution and mobility (e.g. air or water pollution, traffic congestion, lack of green spaces,) issues the area is facing.

3.2.1 The evolution of the artist involved in social and public space.

With the rapid development of technological changes that promise to profoundly change our lives, the need for both public understanding and participation in this movement is more urgent than ever. In that vein artistic work, and especially public art can provide new perspectives and critically explore and interact with these new technologies.
Following the emergence of computational techniques in the early 21st century, architecture and media arts have become closely connected disciplines. Employing information technologies with machine intelligence, architecture is at a turning point, now expanding the definition and design of 'space' to include realities that we otherwise regard as alternate or virtual. In a letter Marshall McLuhan wrote to the anthropologist Edward T. Hall, McLuhan stated, "When the environment itself is constituted by electric circuity and information, architecture becomes the content of the new information environment.
Architecture is the old technology which is automatically elevated into an art form." (McLuhan 1965)
The medium of architecture, as McLuhan suggested, is beginning to expand beyond just physical materials and structure to consider the facade of a building as a canvas that can be augmented. In direct relationship to these ideas, media arts, and therefore media facades, provide unique opportunities for communication in urban public spaces.
In Matthias Hank Haeusler's work Media Facades: History, Technology, Content (2009), he argues that media facades fundamentally alter the perception of buildings and cities by permitting buildings to dynamically change their appearance (Hausler 2009). A building's surface is the most dynamic part of its character, and its openness to change continuously generates new interactions between people and the urban environment. The cognitive capacities of materiality, building systems and smart cities provide artists, architects and urban designers with new tools to reconsider such interactions from multi-layered perspectives. Architecture and public spaces are transformed into intelligent forms of technology that can autonomously converse with and respond to human perception, the urban environment and other physical or perceptual parameters. Vast flows of urban information are interchanged between the building and the public, creating architectural extensions of the urban realm – a narrative that is otherwise invisible.

In the autumn of 2017, RefikAnadol Studio was commissioned by the Los Angeles Philharmonic to showcase the institution's history and explore its future as a commemoration of its centennial celebration. The home of the Philharmonic, the Walt Disney Concert Hall (WDCH) was completed in 2003 and designed by Frank Gehry, who had famously hoped that the beauty of the music created within its walls would one day be reflected outside. If a building such as the Walt Disney Concert Hall could share its memories – if its 'consciousness' came to life – perhaps we could also imagine a new trajectory for architecture itself. To mark this momentous anniversary, the studio collaborated with the Artists and Machine Intelligence (AMI) programme at Google Arts & Culture as well as Google's open research project Magenta to explore this idea, paying tribute to the past and using the facade of the building to imagine what is to come.
To make the concert hall 'dream', the studio utilised a creative, computerised mind to mimic how humans dream, processing memories to generate new combinations of images and ideas. Working with the AMI and researcher Parag K Mital, a machine intelligence was applied to the orchestra's digital archives –nearly 45 terabytes of data consisting of 587,763 image files, 1,880 video files, 1,483 metadata files and17,773 audio files (the equivalent of 40,000 hours of audio from 16,471 performances). The files were parsed into millions of data points that were then categorised by hundreds of attributes, by deep neural networks with the capacity to both remember the totality of the LA Philharmonic's 'memories' and create new connections between them. Much of the work came from collaborating with retired archivists and parsing through hundreds of thousands of paper records, converting thousands of audio reels, vinyls and out dated recording media into digital files, and working through millions of timesheet entries describing each of the performances. The accompanying soundtrack was also created from hand-picked archival audio. Sound designers Robert Thomas and KerimKaraoglu augmented these selections by using machine-learning algorithms to find similar performances recorded throughout the Philharmonic's history, creating a unique exploration of historic audio recordings. In sum, the archival information – this 'data universe' – was the studio's material, and machine intelligence our artistic collaborator. In order to actualise the audio/visual (A/V) experience, the studio employed 42 large-scale laser projectors, with 50K visual resolution, 8-channel sound, and 1.2M luminance in total. Bespoke custom software in a VVVV programming environment was developed to tackle the challenge of three-dimensional video mapping of the compound curves of the architecture as well as designing an entire simulation of the project in a game environment developed in Unreal Engine software. Virtual-reality tools were also developed to help simulate the totality of the synesthetic experience.
As the performance of WDCH Dreams began, the memories of the institution flashed across the building as it learned about and understood its past. For these scenes, the studio plotted contact sheets of all images and videos stored within the archive, displayed the original CAD files and models of the building, and plotted the lines of code describing the metadata and file names. With an understanding of this, the building began to develop a consciousness

and draw connections between those memories. Google AMI and Google's Magenta teams collaborated with the studio to analyse the datasets and generate classification labels for clustering and mapping the archive using Google search's neural stack. Processed data was fed into dimensionality reduction algorithms such as Uniform Manifold Approximation and Projection (UMAP) to project a 256-latent-dimensional embedded sculpture into 3D space. Generative machine-learning techniques such as NVIDIA's Progressive Growing of Generative Adversarial Networks (PGAN) utilised the images of the institution's history to hallucinate images of its possible futures.

Pairing a computer's mind with a building's structure transformed both, giving the neural networks of the machines a canvas on which to create, and architecture, a consciousness with which to dream.

The project's radical visualisation of the Los Angeles Philharmonic's first century was an exploration of the synergies between art and technology as well as between architecture and institutional memory. The multiplicity of the steel skin recalls Stan Allen's 'Field Conditions', moving 'from the one toward the many, from individuals to collectives, from objects to fields'(Allen 1999). It blurs not only the boundaries between the building and its surroundings, but also the disciplinary divide between architecture and media art. As the building is provided with a unique form of consciousness that is generated through its own archival memories and an understanding of its past, it can begin to dream about all the alternate forms and shapes it could exist in – speculating on what the future of architecture may hold.

The integration of media arts into the design of building materials, facade systems and public spaces has made it possible to fulfil communicative functions. Social contacts and identities are increasingly being determined by virtual spaces in which public life takes place. Architects and urban designers must pay more attention to linking up this new virtual public interface with real city spaces if we are to maintain users' social relevance and urban life. Media architectures could counter the growing sense of displacement in public space – dependencies on mobile devices, ubiquitous screens and social networks – acknowledging civic and sociocultural concerns in public urban settings.

For WDCH Dreams, the urban site played a significant role in the intersections of social media culture, technology and virtual public space. As thousands of Los Angeles community members and visitors witnessed the performance, the gathering space transformed into a social dimension of place not limited to the physical urban realm, but specifically the virtual space of social media networks. For instance, consider that there are over a thousand posts shared on Instagram using the hashtag #WDCHDreams. Can the building learn from this data? Social media popularised the architectural experience to users around the world, unifying them in a public virtual dimension. The instant sharing of location, user and image data ultimately influences the way humans perceive and navigate the built environment by bringing them to the site physically, or virtually via social network sharing. Despite the seemingly lack of social awareness as users concentrate on their screens, photogenic

architecture and media content can provide opportunities to allow alternative interactions with people and environments. (see Figure 1, Figure 2)

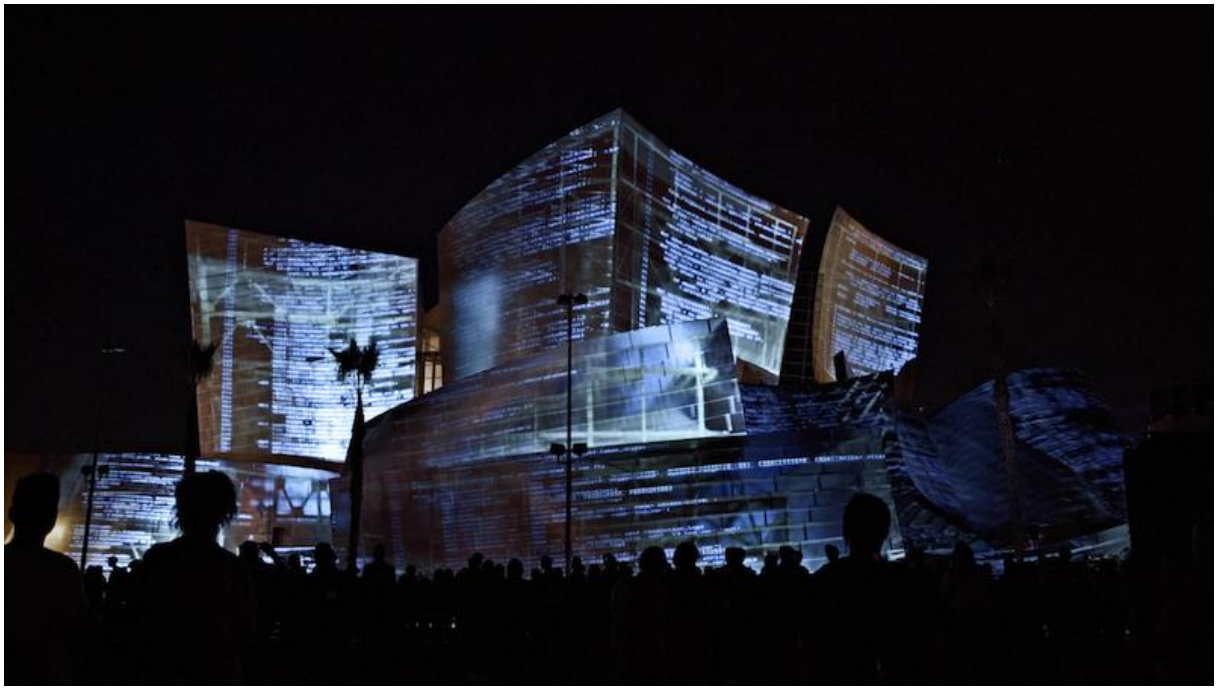

Figure 1. WDCH Dreams project 2018. Copyright RefikAnadol.

In order for these ideas to have any influence on public, the role of art becomes imperative for creating an intuitive understanding. The idea of participatory art, as realized in WDCH Dreams, was noted by McLuhan, "The art object is replaced by participation in the art process. This is the essential meaning of electric circuitry and responsive environments. The artist leaves the Ivory Tower for the Control Tower and abandons the shaping of art objects in order to program the environment itself as a work of art."(McLuhan 1966). Artists have the tools to create projects that shine light on the expansion of human knowledge through social media networks, material technologies, production technologies, computing technologies and many more subfields, and how they impact the lives of people. It is the artist's role to visualise this flux so that it may bring together scientists, artists, educators, urban designers, architects and legislatures to create future platforms that allow all users to opt in and use their data to bring about tangible change.

Media and public spaces – both virtual and physical – house individual inputs for machine intelligence applied to architecture to understand and narrate human behaviour and the social-technological changes that are underway in contemporary society. Borrowing from Lev Manovich's 'Poetics of Augmented Space,' in other words, architects along with artists can take the next logical step to consider 'invisible' space of electronic data flows as substance rather than just as void something that needs a structure, a politics and poetics." (Manovich 2006). Media arts can find many opportunities to visualise all the facets of the urban organism and tap into making the invisible conduit of data visible through tangible performances, augmented architectural spaces and sculptures. This would require a more

interdisciplinary perspective to further explore connections between art, technology and architecture, and how they intertwine with urban or institutional memory.
As Peter Sloterdijk notes in “Excerpts from Spheres III: Foams”, “He who engages in making articulate background realities that were previously kept in unspoken shared thoughts or knowledge—and even more in what is unthought or unknown—commits himself to a situation in which the stringency of what is required and kept silent is advanced and irresistibly endless.” (Sloterdijk 2008). It is the responsibility therefore, of artists and designers to create these glimpses into the unknown, of critical and radical futures, and to visualise the current cultural consciousness.

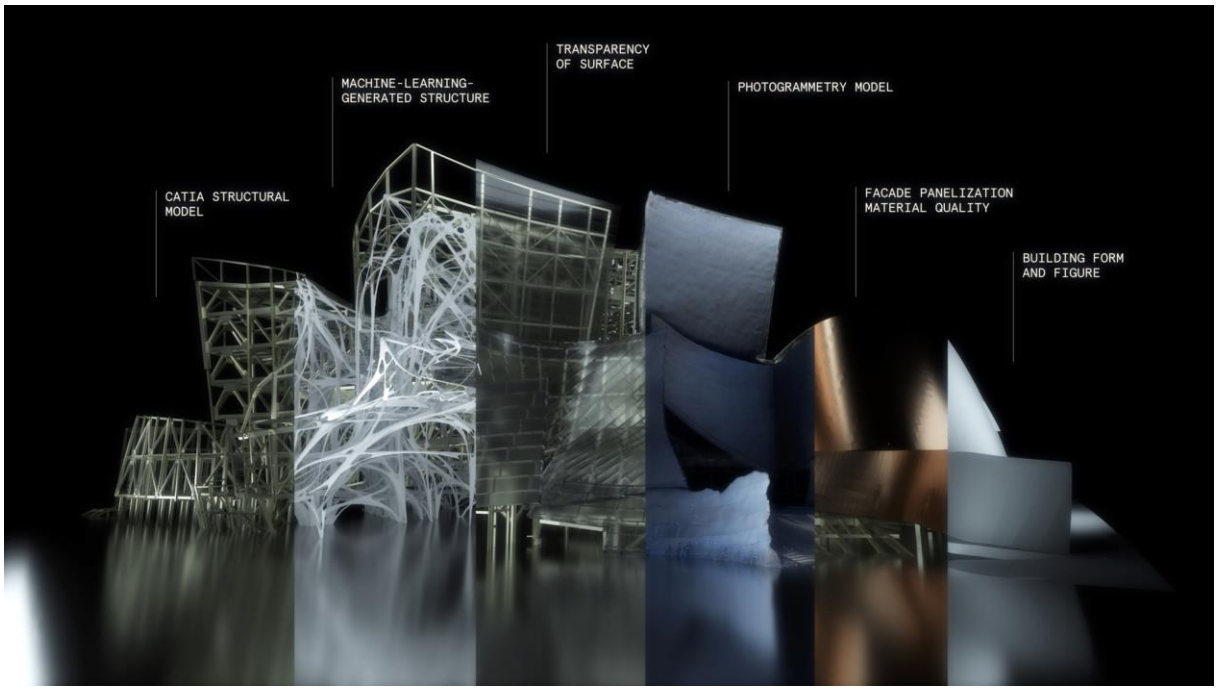

Figure 2. WDCH Dreams project 2018. Copyright RefikAnadol.

3.2.2 Intercultural cities, how arts could promote cooperation and integration, international experiences. (CdH)

Art projects have become an important part of community development strategies, contributing positively to the social aspects of the creative city, where multiculturalism is today a key issue to generate creativity. Community arts can lead to qualitative improvements in the sense of identity and the construction of a better citizenship. Furthermore, this will bring general well-being as increased confidence, development of new skills, acquisition of new friends across diverse backgrounds, awakening of artistic vocations and improved community empowerment and self-determination. Analysing the way art community projects can address societal challenges faced by cities might inspire MindSpaces innovative working model and help extrapolate good practices of co-creation and cooperation.

The cultural policies of recent years no longer understand culture as an object or a service, but increasingly as a collective way of managing a given community. Culture per se, the intangible - languages, symbols, traditions - and the tangible - heritage, cultural products, equipment, etc. - is a common good that makes sense when it incorporates as a participatory agent the community in its broadest sense, that is, artists and also anonymous citizens. Nowadays, the "cultural process" understood as an instrument of empowerment of communities and a new voice in the production of culture, as a recovery of shared public spaces as natural scenarios of encounter and expression of this culture, has become more and more relevant. In short, culture is a means of dialogue and communication between the members of a community.

This view repositions the community and, consequently, the agent that traditionally manages culture: public power. If historically the public administration has been the possessor, incentive and manager of the culture, at present it passes through the recognition of the communitarian social reality, from where multiple and unpredictable cultural expressions emerge. And they must be multiple and unpredictable since this is the value of the creative process and of freedom of expression and constitutes the basis of the voice of the community as creator and creative.

In the context of contemporary artistic creation, in its different languages, the dimension of community participation in creative processes is currently experiencing a moment of great expansion. This movement simultaneously passes through the educational, social and community approaches that run through artistic languages as a possibility of intervention in the current context. In this field, the balance between the needs, identities and aesthetics of a community is consolidated along with its ethical commitment to build a permanent, unique and innovative dialogue with artists and professional cultural managers.

Community cultural policies therefore increasingly play a fundamental role in the development of the territories they seek to integrate the promotion of a modern knowledge-based economy with social cohesion and sustainability. This is the basis of the "creative cities" defined as such, which foster collaboration and synergies between artists, collectives and anonymous citizens, generating cultural, economic and, also, high social return.

These new actors in the panorama of artistic and cultural creation in the framework of cities encourage co-creative programmes to enable the development of the main objectives of any modern society: social cohesion, interculturality, education, urban regeneration, political participation and governance, security and peace, sustainability, etc.

Thus, government intervention focuses on the promotion of free artistic creation, together with the promotion and accessibility to a quality cultural offer and the protection of heritage. The new guidelines for artistic creation are linked to the promotion of cultural democracy, promoting spaces for participation and social expression and particularly favouring the most disadvantaged groups. In addition, the incorporation of cultural and creative industries and creators broadens what we consider the cultural sector, in such a way that it is practically transversal to all citizens. In fact, cultural consumption is consolidated as an indicator of the cultural development of society.

In this context, new cultural policies based on community creation are developed in the public, urban space, in the city as a meeting place and a place for the development of society. The relationship between public space and community creation is essential and underpins an important part of these new policies. Thus, culture is positioned not so much as a space of services but as an engine of development and social cohesion in an urban environment, dignifying spaces that until now had lacked value. Co-creation projects are important instruments for exchange and dialogue between collectives, reinforcing the strategic value of culture as a disseminator of symbols, of positive images of people and their territories, but also as a capital of knowledge and, therefore, of critical gaze. They constitute resources for the citizenry, endowing it with elements of reading, understanding and critical and creative interpretation of an increasingly complex reality.

On the other hand, cultural policies with a community accent are an important motor of development and urban intervention. Projects that favour synergies and dialogue between artists/creators and community open the perspective to a new democratic quality, avoiding the commodification of cultural resources and influencing the local and proximity factor. They are an opportunity to give voice to the citizens, to the residents, favouring in this way the inclusion and the social participation. These projects generate positive social change, strengthen the well-being of citizens and generate a framework for finding innovative solutions to society's problems.

Finally, community creation policies contribute to the revitalisation of the local economy, in particular of craft sectors directly or indirectly linked to creators, as well as to the urban revitalisation of industrial areas.

In conclusion, art and artistic creation as an element of dynamism and dialogue with the local community contribute to generating intangible values for citizens and creative value chains that, starting from the artistic viewpoint, incorporate the view and action of people in an exercise of consolidation of a new society much more participative and creative.

3.2.3 How architecture and art contributes to new social uses

There has been an increasing amount of debate regarding the turn towards a more sensitive to social needs architecture and design approach over the last decade. Such approaches often showcase an overall focus on action and processes rather than solely aesthetics (Richter 2017).

Architecture analyses uses and forms them into a program that reflects the relevant social needs. In a simple way a modern building could be visualized as a system of horizontals and/or verticals patterns, composed to showcase a functional type of unity. Uses respond to the requirements and needs of their time, in that sense architecture responds to society and is interconnected and ever-evolving along with it. In this manner architecture inevitably becomes a demonstration of what society "looks like" at a specific given moment, quoting Mies Van der Roheit could be stated that "*Architecture is the will of the Epoch translated into space***"** (Nuttgens 1976).

Besides architecture art also greatly affects society. It provides a direct reflection of the ambitions, thoughts, wishes and concerns of society at a specific time. It forms a pod of ideas, through which, the design procedure is enriched and connected to the societal body. Art can provide communities a new means for interaction and social engagement, but it can also be aware of its current political, economic and social issues, evoking communities to be involved thoughtfully thus affecting social progress.

Even though all artforms demonstrate a level of social character, architecture has a certain public character and a deep social nature. It could be argued that it is a type of a social art form. The main goal of architecture is to design spaces for human life and activity thus meeting specific social needs. Architects primarily integrate social needs into design thinking in a way that produces a great amount of effects on social structures, particularly on land uses and urban planning.

It is generally agreed that is architecture is a social transformer that provides the means for organizing society. This is claim reflects a Modernist approach that still applies in the terms of today's society. The broad means by which architecture affects society, can be seen in its holistic approach whereby design decision is simultaneously of social, aesthetic and

engineering significance, affecting human life and the entire manmade environment (Fisher 2016).

Examples of Architecture and Art social Impact

The Guggenheim museum Bilbao

Bilbao's cultural jewel, the Guggenheim museum designed Frank Gehry opened its doors in 1997. The city of Bilbao constructed the museum as an answer to a number of serious problems it was facing. It suffered from high unemployment rate, urban deterioration, pollution and poor public transportation. All those issues were taken into consideration thus the main goal of Bilbao's approach was to increase the quality of life of its citizens. Several new complexes were built in the city, additionally a new a subway line, water/air clean-up systems and an airport. The most significant construction was that of the Guggenheim Museum along with other cultural investments. The museum has brought hope to citizens and has generated a large amount of impact on the local economy. (see Figure 3)

Figure 3: The Guggenheim Bilbao. Photograph: ©FMGB, Guggenheim Museum Bilbao, 2017.

Centre Pompidou

Centre Pompidou is an intriguing structure that transformed a car park in the Centre of Beaubourg into a museum of the future and a Landmark that changed the face of the area. Its impact and legacy is evident today, the contrast between the traditional architecture and this modern large scaled structure is what gives a specific character to the area and attracts thousands of visitors every year. The museum's construction was part of a greater renewal plan, where a number of traditional isolated neighbourhoods where intervened. (see Figure 4)

Figure 4: the Pompidou Centre in Paris. Photograph: Alamy

Le Bassin by Takis, La Défense Paris

A pool that contains forty-nine colourful metal lights, with a variety of heights ranging from 3,5 to 9 m, was installed in 1988 at the business district of La Défense. Just three kilometres away from the city limits of Paris, it still remains a popular spot among citizens and a main attraction for tourists. It is also the largest public space ever given by a state to an artist in Île-de-France and covers an area of 3,500 square meters. (see figure 5)

Figure 5: Le Bassin by Takis. Photograph: Wikipedia commons

3.3 Art and Design in workplace environments

Inspiring Workplaces is the second Pilot Use Case (PUC2) designed to test and develop the MindSpaces platform specifically for designing better quality workplace environments. MindSpaces research partners collect and analyse behavioural, emotional, and textual data from people inhabiting workplace environments physically and virtually (AR/VR environments) to develop design and analysis tools used in designing workplaces. Artists, architects, and designers will leverage the tools and data insights to explore and envision improved workplace environments that leverage well-being.

3.3.1Wellbeing produced by Art environments, neurological and psychological studies.

In psychology, well-being has been a long-standing interest. A classic and seminal study on the psychological basis of well-being popular is the study of 'flow' that investigates how one can be immersed in a task, and how this produces well-being (Csikszentmihalyi ea. 1992). Also, the connection of art and well-being has been studied, in particular the healing power of music, where music can be seen as a way to connect to the 'self' in everyday life (DeNora 2013).

Some studies apply these findings about the psychological basis of well-being to the design of cities and to architecture as 'a healing art' (Day 2014). Neurological studies on art, or 'neuroaesthetics', typically are concerned with, on the one hand, the rules of art and their evolutionary basis, and, on the other hand, the brain circuitry (Ramachandran 1999, Vessel ea. 2012).

The so-called aesthetic triad (see Figure 6) explains the neurological basis of aesthetic emotions. It contains the dimension of (i) emotion-valuation, with the aspects of reward, emotion and preferences (ii) sensory-motor functionalities as sensation, perception and motoric operations and (iii) meaning and knowledge, referring to expertise, context and culture (Chatterjee 2016).

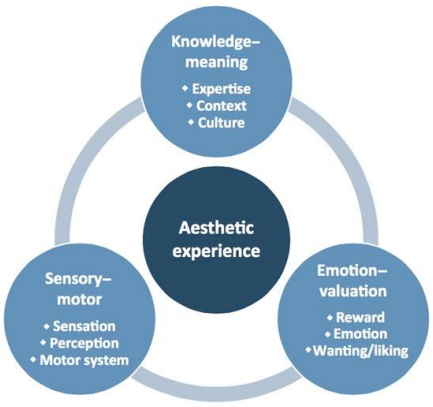

Figure 6: the aesthetic triad of Chatterjee ea. 2014

The evolutionary origins of the art-brain connections are contested. The central dispute is whether the interest in art is essential to the survival of homo sapiens as a species, or whether the occurrence and appreciation of art is a trivial evolutionary coincidence. Some researchers regard our responses to art as a primary adaptation or instinct; others see it as an accidental by product of other adaptations (Huston ea. 2015).

In general, experiences of emotions, from art or otherwise, cannot directly be related to neurobiological processes. Research, however, has pointed to active brain areas during experienced emotions. See Figure 4. Materialist theories start from the assumption that mental contents are to be explained as physical processes (Barrett ea. 2007). Others, however, stress that even when experiences have a material basis, it is not mandatory or possible to explain experiences solely in physical terms.

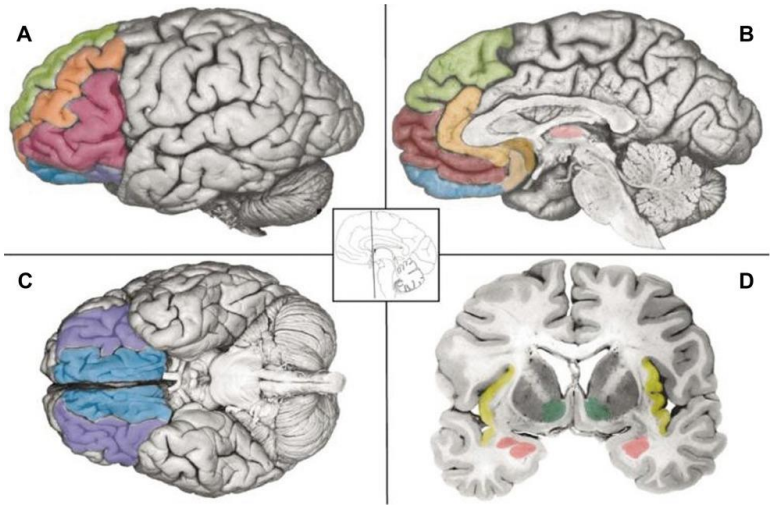

Figure 7 - Brain areas in the perception of emotions. Source: Barrett ea. 2007

3.3.2 Designing Workplaces for High Performance and Well Being

This chapter provides a concise background surrounding the problem of workplace design in relation to well-being and workplace performance. The design and spatial organization of workplaces and their relationship to well-being and workplace performance have been widely considered and analysed across many disciplines including architects, social scientists, psychologists, business organisation, cognitive scientists, and many more. It is consistently acknowledged that strong relationships exist between the physical features and layout of workplace environments and social interaction, well-being, and workplace performance. Yet there is little consensus or operational knowledge that can be instrumentalized in the design of workplaces. In fact, much of the empirical research has led to conflicting conclusions. For example, regarding the influence of open-plan office on communication patterns, many studies suggest increases in communication while many others suggest decreases in communication (Sailer and Penn 2009). Many challenging factors contribute to our lack of understanding of exactly how well our buildings function. To design workplaces for high performance and well-being we must first clearly define these terms and align them with the goals of contemporary workplaces. We must identify parameters that relate to and impact them. We must identify the challenges of this research and investigate methodologies for measuring and correlating design features with measurable performance and well-being data.

Workplace Design and Well-Being

In her paper *Design, Productivity, and Well-Being,* Judith Heerwagen argues that there is a recognition that for a workplace to be effective it must be designed to succeed across three interrelated domains: *environmental sustainability, organizational effectiveness, and human well-being* (Heerwagen 1998). She says that central to success is a building's impact on people individually and collectively and that it is key to identify the major dimensions of organizational effectiveness and then to identify the key features and attributes of a building that influence them. A building must have positive effects on both individual and collective work performance, psychosocial well-being, and health.

Biologist Stephen Boyden, in an article on the biological foundations of well-being, distinguishes between "survival needs" directly effecting health and "well-being" needs indirectly effecting health through fulfilment, quality of life, and psychological health (Boyden 1971). He defines a list of potential well-being needs which directly relate to building design as:

- Opportunity to engage in spontaneous social encounters
- Freedom to move between one social phase and another (from solitary work to group interaction)
- Opportunity to engage in a full range of species typical behaviours (creativity, self-expression, cooperation, exploration)

- Opportunity for regular exercise
- Noise levels not much above or below that in nature
- Meaningful change and sensory variability
- An interesting visual environment

We see that there are correlations between how a space enables effective use of individual senses (sight, sound, etc.), opportunities for choice and variability, and opportunities for effective collaboration and social activity.

There has been extensive research surrounding the relationship of design and well-being showing direct links between people and nature (Heerwagen 1998; Orians and Heerwagen, 1992; Heerwagen and Orians 1993; Kaplan and Kaplan 1989; Ulrich 1993; Kellert and Wilson 1993; White and Heerwagen 1998). These studies suggest that built environments containing key features of preferred natural settings are more supportive of human well-being and performance than environments lacking these features. This applies to already built environments physically containing natural elements such as trees, vegetation, and water (Ulrich 1993; Kaplan and Kaplan 1989). It has also been argued that human environmental preferences should align with features of the ancient "savanna environments" where Homo sapiens lived (Heerwagen 1998; Orians 1980). This included clustered trees, semi-open spaces, cover from excessive sunlight and rain, and high degrees of visual access to the horizon for planning of movements. Additionally, studies have shown stress reduction and health promotion through passive viewing of natural stimuli through windows, videos, and photographs. For example, R. Kaplan studies of field workers showed workers who had window views of nature felt less frustrated and more patient, and reported more overall life satisfaction and better health than workers who did not have visual access to the outdoors or whose view consisted of built elements only (Heerwagen 1998; Kaplan 1992). The positive effects of nature may also extend to the immune system, directly affecting human physical health (Parsons 1991).

In considering the relationship of natural comfort to well-being it is important to consider opportunities for workplaces to offer opportunities for people to adjust their environments rather than taking a "one size fits all approach." According to Heerwagen, this is for two primary reasons. People's preferences differ in terms of their ambient environment due to differences in cultural experience, lifestyles, genetics, and gender. Also, people vary their preferences over time due to changes in health, clothing, activities they are performing, etc. People actively adjust their environment as well as their behaviours to achieve comfort. Researchers have documented performance benefits of advanced comfort control benefits (Kroner et al 1992).

Additionally, Heerwagen argues that much like our ancestors' evolutionary need to be attentive to "ephemeral qualities" of their environment associated with time, daylight, weather to guide behaviour, sensory variability in buildings is needed to guide behaviour (Heerwagen 1998). It has been found that an environment devoid of sensory stimulation and

variability can lead to boredom and passivity (Cooper 1968; Schooler 1984). It is therefore a key principal to provide users the ability to adapt the comfort settings of their workspaces.

Natural environmental elements have been found to reduce stress. Roger Ulrich has consistently seen stress reduction and health promotion in his research providing people with passive views of nature through windows, photos, and videos (Ulrich 1993; Ulrich 1984). A field study of office workers had similar results (Kaplan 1992). Kaplan found that workers who had window views of nature felt less frustrated and more patient. Workers with window views also reported higher overall life satisfaction and better health than workers with no views of the outdoors. Many studies also of course show direct positive effects to the immune system through exposure to nature (Parsons 1991).

Ulrich identifies a strong correlation between contact with nature and positive moods (Heerwagen 1998). It has been found that positive moods strongly influence job satisfaction, work involvement, motivation, organizational attachment and lowered absenteeism (Mitchell 1989). The research of Clark and Watson (1988) showed that positive moods are related to the physical setting of work and everyday events such as social activity and interaction between workers. They found that negative moods are associated with everyday difficulties and annoyances such as uncomfortable and distracting work environments (Clark and Watson 1988). Further to this, many studies have shown cognitive and social functioning are impacted beneficially by positive moods (Isen 1990; Isen et al, 1987; Moore and Isen, 1990. These studies showed that positive moods are associated with 1) Enhanced discriminative learning and more efficient decisional processes on complex tasks. 2) Greater use of inductive rather than analytic heuristics in problem solving. 3) Higher joint benefits in negotiations and more innovative approaches. They begin to show that complex cognitive strategies are less likely when people are depressed, unhappy, or stressed since negative moods and stress cause restricted attention and more stereotypic responses. Daily discomforts and annoyances have a large negative affect and are problematic for higher level cognitive function (Clark and Watson, 1988; Heerwagen, 1998). Further experiments have shown direct impacts of nature on cognitive ability and focused attention. For example, one study showed increased working efficiency, lower blood pressure, and higher attentiveness for subjects working in a windowless room with plants than the same room without plants (Lohr et al 1996). In another study varying window views, Tennessen and Cimprich (1995) found that people whose view was predominantly natural scored better on tests of directed attention.

Another design feature that has been researched is the relationship of colour on moods and behaviour. For example, a study of colour in prisons found that certain colours have more positive and more negative effects on behaviour and mood or as Schauss put it “tranquilizing aggression” (Schauss 1979). He found that by painting the walls pink, aggressive behaviours were reduced among inmates. Aquent conducted a six-week study painting their office a different colour every week to understand impact on mood and motivation through surveys of employees (Telegraph 2008). According to business psychology consultant PearnKandola,

greens and blues were associated with least restful and soothing, yet workers reported the highest productivity associated with them. Red and black received positive responses with people suggesting they associated them with a bar or nightclub. Finally, research by colour psychologist Dr. David Lewis on behalf of Canon found that 80% of UK office workers believe that the colour of their surroundings has a large impact on their emotions and performance, 67% disliked the look of their offices, and 98% disliked the "high-tech" look of modern offices (Telegraph 2008). Lewis tested his theories by setting up "colour booths" where subjects were tested for their performance. He found that subjects performed 10% higher at problem solving with their favourite colour. Blue was found to be the all-around best colour for enhanced mood and brain function while red increased mental agitation and tension (Telegraph 2008).

Some of the key insights identified by Heerwagen's research on well-being and productivity are (Heerwagen 1998):

- Buildings that integrate, in an analogous manner, the features and attributes of preferred natural settings and nature stimuli are more likely to be supportive of human health and well-being than buildings which lack these features.
- Certain spatial and ambient features of savanna habitats are also important for human emotional functioning. These include a balance between visual access and visual enclosure, visual perspectives that are primarily horizontal rather than vertical, presence of tree-like forms (especially an overhead "canopy"), and multiple retreats.
- Building factors most likely to influence health and safety are the presence or absence of toxins and pathogens in building materials and systems; the degree to which toxic or noxious substances are used in work processes; and quality of lighting, especially lighting for computer work.
- Well-being, on the other hand, has to do with quality of work life, motivation, psychological state and social support. The research presented here suggests that impacts on well-being may come from a different set of features – such as presence of daylight and windows, opportunities for active and passive contact with nature, sensory change and variability, and opportunities for relaxed enjoyment of the environment.
- Active comfort maintenance has evolutionary origins, and research shows that the ability of people to adjust the ambient environment to their own preferred levels may influence work performance.

Defining Workplace Performance

How do we further define the criteria of a high-performance workplace today? It has been shown that well-being is indirectly, but strongly related and influential on work performance. We must therefore design for high well-being of our workers which is affected by many direct and indirect factors. Workplace performance is measured both in is relationship to individual workers and collective performances. This means that we must

measure not only individual, but also group behaviour in relation to the designed workplace environment.

Workplaces of today are diverse ecosystems required to support and enable increasingly adaptive and interdisciplinary collaborations. Most workplaces today are increasingly agile and dynamic habitats, for example Activity-Based Working (ABW) removes designated desks and offers different work settings to support typical work activities, providing workers with more choice about where, when, and how they work (Montanari and Mascolo and Sailer and Nawaz 2017). More businesses are embracing the Gig Economy which has given rise to the exponential growth of co-working spaces in past 10 years globally. Building owners are increasingly looking to curate not only the type, but size and stage of development of occupiers, to create a synergistic mix of entrepreneurial and established businesses. This requires us to consider designs which are more adaptive and flexible for building stakeholders, business owners, and building users. Gone are the days of one work desk and one type of environment for all forms of work. This means that workplaces must be designed as a multi-objective problem constantly negotiating between specific workplace cultures and potential adaptability to a specific range of effective ways of working individually and collaboratively.

Heerwagen presents a useful conceptual equation for worker performance as:
Performance = Ability x Motivation x Opportunity (Heerwagen 1998).

Here *ability* refers to whether a person *can* do a task, *motivation* refers to measuring how much someone *wants to* do a task, and *opportunity* relates to *accessibility,* or whether a person has the resources needed to do the task. In considering workplace design performance we must consider the design's relation to these factors. For example, a building can positively effect "ability" by providing comfortable conditions, enabling ability to individually control those conditions, and by reducing distractions and health and safety risks. "Motivation" is closely related to *mood, which* creates *"affective context"* for thought processes and behaviours (George 1989; Heerwagen 1998).

It can be said that a building has both positive and negative effects on our performance (Aronoff and Kaplan 1995). As Heerwagen highlights behavioural psychology and other fields have tended to focus more on the negative effects of buildings rather than the potential positive ones. This means most work has focused on reducing problems that negatively affect our performance rather than identifying how design features can increase our performance, assuming that by eliminating things like glare, over-crowding, poor air quality, etc. we will increase performance and well-being.

Performance must apply to individual, collaborative and collective social behaviours and well-being. We could say that our buildings must focus on positively enabling and encouraging individual and collective ability, motivation, and opportunity to perform

effective work functions which are dynamically changing over time relative to the social and environmental context.

Problems with Identifying and Operationalising Relationships

To instrumentalize this research for our design process we must instead ask how do the features we design (spatial organization, spatial features, materials, assets, etc.) affect, enable and encourage positive well-being, workplace behaviour and performance? These relationships have been tackled by researchers across architecture and design of workplaces, psychology, sociology, organisation and management (Sailer 2009; Sailer and Penn 2009). It has been argued that buildings “constitute the social organisation of everyday life as the spatial configurations of space in which we live and move" (Hillier 1996), that space may be "comprehended as a vector of social interactions" (Fischer 1997), and that "office buildings can play a pivotal role in business success" (Duffy 1997). There was a strong discourse for this topic starting in the 1970s and 1980s using empirical studies of individual spatial variables relationship to communication within workplaces. For example, one study showed a lowering of weekly communication between R&D engineers when the distance between their desks was increased (Allen and Fustfeld 1975; Tomlin and Allen 1977). Others studied relationships of physical space and organisational outcomes in environmental psychology collected through personal experience, early empirical psychology and sociological studies, and newspaper stories (Becker 1981; Pfeffer 1982; Steele 1973; Sundstrom 1986). Although many highlighted the significance of these relationships and identified factors such as proximity, density, visibility, office layout, and furniture arrangement as affecting the way organisations of people behaved, it is widely agreed that evidence was thin and speculative. Most studies remain devoid of a rigorous research methodology and documentation and often there have been conflicting findings. For example a variety of studies of cellular versus open plan office spaces have been conducted, but some suggest increased communication (Allen and Gerstberger 1973; Brookes and Kaplan 1972; Hundert and Greenfield 1969; Ives and Ferdinands 1974), while others suggest decreases (Clearwater 1980; Hanson 1978; Oldham and Brass 1979), while another set shows no changes (Boje 1971; Boyce 1974; Sloan n.d.;Sundstrom et al. 1982).The inconsistencies in results can be attributed to the differences in how studies are setup, measuring variables and in setting up the studies, since they varied in data gathering procedures (self-rating, questionnaires, participant-kept diaries), the chosen research design (pre-post comparison, retrospective studies, comparison of different departments), physical settings (open plan offices can vary significantly concerning density, distances, barriers, etc.) and definition of variables (sociability, supervisor feedback, confidential conversation, interdepartmental communication, time involved in communicating, etc.)(Sailer and Penn 2009). Sailer and Penn suggest that past methodologies for operationalising variables differ significantly with each study and even where the same methods are used, contradictory evidence emerges, where one organisation reacts differently to another to similar spatial conditions. This suggests a lack of common understanding of the nature of the space-organisation relationship (Sailer and Penn 2009). According to Hillier, "Generic function refers not to the different activities that people carry out in buildings or the different functional programmes

that buildings of different kinds accommodate, but to aspects of human occupancy of buildings that are prior to any of these: that to occupy space means to be aware of the relationships of space to others, that to occupy a building means to move about in it, and to move about in a building depends on being able to retain an intelligible picture of it. Intelligibility and functionality defined as formal properties of spatial complexes are the key 'generic functions', and as such the key structures which restrict the field of combinatorial possibility and give rise to the architecturally real." (Hillier 1996).

In *Spatiality and Transpatiality in Workplace Environments,* Penn and Sailer draw upon a series of case studies in knowledge-intensive work environments conducted between 2005 and 2008 comprising a university, a research institute, and four media businesses with all except the research institute studied before and after spatial changes were implemented (Sailer and Penn 2009). The spaces were analysed using space syntax and ethnography, targeted observations of spatial usage, and through interviews, surveys, social network analysis(SNA) (Wasserman and Faust 1994; Penn and Sailer 2009). By investigating a number of cases with a comparable setup, similarities and differences across the sample could be identified. The research identified spatial features which have a “generic” effect on function in all the studies while others would have contradictory or different effects specific to certain cases (Sailer and Penn 2009). For example, evidence from empirical case studies suggested that basic anthropological behaviours like movement could be explained by spatial configuration-in-use, therefore describing a generic function applicable to every office building (Penn and Sailer 2009).In contrast, to the phenomenon of movement associated with generic function, the majority of evidence showed distinct organisational responses to similar spatial configurations. For example, no uniform relationship was found between proximity among co-workers or spatial integration of a building and potentially related behaviours such as increased face-to-face interaction. This suggested that individuals may relate to each other in a dual way, i.e. either by means of spatial closeness (spatiality) or by means of conceptual closeness (transpatiality). Transpatial affinity however does not mean that relationships are non-spatial (Sailer and Penn 2009). The concept of generic function as introduced by Hillier was found not to be fully applicable, since generic function did not emerge prior to programming and usage of a building. This suggested that ahead of a design intervention, architects may draw on the modelling of potential movement flows based on the spatial configuration of their design solutions (Sailer and Penn 2009). When the case studies stepped beyond simple impacts of space on movement, it was found that most collective behaviours in workplace environments emerge in patterns unique to the organisation, specifically the more complex behavioural responses like interaction, collaboration or knowledge flow may particularly depend on a tangle of differently formed influences. Sailer and Penn argued that spatial configuration formed only one affordance to complex behaviours among many others, like conceptual closeness or organisational culture and character (Sailer and Penn 2009).

WeWork Case Study:

Peter Drucker, named by some as “the founder of modern management” in business, said, “If you can’t measure it, you can’t improve it (Denning 2014).” These previous studies begin to show the complexity of developing a generalisable technique for measuring human behaviour and workplace performance in relation to spatial features. To understand and operationalise “spatial” and “transpatial” relationships with workplace performance requires a great deal of pre and post occupancy data on how workplaces are used with generalisable spatial features rearranged in different configurations over a series of different spaces. Typically, architects have no opportunity to do systematic post occupancy analysis to gain insight into how their designs are used and how they perform. Architects have devoted tremendous amounts of energy to using digital tools for developing design, but very few have developed effective methods for evaluating a building’s social and behavioural performance. Even fewer have developed effective empirical research on the social and behavioural performance of the buildings we design.

As Frank Duffy said, “Because our heuristic seems to be “Never look back”, we are unable to predict the long term consequences of what we design (Duffy 2008).” Bordass, Leaman, and Ruyssevelt (1999), who have spent their careers evaluating buildings, conclude that "the sad fact is that hardly any architectural or engineering design practices consistently collect information on whether or not their buildings work." In a survey of 29 mid-sized American architecture firms in 2015, Julie Hiromoto found that "post occupancy evaluation is currently rare" because of the "design team time and cost required to produce meaningful results" (Hiromoto 2015). According to Hiromoto’sstudy building evaluations tend to focus on few established techniques (Hiromoto 2015; Davis 2016):

- Quantitative measurements primarily of daylight, acoustics, and the thermal environment.
- Observational studies of density, utilization, efficiency and differences between plans and occupation.
- Data collected from facility managers on energy and water usage.
- User surveys focused primarily on happiness, energy levels, perceived health benefits, and personal perceptions of the space.

One quote from a UK policy report reads, "The ways in which office accommodation can create value for a business (…) are [still] inadequately understood. (…) The collective failure to understand the relationship between the working environment and business purpose puts us in the position of early 19th century physicians, with their limited and erroneous notions about the transmission of disease before the science of epidemiology had been firmly established (CABE 2005: 1f).”

WeWork was founded in 2010 and is one of the world’s fastest growing companies with more than 335 office worldwide. It provides a strong case study for gaining insights into the effect of workplace design on workplace performance, productivity, and well-being. Managing over 335 office spaces worldwide, WeWork’s business model includes its own in-

house teams for design, construction, sales, and building operations. Daniel Davis is a researcher who focus's his research on how technology influences architecture, and how architecture influences people. Specifically, he was the head of the research team at WeWork focused on data driven design of high-performance coworking office spaces.

WeWork is a vertically integrated business model which strongly impacts the value of the research giving them a unique opportunity to invest in their own current and post occupancy research to gain key insights into design performance (Davis 2019). The company focuses on using a finite set of similar design elements combined and configured in different ways in each office while monitoring how the offices perform to establish relationships between design and performance. They have fast access to thousands of users, can generalise research findings over large quantity of related test projects, and have financial pressure and incentive for high design performance. That business model enables research that incorporates thousands of people, that generalises across projects and that is tied to the success of the company (Davis 2019).

Architect's "designs" are typically processed by several layers before reaching end users (the architect passes the design to a contractor, who deals with a developer, who deals with a broker, who works with users). For this reason, architects are far removed from users and have little opportunity to really know who they are. Rarely do clients continue to interact with architects after designs are "completed." According to Davis (2019), WeWork's business gives them the opportunity to observe and survey all their users. For example, they're researchers have studied the emotional impact of aesthetic choices by surveying tens thousands of users in hundreds of different workplaces. They have asked people to name their closest work friends in order to understand how spatial decisions impact social networks (a revised version of Festinger's seminal dorm-room study) (Davis 2019).

In *Evaluating Buildings with Computation and Machine Learning*, Daniel Davis argues that by analysing a buildings 'data exhaust' and specifically leveraging the extraordinary amount of data exhaust captured by WeWork about people's architectural preferences in relation to known spatial configurations they are able to potentially supplement traditional post occupancy evaluations with computationally driven evaluations (Davis 2016). Davis suggests that the lack of previous successful investigation of machine learning and computationally driven evaluation in this field is primarily driven by the lack of access to and quality of data that WeWork has. In each of WeWork's buildings they have a similar mix of room types (offices, meeting rooms, lounges, phone booths, and other amenities which are then customized to their local market (Davis 2016). One research study was to locate which meeting rooms were preferred and identify features that contributed to this. To do this they analysed the data surrounding over one million meeting room reservations over three years and specifically focused on a three-month period focused on 158,000 meetings from 728 rooms in 44 buildings (Davis 2016). To identify rooms people preferred they analysed room utilisation (percentage of time the room was booked during peak hours) and lead times (if a person books a room well in advance it is assumed they would pick their favourite room) and

finally users were asked to rate their meeting rooms. By having all three of these pieces of data and finding strong positive or negative correlations they were able to infer ratings, lead times, and the utilization rate are not analogous and not measuring the same thing (Davis 2016). For example, one reason for a negative correlation between utilisation and rating may be that members tend to always give the room a rating of four or five unless there is a problem with the room and if a room is highly used there may be more opportunities for short-term problems such as white board markers running out (Davis 2016). Meeting rooms were also analysed in relation to one another. It was found that there was no significantly higher use of higher rated rooms. By having all three pieces of information they were able to identify that in fact utilisation and lead times were more accurate measures of people's preferred meeting rooms than the ratings they provided (Davis 2016). Additionally, they were able to use machine learning to identify and predict common building issues by data mining all the IT tickets which contained timestamp, subject and additional metadata. Through this study they could find which aspects of the built environment were causing the most problems for WeWork members (Davis 2016).

Additionally, WeWork has developed machine learning methods for predicting the success of office layouts. Using data from 3276 private offices in 140 buildings, they trained the support vector classifier for 56 design features such as whether there is a window and the degree of "squareness" of the office. (Bailey, Phelan, Cosgrove and Davis 2018). The model was able to predict the lowest performing offices to within 60-70% precision and recall between 20 and 40%. The model focuses on calibrating an occupant model with occupant usage information and expanding the range of input features to include spatial attributes. They focused the work on their own private offices with co-working spaces not attempting to predict occupant schedules, but to predict the percentage of month-to-month utilisation. Additionally, they only use physical features of the space to predict the utilisation and did not factor in variables such as time, price, or tasks (Bailey, Phelan, Cosgrove and Davis 2018). Spatial features included inherited rules of thumb for a pleasant space and insights from previous research. For example, a window is considered as a feature to affect desirability or that the density of the office would affect desirability. They also extended the knowledge gained form the meeting room study to recognize that the spatial position of a meeting room affects desirability (Phelan et al. 2016). Additional insights gained from interviews suggested that the degree of squareness of a room affects desirability due to its reconfigurability (Bailey, Phelan, Cosgrove and Davis 2018). Success metrics were then assigned. For example, good offices are constantly leased while bad offices are empty or hard to lease which they then generalised as "mean occupancy." They then settled on a support vector classifier method and went through a process of dimensionality reduction due to the high quantity of spatial features they were considering. The classification model was then able to obtain not only the prediction of the class labels (above or below), but also the probability of the respective labels (the confidence on the prediction). Finally, SVC prediction data was mapped back over the plan visually as a heat map. They have operationalised this for the design team through an API to augment the design planning process (Bailey, Phelan, Cosgrove and Davis 2018).

Conclusion

In order to design effective workplaces, we must unravel the relationships between spatial features and the workplace's ability to deliver a high degree of well-being and performance to its individual workers as well as collectively and collaboratively. It has been noted that high quality social activity in offices contributes to well-being as well as it being desirable to encourage unplanned collaboration. Interrelated to this is the ability of the workplace to be flexible and adaptable by individuals and teams. Workers need more degree of choice for more focused tasks and collaborative working. Natural elements, stress reducing and non-distracting environments with high degrees of adjustability have been shown to raise the mood, motivation, and cognitive functions of workers enabling better social functioning as well. It has been identified that there are general relationships between spatial features and movement patterns, while other relationships are "transpatial" meaning that they are both related to spatial features as well as social and socio-organizational and cultural relationships. There has been a clear acknowledgement that spatial features and relationships exist which promote and influence well-being, productivity, communication, and other success criteria of high performing offices, but due to several factors little empirical evidence exists that can be operationalised. The WeWork case study begins to show the power of leveraging data exhaust and new forms of post-occupancy studies over larger sets of similar buildings with similar features. This model is allowing us to begin to generalise relationships between behaviour and design and predict which designs will be most successful in enabling high functioning workplaces with increased well-being of its workers. Architects must find effective ways of collecting occupancy data and analysing it against design features before, during and after design changes occur to begin to move away from rules of thumb toward truly data driven design decisions. With greater insight into evaluating the elements of our designs, architects will be empowered to design workplaces with higher potential for desired performances such as **well-being, happiness, productivity, and collaboration.**

3.4 Art and domestic environments

In the third pilot use case (PUC3) artists and creative thinkers are called to propose innovative, art related ideas concerning the quality of senior friendly environments and the level of emotional and functional friendliness. The third use-case addresses challenges of a sensitive audience, i.e. senior people and their domestic inhabitation.

3.4.1 Initiatives related with health, housing and caring using arts.

This section will deal with the issues of the ageing population in Europe and the solutions provided through arts.

It is a fact that Europeans are living longer, and healthier lives and the fertility rate remains low. These developments reflect the deep transformations in the age composition of European populations.
According to the report of the United Nations "World Population Ageing", the global population aged 60 years or over numbered 962 million in 2017, more than twice as large as in 1980 when there were 382 million older persons worldwide. The number of older persons is expected to double again by 2050, when it is projected to reach nearly 2.1 billion. In 2030, older persons are expected to outnumber children under age 10 (1.41 billion versus 1.35 billion); in 2050, projections indicate that there will be more older persons aged 60 or over than adolescents and youth at ages 10-24 (2.1 billion versus 2.0 billion). Globally, the number of persons aged 80 years or over is projected to increase more than threefold between 2017 and 2050, rising from 137 million to 425 million. Hence, challenges posed by demographic change have increasingly been an important point of debates on the future of the EU.
Individuals will generally wish to stay in their homes for as long as possible – which also minimizes the social costs - meaning that the home becomes a place where older people spend most of their time. Only a 3,3% of the population older than 65 year live in an institutional centre and also in Europe, a 50% of people older than 80 years old, live alone, and a 35% live as a couple. These data clearly state the necessity of making the living place a pleasant place where to grow older and art represents a powerful tool to address this challenge.

Karen Kubey, one of the editors of the *Ageing in Place Guide*, released by New York city's department for the Ageing, emphasized that professional designers have an important role to play alongside government efforts: "while social and health services for seniors are critical, even the smallest residential design retrofits can have potentially life-saving impacts […] From preventing falls through something as simple as choosing the right kind of carpet, to designing beautiful, welcoming shared spaces to help address social isolation, architects and interior designers have the chance to improve, and even extend, the lives of seniors."

Along with changing family, household structures and design, and urban structure, some initiatives can be promoted by using arts. Indeed, art therapy gives aging seniors something to look forward to, and it can even bring a sense of purpose. The benefits of art are proven and can be listed as such: improving health, boosting self-esteem, cultivating emotional resilience, increasing brain connectivity and plasticity, enhancing social skills, reducing and resolving conflicts and reducing stress.
Several studies have been conducted on the benefits of art therapy for seniors. At times emotional needs can be inadvertently overlooked because of the many physical health problems the client is experiencing. Art therapy is one way to address – respectfully, efficiently and comprehensively – the emotional needs of the frail elderly in a culturally competent manner. Art therapy offers healing by providing social connection, the experience of control and the opportunity to both express and manage emotions. It offers

hope by facilitating nonverbal communication and providing opportunity to create meaning through life review (Johnson and Sullivan-Marx 2006, p. 309).
A detailed study about the use of art therapy with older adults conducted by Susan I. Buchalter in its *Art therapy* confirms the positive effects of this practice. Seniors are given the opportunity to express their inner experiences and to share them with others. They also learn new creative stress-management techniques and they develop self-awareness. In some cases, art therapy also makes seniors discover a talent that they didn't know they had and makes them acknowledge long forgotten strengths. They become valued as part of the community with no prejudices and fostering inclusion. Problem solving, creativity and promotion of self-esteem are other positive effects of art therapy.

3.4.2 Technologies and materials that could improve elderly people experience.

Many authors are debating about the intangible definition of user experience, referring to it as an interaction between user and product. There is a standard definition, "ISO 9241-210: 2010: User's perception and response in regard to the interaction with a product or a system". The experts argue that the interaction process is personalized because it generates emotions, feelings and ideas that are also influenced by spatial-temporal situations, meaning that we need to consider it more holistically. (Kujala, Nurkka 2012)

In the elderly, more importantly, we need to consider the symbolic experience. This means that they will associate historical facts and memory recoveries to the experience, and they could be emotionally connected due to it's in harmony with their values and identity. Additionally, the objects that are present in their homes may be more valuable to them because cultural, life events and family memories are associated.

Jaron Lanier argues about the importance of the haptic experience, when all the senses are activated, because our body is very present in how we interact with the world. Which is why he wrote: "We tend to use visual metaphors to convey analytic mastery, seeing a situation clearly, while haptic metaphors tend to convey intuition, gut feeling. Haptics is about you as a part of the world, not as an observer" (Lanier 2017, 124) "It might take generations before we fully internalize how obsolete visual dominance has become in the *Information Age*." (Lanier 2017, 128).

The last considerations help us to understand which technologies and materials could improve the elderly's experience. Perhaps the projects needed to develop with those users need not to be visuals, but to concentrate in the other senses such as sound and touch, as most of them have impaired vision.

Touch is the first sense that humans develop when they are born. Our skin is a receptor of sensations informing us about temperature, humidity, texture, hardness, and more, of the materials or beings that we come in contact with. Some artistic projects are considering using virtual reality (VR) in combination with robotic texture experience, this way we could interact and feel the objects in VR.

MIT Media Lab has a research group named “Fluid Interfaces”. They have many projects that explore the relationship between senses and emotions. One of them is “Chill.out”, this project involves using electrodermal activity, heart rate variability, and relative facial temperature to apply thermal interfaces that could improve emotions related with stress and the attention levels. (MIT media lab website)

This project exemplifies very well how using body sensors we could improve emotional state of old people.

Another important point to create experiences through Art and Technology is by generating wellbeing in the elderly with strategies of “Art Therapy” to stimulate their curiosity, self-expression and supporting their identity. There are some current studies that propose the possibility of VR as an artistic medium, and the choice of using VR as artwork for artistic creation, providing infinite creativity and the expansion of artistic treatment.

In Ying-Chun Liu’s last paper, he uses *Tilt Brush* invented by Google as an art medium to explore the effectiveness of virtual reality in the application of art therapy. The *Tilt Brush* used in this study is a virtual reality drawing application launched by Google in 2016. Users can create paintings in a room-size three-dimensional space and has received positive feedback from users. Disney’s hand-painting animator Glen Keane pointed out that by completely immersing himself in paintings, he can express his true feelings in the depths of his heart. This mode of thinking is consistent with many elements of art therapy. (Liu 2019)

Last year the Japanese government launched Society 5.0., a program which aims to apply technology to the wellbeing of the population and mostly towards the elderly. Some of the appliances that they describe in its website include:

“Home appliances embedding artificial intelligence (AI) are developed and sold all over the world as well as in Japan. ‘Convenience’ will accelerate when home appliances are linked to each other. AI will support your daily life.”

One important application of Artificial intelligence is the natural language recognition. Algorithms through design devices or installed in care robots could establish conversations with the elderly people in order to organize their agenda, put them in contact with relatives, friends or doctors, helping with their purchases or just being a voice that is creating a meaningful conversation or remembering past facts of their life.

In conclusion, some of the technologies present in MindSpaces Project are: AI, VR, body sensors, have a direct application in increasing the wellbeing of elderly. Other technologies, like robotics, haptics applications, etc, could be brought to the project by artists in residence. Art and Technology can merge and brainstorm on how to help people - either by suggesting a modification in their living space or by composing an artwork that can function as a tool tailored to seek improvement in people's well-being.

4 ART AND EMOTIONS

4.1 Arts and Emotions. A psychological approach.

During the last decades, many studies have shown that experiencing and making art has many positive effects on individual well-being (Tay ea. 2018). In general, art addresses the quest of purpose and meaning; experiencing art may forge social bonds. The positive effects of art experiences are produced by various mechanisms, such as being 'carried away' by the art, or, being prompted to question worldviews and values (Tay ea. 2018). Likewise, reported outcomes are variegated. Many studies point to positive neurological and physiological changes, such as lower levels of cortisol, a stress hormone, or galvanic skin response. In addition, psychological competencies may improve, such as increased creativity or adaptation to circumstances. Other studies point to increase of self-reported (subjective) well-being. See Figure 8 for an overview of the various pathways.

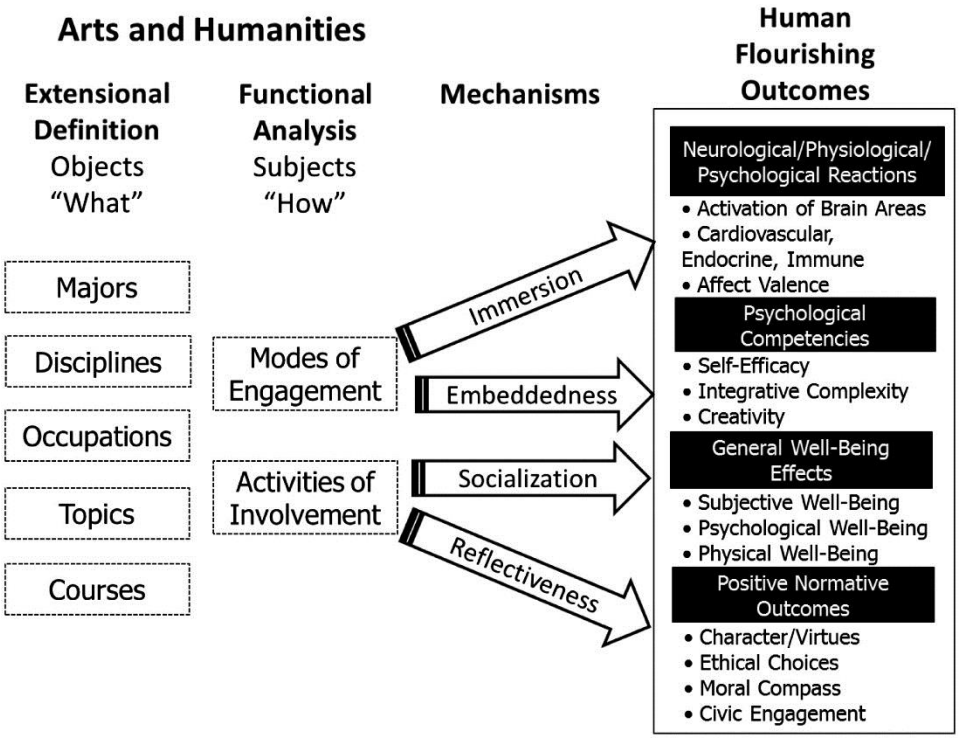

Figure 8: Framework for the role of the arts in human flourishing presented by Tay ea. 2018

There has been ample attention to the interaction of cognitive and emotional aspects of engaging with arts. Leder ea. (2004), for instance, present a model with five stages of information processing and aesthetic emotions, see Figure 9. *First*, the perceptual processing of the art. This relates to the aesthetic preferences and the nature of the stimuli. Arts may come with different degrees of visual complexity, for instance, or with different colours. According to Gestalt psychologists the perceptual processing is governed by a limited

number of principles. In general, the processing of perceptual stimuli is quick and difficult to measure. The *second* stage contains implicit memory processes, in which unconsciously and quickly the perception is compared to memory. Research here points to different principles: on the one hand familiarity of the perceptions tends to be better appreciated, on the other hand, novelty is appreciated, too. Art, after all, tends to deviate from the expected. It seems that experience and expertise matter importantly here. The *third* stage is the explicit classification, in which the art observer articulates the perception. Here, expertise vastly matters, with limited expertise resulting in simply categories ('landscape', 'colourful'), while experienced art observers would express distinctions about light, forms and refer to earlier artworks. Also references to art styles and schools of art appear in this phase. In general, more expertise results in more explicit articulation. The *fourth* stage, cognitive mastering, relates to classification of style, which, when successful, probably evokes self-rewarding. This would explain why aesthetic experiences are pleasant: self-rewarding leads to seeking new experiences. The stage of cognitive mastering also relates to the search of meaning and to further cognitive interpretations of the artwork. Again, the stage is different for naïve and experienced art observers, with the former working with categories derived from their own (emotional) situation, and the latter deploying a more generalized repertoire. This phase is closely connected to the *fifth* and last one, yielding an evaluation of the artwork. The evaluation is embedded in and derived from the cognitive network that is elaborated by the observer. Tay et al. add that while the framework may seem to be mechanistic, individual differences in the appreciation of art are likely. Artworks can be differently experienced, depending on conditions and of timing.

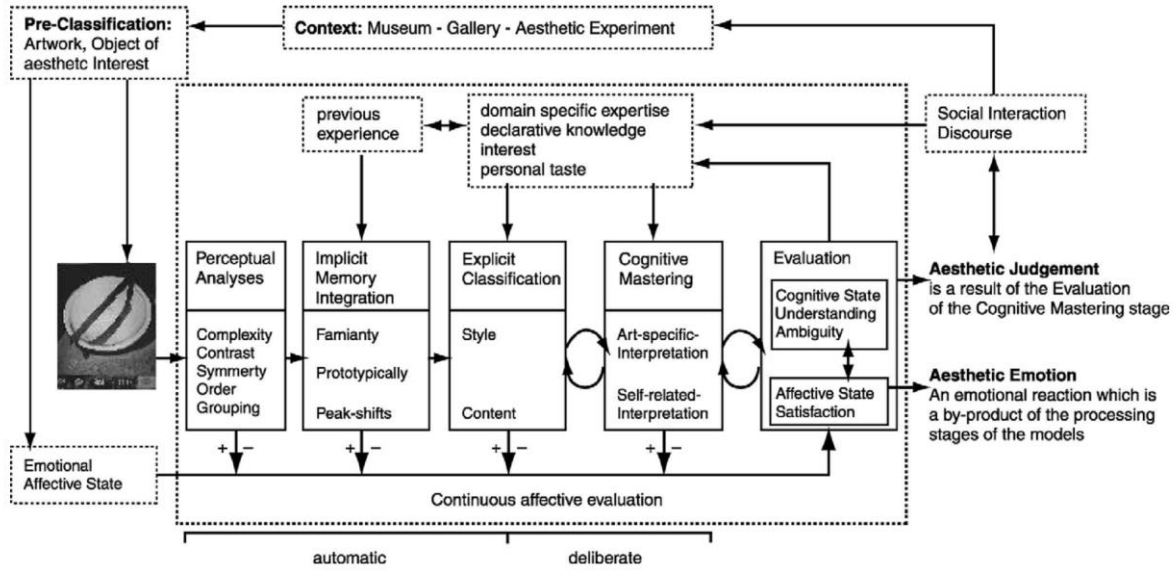

Figure 9 - A model of aesthetic experience according to Leder ea. (2004)

A strand of research extends these findings to brain research and to tracing the information and emotional paths of arts and emotions in MRI (magnetic resonance imaging) scans (Cupchik ea. 2009). Many studies take the positive effects of arts as a starting point to consider it as therapy; concluding even that art-making - as an emotion regulating exercise - is in many cases more effective than other therapies (Gruber ea. 2018).

4.2 Sociological studies about cultural and arts engagement of citizens.

Many sociological, regional and urban studies have explored how culture and arts engage citizens (Markusen ea. 2008). An important tradition is to consider how arts and culture may bring significant economic benefits. In general, the so-called 'creative sector' or 'cultural sector' is important for urban areas in terms of employment, entrepreneurial potential and community welfare. While the number of workers that would label themselves as 'artist' is very low, around a few percentages, the visibility and appreciation is high. According to Markusen and Schrock (2006), the cultural economy encompasses a broad range of institutions, including religion, sports, entertainment, and media (book) suppliers. These have overlaps, too, as for instance religious organizations employ one third of all musicians in the USA (Markusen and Schrock, 2006). More than most workforce, artists have high levels of self-employment. Markusen and Schrok (2006) report as much as 45% as compared to 8% in the total workforce.

The potential role of arts in the civilization of individuals has been recognized and flagged since the Romantic era. Schiller, for instance, in his 1795 essay 'On the Aesthetic Education of Man' claims that aesthetic education helps to bridge, on the one hand, the stress on logic and cool reason, with, on the other hand, the need to address feelings and emotions. This power of arts to bridge between reason and emotion also brings, of course, the risk of abuse by political powers. The risk is to steer the gaze to, say, vulnerable minorities or strangers, to fill it in with particular political laden meanings and thus to frame political options accordingly. The whole idea of state-supported art, therefore, touches these dangerous grounds.

Many studies have pointed to the renewed interest in the economic significance of cultural or artistic activities. Such renewed interest is to be understood as part of bigger societal and economic shifts: from an industrial basis and a logic of predictability, to a service-oriented economy with a logic of experience. This shift brings economic opportunities for cities, but also asks for intensified participation by citizens. As Miles et al (2000) note: "One of the challenges of the new century is to democratise this [cultural] process and create transparency in the production of urban spaces. That is, critically, to see what takes place and according to what sets of assumptions." (Miles ea., 2000, p.4, also cited in Garcia 2004).

In this novel appreciation of the culture and arts in urban areas, old dilemmas reappear, in particular the opposition between the centre and the periphery. The new thriving of inner cities often come together with gentrification, with its expulsion of lower income groups,

and the growth of suburbs (Garcia 2004). Together with this shift in the 1970s and 1980s, attention for citizen participation increased. The idea was that it was no longer sufficient to legitimize policy with elections and mandated politicians, but that citizens should be consulted about options - or that they even should be invited to co-design public policies. The rationale was that the creative potential of citizens should be exploited.

Now, since many decades, municipalities around the world have invested in culture and arts to stimulate economic development, at regional and neighbourhood scales (Schuster 2000). Various goals are at stake here, such as economic impacts, social impacts and cultural impacts (Garcia 2004). The hope is that investments in culture will help identity building of communities and will improve social cohesion and civic engagement. Cities have also definitively invested in cultural tourism; museums, for instance, have become attractive landmarks in a city (Hammett and Shoval 2003).

Many studies show that cultural manifestations and fostering of arts can also bring public well-being and develop democratic participation; it may even improve race relations and community participation (Cornwell 1990). The question, however, is whether the attraction of visitors and tourists goes at the expense of engaging local citizens. Many points to the 'commodification' of art (Gray 2000) and to the risk of 'instrumentalist' uses of art for economic or political purposes (Mirza 2005). This stress on the healing effects of cultural and arts engagement has been labelled as the 'therapeutic ethos', now prevalent in many cities and regions (Mirza 2005). This stress has been paralleled by a post-modern loss of confidence in what was known as 'great art'. Alternatively, culture and arts have been seen as novel aspects of political struggles, uncovering underlying tensions about ethnicity and identities.

According to Mirza 2000 the 'therapeutic ethos' for the arts sector brings along new social roles for arts and culture. Here, the modernist-romantic assumption that art is to civilize individuals has been replaced by the therapeutic principle that art is to fulfil emotional needs, of ethnic minorities or other disadvantaged groups. Instead of empowering people in their political struggles, art is in this perspective used to reconcile people with their life. In this way, the age-old question resurfaces: is art to make people feel good or is art to challenge societal beliefs and arrangements? The goal of MindSpaces project to address both of these challenges. MindSpaces is at the vanguard of a new wave of artists, designers, architects and engineers that affirm the necessity of an interdisciplinary approach that integrates novel technologies to inform art and design. By integrating approaches from neuroscience, physiology and psychology with artistic and architectural research, sociological and ethnographic methodologies, human experience can be directly linked to design by correlating specific measures of the built environment (input) with quantified measures of the brain's and body's responses (neural, physiological andpsychological responses), as well as sociological, behavioral and economic outcomes (output).

5 ART AND TECHNOLOGY IN MINDSPACES

5.1 Technologies in MindSpaces, procedures to build research in art

MindSpaces Project is articulating the cooperation of new emerging technologies, such as AI applied in big data image processing or semantic analysis, on social media, internet and texts, technologies of virtual or augmented reality, 3D scanning by drone cameras and laser cameras, 3D modelling by advanced software and EEG sensors, etc.

In this chapter we will explore three of the main technologies in MindSpaces and its possible use in art research: Artificial Intelligence, Virtual Reality and EGG sensors/algorithms. Methodologically, it will bring the conceptual thoughts of the most prominent theories or pioneers of those technologies, followed by examples of work of artists doing research with the technologies and finally reaching a suggested path of research that the artists participating in Mindspaces project could follow.

In a recent report, *The adoption of digital technology in the arts*, elaborated by Digital Innovation Fund for the Arts in Wales, the authors argue that Arts envisioned technology evolutions, and that science fiction predicted many scientific and technological developments, as well as the fact that and the skills and practices that are present in the Arts are highly valuable in innovation. The arguments reflected in the report support the work processes of MindSpaces, integrating the technologies in a platform, and not making an individual research and cooperation with the arts based only in one technology. The authors says: “One of the important developments in technology is not the development of the individual technologies per se, but the **development of so-called platforms** providing an integrated set of technologies around a common purpose”.

Conceptual considerations about **AI.**

Lev Manovich, a Professor of Computer Science at The Graduate Center, CUNY, and Director of the Cultural Analytics Lab wrote in his last book, AI Aesthetics, 2018:

“*Today AI is starting to play a crucial role in culture, increasingly influencing our choices, behaviours, and imaginations AI has become a mechanism for influencing the imaginations of billions* “(Manovich 2018)

From the first concepts of Artificial Intelligence in the second half of the 20th century, the evolution to our contemporary era is based in data management. This data related with culture and art are mainly language and images. Algorithms have evolved not only to classify and recognise those data, but also to provide recommendations that matches data coming from the users regarding their behaviours, which then produces specified content for the user. The next step, that is now ongoing, is the participation of AI into de creative process, some examples are in the composition of music or writing texts. (Manovich 2018)

AI is currently widely used by the cultural sector and by social media and internet commerce, from data management that select content and give recommendations, to understanding the user behaviour and targeting content. Recent applications are going further into the creative process, assisting the production and also doing autonomous creations like composing music or writing articles (Manovich 2018).

Examples of current artistic projects with AI

Many contemporary artists are using AI, we could discuss some examples that were happening during 2019 at the most prestigious Art Centres in Europe.

In October 2019, Serpentine Galleries presented the project **i-Magma**, by the artist Jenna Sutela. In the website of the project wrote: "his work places an emphasis on altered states of consciousness and the creation of artificially intelligent 'deep-dreaming' computer systems that mimic the brain. Influenced by divinatory practices such as the I Ching, i-Magma builds a bridge between these ancient systems of knowledge and our contemporary attempts to divine the future. It's within this accumulation of data and matter that Sutela suggests the potential for a new collective consciousness driven by magma".

In Barbican Centre London's exhibition, *More than human*, 2019, they displayed several projects that artists created with AI or questioning the ethics of the current applications.

One of the projects using **semantic analysis** was *Waterfall of Meaning* by People + AI Research (PAIR) in collaboration with Google Arts & Culture, 2019. The instructions stated: a machine could easily read pages of text, but understanding subtext is more complex. Making associations with words, sometimes subconsciously considering them to be new or old, good or bad, male or female. *Waterfall of Meaning* uses technology called "word embedding" to analyse millions of sentences and map a word's meaning based on their use. The groups in the waterfall show what the machine has learned and reflects how people use language.

Other projects are **questioning the current development of the technology**: *Gender Shades*, 2018, by Joy Buolamwini, wrote about his research in MIT Media Lab: "Recent studies demonstrate that machine learning algorithms can discriminate based on classes like race and gender. In this work, we present an approach to evaluate bias present in automated facial analysis algorithms and datasets with respect to phenotypic subgroups".(Buolamwini 2018).

In Vienna, 2019, MAK Museum carried out an exhibition about AI: **"**Uncanny values: Artificial Intelligence and you", one of the works: *Behold These Glorious Times!*, 2017 by the international renowned artist, Trevor Paglen, who has been working on the political dimension of technologies for a long time. In his video installation, we find ourselves face-to-face with hundreds of thousands of images used to **train neural networks** to recognize and analyse the human world: objects, gestures, facial expressions and emotions are on display in hypnotic rapidity, the original pace used to train machines to "see". Plagen poses questions about the origin, modes of production, categorization, monetarization and politization of these continually growing and changing image worlds.

Conceptual considerations about VR

One of the key technologies that will be use in MindSpaces platform is **Virtual reality** (and augmented reality). In **Jaron Lanier's** recent book, *Dawn of the New everything, a journey through virtual reality,* the artist and technologist inventor of VR, wrote: "VR's deep mission was to find a new type of language, or really, a new dimension of communication that would transcend language as we know it." (Lanier 2017)

Also, he introduces a very important issue to create virtual experiences that is haptics, sensations that comes for all of our body's sensor cells and they are connected with human motion. Lanier argues that thinking in haptics is considering humans as part of the world and not just as an observer. Talking only about visuals is obsolete for him, but recognizes that the educations in this haptic perception could take long due to the current prevalence of visuals. (Lanier 2017).

In MindSpaces platform, artists will research experiences using VR technology with EEG feedback. MindSpaces aims to create a novel approach to urban and architectural design by generating 3D-VR immersive and emotion-adaptive 'neuro-environments' that will help in designing emotionally-relevant spaces. We could conclude that VR is not just an evolution of video display, making the image more real and 360 º of vision, this technology opens the artistic research to a more holistic experience, we could create unexpected worlds, with no dimensions, and the possibility to go out of our body, feeling otherwise and developing empathy with the natural world.

Examples of current artistic projects in VR

The art world is now welcoming VR technology and the artists, and also those who are not mainly digital artists, are making projects with this technology. In the last Art Basel Fair 2019, in the Unlimited section, a big display of VR headsets were showing the VR works: "Coach Stage Stage Coach VR experiment Mary and Eve", 2017, by**Paul McCarthy**, a very renowned artist, mostly known for his art installations and painting.

A similar research in VR was made by Acute Art, a London VR producer, inviting highly recognized artists to explore this technology. They create works in collaboration with OlafurEliasson, Anish Kapoor, Marina Abramovich or Jeff Koons. OlafurEliasson, in the Verbier Art Summit 2018, regarding VR creation, talked about the great possibilities of the technologies thinking spaces with no dimensions or sharing virtual spaces with people that is located in very distant parts of the world.

Research in out of body experiences has been carried out in projects like *"the machine to be another"* by the collective **BeAnotherLAB** which creates the illusion of being in the body of another person, and also changing genders or race. They describe themselves in the website as: "an interdisciplinary multinational group dedicated to understanding, communicating and expanding subjective experience; **focusing our work in understanding the relationship between identity and empathy from an embodied perspective.** Despite our focus on artistic practices, the team has backgrounds in Cognitive Sciences and Psychology, Interactive

Systems Design, Digital Arts, Computer Sciences, Social Communication, Anthropology, Cultural Management, Philosophy and Conflict Resolution".

Embodiment was also the practice of the artist Xin Liu, past resident in MIT Media Lab, with *Tree* that is a virtual experience that transforms you into a rainforest tree. The artist is using virtual reality and sensory displays to create immersive feelings like your arm is a branch and you feel how it grows or the weight of a bird that is posed on it.

Conceptual considerations about electroencephalogram (EEG) technologies.

Brain Electro activity is a field of research from the end of the 19th century, several technologies were used to detect the electrical waves that are produced by our brain when it faces different stimuli. EEG technologies are related to non invasive technologies, based on electrodes placed on the scalp. In the last two decades many studies have been carried out in the relationship of EEG measurements and emotions. Also, new light and inexpensive devices appeared in the market.

Several authors agreed on the different emotions that could be tested: anger, disgust, fear, happiness, sadness and surprise. Others conduct their research based in arousal, valence and dominance. Most of the tests conducted used video and audio recordings to stimulate the participants who were asked to express the emotions experienced. Different algorithms and datasets were developed through multiple tests, and now, researchers could use them to evaluate their EEG-emotion experiments that could combine with peripheral physiological signals. (Lakhan et al. 2019).

In relation to the MindSpaces research, correlating VR experience with EEG data is a very new field. In their paper "Emotion Recognition Using Frontal EEG in VR Affective Scenes" Tianyuan Xu and his co-authorscarry out an experiment with VR stimuli and EEG data collection. Authors argue about the capacity of VR producing more immersive and realistic scenes that could engage more emotional reactions based in the emotions: happy, fear, peace and disgust. After, the viewers were scoring them based in valence, arousal and dominance base on SAM. (Xu et al. 2019).

The project *The Wikiart Emotions Dataset* was correlating emotions expressed by the viewer infront a selection of 4000 images of Art (mainly paintings) selected by the online image archive of Wikiart. In their recent paper Mohammad and Kiritchenko, explain the process to create this correlation of emotions and images and titles of the artwork, based in questionnaires that were answered by volunteers following a process of crowdfunding. *The WikiArt Emotions Dataset*could be used in MindSpaces project to define emotions related with the type of image that is made by the artists.

Examples of current artistic projects based in EEG

Maurice Benayoun, a partner in MindSpaces project, is a digital artist and researcher interested in EEG for years. Currently, he is exhibiting worldwide a project, *Value of Values*. They defined it as: "Value of Values (VoV) is a blockchain-based art project. It aims to find

out the real, economic value of human values through EEG. Exhibition visitors give – straight from their brain waves – a three-dimensional shape to abstract concepts, like FREEDOM, PEACE, MONEY, LOVE, POWER" (see Figure 10)

Figure 10. Value to Values. Taipei 2019. Copyritht: Maurice Benayoun

Another artistic project using EEG to produce sound performances is Eunoia (2013) and Eunoia II (2014), works by the artist Lisa Park. The EEG waves are detected in real time through a specific software that translates them into sounds. (Mesaroova, Ferrer Hernandez, 2015)

An Art project combining AR and EEG is *The Future Slave* by Mark Skwarek in Liverpool at the art center FACT (2012). The experience was to simulate a future where the citizens of Liverpool are slaves. In the installation in FACT they needed to concentrate in building a wall, and the EEG device detects its concentration and if they fail, the installation produces bright lights and sounds. (Mesaroova and Ferrer Hernandez, 2015)

Conclusion of suggested path in art research in MindSpaces Project.

We have seen that artificial intelligence, immersive technologies (VR and AR) and EEG technologies are present in artistic research, and the field of exploration is always immense.

Art practice understands that using only technology as new media to translate production or concepts coming from another traditional media is not creating accurate research.

These new technologies are changing social systems, behaviours and reality understanding. That's why artists need to start their research by deeply understanding these technologies, its potential, and the achievements and pitfalls that they have faced. Additionally, combining technologies could bring other exponential artistic developments.

Moreover, MindSpaces' platform will integrate the AR and VR with a series of data coming from different sensors and cameras, registering data from the environment and human behaviour in the space, to body sensors from EEG, temperature, heart rate and more. EEG sensors will be explored as an interaction tool with the AR and VR reality between a conscious and unconcious manner, bringing a more transdescental approach to the experience.

5.2 Innovative work between artists,architects, technologists and citizens

As we saw in the previous chapters, the collaboration between artists,architects, technologists and citizens is very important for MindSpaces project. In the last decades several initiatives has promoted the interaction between artists, architects, technologists and citizens. We will analyse some of them, learning about the best practices to be applied to MindSpaces Project inorder to produce innovation within transdisciplinary teams.

Bauhaus, who is currently celebrating its centenary, was a pioneering program that brought together an important faculty of artists, architects, designers, technology experimenters, theatre experts, etc. All students were required to take part in a series of multidisciplinary workshops.

Leonardo, International Society for Art, Science and Technology, celebrated their 50th anniversary in 2018. During this long period, they have being promoting knowledge creation through their publication, *Leonardo magazine* by MIT Media Press, and having events such as conferences, talks, workshops, residences, etc., that wish to join thinkers and professionals coming from very diverse backgrounds, from artists to science researchers, technologists and also philosophers, theoreticians and historians. In a recent editorial: *What Is the Evidence That Art-Science-Technology Collaboration Is a Good Thing?*, Roger F. Malina wrote about the diverse initiatives to include Art in innovation, in Europe through the STARTS program and in the USA through public institutions after the report *Integrating Higher Education in the Arts, Humanities, Sciences, Engineering, and Medicine* by The United States National Academies and National Research Council (NRC) report "Beyond Productivity". He also introduces The SEAD Exemplars project, which is a catalogue of interdisciplinary projects as evidence that the innovation has improved, including the artists. (Leonardo 2018)

MIT Media Lab in Cambridge, MA, is creating this environment of innovation between artists and researchers in a dynamic way that they call: **anti-disciplinary**. This strategy promotes how researchers, including architects, are working in innovative projects that are not related with their original background, degree or previous research experience, which produces unexpected visions around the problem needed to solve or the adequate technologies or systems to apply in order to achieve the optimal impact of innovation. In City Science, the research team includes professionals in design, sound, art, architecture, urban planning,

robotics, AI, big data, computing modelling and more. Later, in this document we will analyse some of the MIT Media Lab good practices.

Other programs are developed by scientific institutions in Europe and abroad. **CERN**, the European Laboratory for Particle Physics in Geneva, Switzerland, who offers residencies to artists to cooperate with physicians, and Symbiotica, at the University of Western Australia, is verifying how artists are interested in scientific research. (Alexemberg 2018).

Collaborations between architects and artists using technologies are historical, and recent initiatives are promoting it again. In March 2019, MAAT Lisbon (Museum of Art, Architecture and Technology) and Whitechapel Gallery London commissioned *Is this tomorrow*, a show of then experimental propositions from leading artists, architects and other cultural practitioners, deploying technologies from digital to bio-molecular. The chief curator of Whitechapel wrote in the catalogue of the exhibition: "Having abandoned their early 20th-century unifying, utopian aim, architects and artists continue to share an interest in form and content, but often diverge over questions of function and intention. Collaboration affords each the opportunity to draw different approaches, different types of experience, and different points of view, and to embrace a level of unpredictability." (Yee, 2019)

Several authors are arguing about the capacity of the arts being involved in innovation, which doesn't mean using technology to make art. Science fiction strategies adopted by artists are advancing innovative developments, also their position which is situated out of commercial interests and scientific disciplines allows them to find new knowledge and technical applications (Alexenberg, 2018). Additionally, artists could try alternative directions with risk taking (Lee, 2018) and could guide innovation to sustain life on Earth and to find new systems to economic growth (Steinmuller, 2016).

Some transdisciplinary strategies to be applied in MindSpaces context

Experiences related by different sources will create a methodology for best practices to create the appropriate environment and dynamics which could generate a fruitful transdisciplinary innovation.

A) The author **Jill Scott** introduces some strategies to follow during artist residences with science and technology teams. (Alexenberg ed. 2008):

- **Knowledge by participation** is much more effective than the knowledge by acquaintance.
- **Robust Scientific Knowledge.** Artists also want to learn about theoretical disputes and how they are resolved among peer groups. Reciprocally, scientists have been known to encourage artists to give lectures about the values and contexts in contemporary art.
- **Strategic discourses.** New discourses might emerge from the sharing of ideologies between art and science in the future.

- **Discourse-Relational Creativity .**Scientific methodology often places art or design commissions only at the end of their processes, just before public presentation, thus deterring art collaborators from being involved.
- **Discourse-Shared innovation.** Facilitators team up and take on the role of trans-disciplinary assessment, assessing the skills of the artist and matching them with those of the scientists. This is not an easy task. **It requires the scientist to focus in creative concepts rather than the artist to simply illustrate scientific research results**. How does the use of the same tools by different disciplines affect how we interpret the results? **One of the most beneficial ways to encourage team collaboration** is to invite artists with scientists on **field trips where empirical evidence is collected or request scientists to see art exhibitions**.
- **Discourse-shared ethics.** Artists are often surprised to find out that so many conflicting viewpoints could simultaneously exist inside this field of research. How can art help scientists bring such diverse and controversial debates into the public realm?"

B) Recently, in September 2019, **STARTS Residencies** shared a publication providing methodologies on how to promote innovation processes involving artists who make original contributions to technology-based projects. Tech projects can take the form of collaborative research, development and innovation projects funded by public programs, or advanced technological projects hosted by a research team or a company located in Europe.

From the STARTS Residency's practical guide, we could select some of the advices and apply it into the MindSpaces Project:

- **Formalize clear roles and collaboration rules**, including intellectual Property management, in a co-production agreement signed by all the stakeholders involved at the beginning of the process.
- **Jam Session. Meet the Technologists.** Producing an event where technologists can present their challenge to artists in a free, open and informal way with a view to starting a dialogue and enhancing mutual understanding.
- **Monitor project development** and provide help if needed. Creativity requires freedom and cannot only be driven by tools. The platform does not formally request regular reports through forms, but it does provide a blogging tool to facilitate exchange and follow-up. The inception meeting, midterms review and final assessment should remain physical meetings, implemented by a mediator.
- **Present the results**. Valorisation is a major driver for all partners and needs to be planned in advance to be successful. Creating a win-win situation: drive innovation, creativity and awareness for both parties.
- **Other advices**: ensuring that technologists expect disruptive creative thinking, boosting motivation of the participants, sharing a common language, checking the resource

expending time with the artist, discussing the co-creation environment (in-between space), dealing with time and unknown under the different points of view. (Vinet 2019)

Other authors are writing about conducting this transdisciplinary research and innovation, analysing historical experiences and concluding that interdisciplinary teams need to share and develop a common language, establish clear goals and communications, and having a scheme for project coordination (Shanken 2005). Listing some of the advantages of interdisciplinarityand also bringing new ideas to a discipline from an outsider, the opportunity to explore grey areas between different fields of studies, to see social problems from different disciplinary point of views and to avoid the social risks of irresponsible action. And some of the barriers that could happen: interdisciplinarity requires an enormous quantity of time and energy to be seen as a subversive by pure disciplinary. (Nissani 1997).

Finally, we could extract some key recommendations for MindSpaces Project:

1) **Initiating the cooperation**: Jam session: mutual presentations, inviting artists to scientific field experimentations and inviting technicians to Art exhibitions.

2) Negotiating a common language and strategies of communication. From the beginning of the cooperation, it is necessary as the "mediator" who connects artists with the research team. The mediator will match the skills of the artists with the technical partners who are more open to its creative approach. Also, the mediator will keep the motivation of all the teams for collaboration.

3) **According goals, responsibilities and IP issues**. From the beginning, artists and technical partners need to negotiate what the goals of the research and innovation project are in a manner that it provides a win-win situation. A plan of work needs to be established from the beginning and sign a contract about the Intellectual property issues that inventions or achievements in research could arise.

4) **Creating in between spaces for the discussion and creativity**. Co-creative thinking will happen in environments that are comfortable for both artists and technicians. Meeting in a neutral space could help to think outside of the box, also producing strategic discourses about the future of technology while being away from their current day to day activities.

5) **Monitoring the project cooperation/ mutual transfer of knowledge.** Continuous feedback could be done in friendly communication through digital tools. The mediator will assist almost in three essential meetings: inception, midterm and conclusions. Also, during the project duration, other meetings could happen to share scientific and technological knowledge with the artists, and attending lectures about artistic creation and theory by the scientific and technological partners.

6) **Valorisation of the cooperation**. Obviously, the results of the cooperation will be shown and reported in the end of the research and innovation process. A continuous valorisation is

also recommended, promoting artists as participants in MindSpaces Project in events and conferences and through social media and other communication channels.

7) **Being in continuous contact with the users or citizens**. Based in co-creation methodologies, artists and technologies in MindSpaces Project will encourage contact with their target audience such as citizens, workers, elderly people, to be aware that the innovation is designed to impact positively in their wellbeing.

5.3 Digital data the new building blocks for Art and Architecture

Big data, or digital data, is becoming a key tool in projects related with Art and Architecture. The collection of data is also key in MindSpaces project.

Let's first introduce the concept of big data. In Adam Greenfield's recent book *Radical Technologies: the Design of Everyday Life* he mentions, "a simple way of defining data, then, might be facts about the world, and the people, places, things and phenomena that together comprise it, that we collect in order that they may be acted upon. Information science holds the data to transform facts we observe into insight and awareness". (Greenfield 2018, 210) The author also argues about how we collect this data and if the process is so objective or if it depends on the perception itself which is always a process of editing and curation.

Today, city councils are aware that the big data, collected from different sources, could improve their management and design, also by being in contact with citizens. Tom Holer argues that we need to be aware of the use of those data and to always have a critical position about the power that we manage. The author defines the contemporary urban spaces more as infrastructures of networked, digital architecture of knowledge than physical structures. (Holer 2009)

Pioneers in Architecture and Urban design are developing tools to integrate this data management into the thinking and planning of new urban areas. City Science researchers in MIT Media Lab have developed these tools and they also produce methodologies to involve focus groups with different stakeholders to decide what the final project will be. Algorithm that manages the data offers predictions about human traffic and car flows, possibilities of development, pollution generated, power consumption, additional infrastructures needed and more. The project's name is CityScope, and in a recent publication they defined themselves: "City Science group proposes a novel methodology of interaction and collaboration called CityScope, a data-driven platform that simulates the impacts of interventions on urban ecosystems prior to detail-design and execution. As stakeholders collectively interact with the platform and understand the impact of proposed interventions in real-time, consensus building, and optimization of goals can be achieved" (Alonso)

Recently, **STARTS Prize 2019** awarded a project based in City data management made by a collective, 300.000 km/s, which is a professional firm of architects, urban planners and engineers who provide designs, data analyses and consulting services for cities.

Ciutat Vella's land-use plan, this project defines itself as "a new way of making urban planning. The use of technology has radically transformed an existing type of master plan that responds to this scenario and regulates public establishments, food shops and tourist services in the central district of Barcelona. Fuelled by massive information (open data and big data) and complemented with qualitative data arising from citizen participation, the project applies novel methodologies of spatial analysis based on machine learning and artificial intelligence to inform, simulate and draft a public policy that puts the focus on preserving liveability in cities".

Previously, this deliverabledescribed the project WDCH Dreamswhichuses media facade projections to change architecture by giving meaning to memories extracted from an immense archive of pictures and sounds of the Los Angeles Philharmonic.

Through MindSpaces Project deployment, data will be collected, some from cameras installed in outside and inside spaces to analyse human behaviour in those spaces, also environmental data (from sensors of temperature, pollution, wind dynamics, light intensity, etc), data extracted from opinions and publications of the users in social media, and others from human body sensors, including EEG signals during the prototype testing of MindSpaces Platform and virtual reality environments. All of this data will "feed" the MindSpacesplatform in order to help artists, architects and designers to find the best solutions in each case.

6 CONCLUSIONS

In this deliverable,we have analysed how Art is influencing the Society from different points of view: philosophically, psychologically and socially, affectingthe emotions and behaviours of the citizens as well as conceptualizing the reality.

Most of the references of the document are very recent scientific studies or publications, and projects developed by research teams or artists.

MindSpaces Project, that follows the philosophy of STARTS program creates a trans-disciplinary Consortium with partners mastering different new emerging technologies: AI applied to semantic analysis or image data analysis, VR, AR, EEG, drone cameras, 3D design, behavioural analysis, etc, and their inviting artists, architects and creatives, into the consortium or collaboration by residences offered through open calls, will use all the knowledge described in this document to better conceptualize the work that will develop MindSpaces' platform and to manage optimally the cooperation with artists.

This deliverableoffers detailed research on the wellbeing process, created by the aesthetic experience and positive emotions. The studies and research in ecology and neuroscience cannot conclude that emotions generated by Art experience is making a direct change in neurobiological processes, but are opening this field to new research, which is one of the challenges of MindSpaces project.

Additionally, related with wellbeing and the design of working environments we have seen several use cases where environmental visual perception and volume display could reduce stress and promote interaction and happiness, and finally productivity. This knowledge will be the basis for the emotional evaluation of users in the different VR environments that they will experience.Methodologies described about transdisciplinary research and innovation teams including artists will help to achieve impactful results that are user, citizen and human centred.

Contemporary Art has the ability to be visionary and to bring critical opinion about the current issues of the society. Human centred technologies should be designed, from their initial concepts, by anti-disciplinary teams that could anticipate the social impact and lateral problems that those technologies could produce.

MindSpaces through their three user cases: public and outdoors spaces, working spaces and elderly home spaces, wants to test prototypes of neuro-design spaces based in a platform of new emerging technologies with two big key drivers: Art and Society.

Society, which is the final user of the platform, will participate in both directions, being part of data production as well as giving feedback of the space designs articulated by the cooperation of MindSpaces platform and the artists.

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