Journal of Open Innovation: Technology, Market, and Complexity

MDPI

Article

An Organizational Perspective on ArtScience Collaboration: Opportunities and Challenges of Platforms to Collaborate with Artists

Claudia Schnugg [1,*] and BeiBei Song [2,3]

[1] Independent Researcher + Curator, KJ 45, Wels 4600, Austria
[2] Song Essinova, LLC, Belmont, CA 94002, USA; bsong@essinova.com
[3] Graduate School of Business, Stanford University, Stanford, CA 94305, USA
* Correspondence: mail@claudiaschnugg.com

Received: 28 November 2019; Accepted: 17 January 2020; Published: 21 January 2020

Abstract: Artists are often seen as innovators and producers of creative and extraordinary new ideas. Additionally, experiencing art and artistic processes is an important opportunity for learning and exploration. Thus, corporations and scientific organizations have experimented with initiatives that generate artscience collaboration, such as fellowships, long-term collaborations with artists, and artist-in-residence programs. Looking at outcomes in the long-term, it is possible to identify important contributions to scientific, technological, and artistic fields that stem from artscience collaboration opportunities in organizations. On the other hand, it is often difficult to define immediate tangible outcomes of such processes as innovation as interdisciplinary interaction and learning processes are valuable experiences that do not always manifest directly in outcomes that can be measured. Drawing from cases of artscience programs and qualitative interviews with program managers, scientists, and artists, this article explores how artscience collaboration in an organization adds value and helps overcome organizational challenges regardless of such outcomes. By shifting the focus from the outcome to the process of artscience collaboration, it is possible to discover in more depth value-added contributions of artscience experiences on an individual level (e.g., new ways of knowing and thinking, understanding of materials and processes, and learning). Moreover, such contributions tell stories of connecting the process of artscience programs to the organizations' goals of developing a new generation of leaders and driving a more adaptive, innovative culture. These benefits of artscience opportunities need to be supported by managerial activities in the organization. Thus, it enables a more differentiated understanding of possible contributions of artscience collaboration to organizations and helps to define the best model to create such opportunities. The article also recommends future research directions to further advance artscience collaboaration, especially in light of pertinent movements such as STEAM and Open Innovation, and promising developments in related fields such as neuro-aesthetics.

Keywords: artscience collaboration; artist-in-residence; artist residency program; arts-based initiatives; artscience; interdisciplinary collaboration; art and technology; art and innovation

1. Introduction

Just like society and individuals, organizations today are confronted with global challenges from climate change to digitization in private, public, and work life, from antibiotic resistance to microplastics in the food chain and growing waste problems, from widening income disparity to the paradox between an interconnected world and the rising forces of nationalism. Organizations are searching for ways to address these issues and provide solutions. They also have to face additional challenges of competition

from rapid developments in or even outside their fields, often posing threat of obsolescence. They need to keep the ever-increasing pace of developments in technology and digitization, while encumbered by legacy systems, existing structures and outdated mode of decision-making. They need to invest in new opportunities and create spaces for innovation. Moreover, they need to identify and internalize new approaches in order to adapt their culture, structure, and management systems to external changes.

Arts-based initiatives (ABI) or artistic interventions in general have been brought into organizational (especially corporate) contexts to address these challenges named above. ABIs have been investigated by management and organization scholars throughout the last two decades, as interventions and initiatives on all organizational levels in order to add value and create change, in areas including product development, human resources, learning processes, and organizational development [1–5]. Various theoretical angles have been used to analyze ABIs and their effects in organizations (e.g., [6–8]). Various forms of ABIs have been explored in organizational settings: it is possible to bring in the artwork, bring in the artist for direct collaboration or as consultant, or learn from and employ the artistic process [9].

One approach to bring artists into organizations is artist-in-residence opportunities. In such programs, artists are invited into organizations to spend a certain amount of time working there. These periods can be short-term for a few weeks or long-term for a few months up to a year. Especially in long-term residencies, artists are often not expected to be in the organization on a daily basis, and the intensity of collaboration can vary in different phases: there can be phases when the artist spends time at his/her own atelier or on other projects, while there are other phases of intense collaboration and joint project development. The roles of the artists in residence also vary: sometimes their presence is connected to specific projects or departments; sometimes they are collaborating with individual employees for a long period; sometimes they give workshops; yet other times they aim to produce an artwork. These residency opportunities are created to open a space for an ABI that goes beyond consultancy or single workshops with an artist. It allows for conversations, collaboration and ongoing exchange. In most artist-in-residence programs in organizational contexts, the artist is more than a resident who learns and gets access to the experience and opportunities at this new place, but also one who co-creates and collaborates and thus induces learning and change in the host organization as well [10]. Thus, artist-in-residence programs are an ideal means to foster processes and collaborations on pressing topics, innovation, and organizational challenges and often take place within the setting of research, development, and science [11].

As interdisciplinary approaches are essential to tackling complex problems [12], opportunities that facilitate artscience collaboration and bring in artistic perspectives relating to society and culture can play a vital role in addressing the challenges organizations are confronted with. The resulting interaction between artists and organizational employees from diverse disciplinary backgrounds—scientists, engineers, and managers—is understood as an important contribution to fostering individual creativity, new insights, and new perspectives on issues within organizational or scientific fields [13]. As a systematic way to enable these interactions, artist-in-residence programs are gaining popularity among both governments and organizations, which invest in these opportunities [14–17] and integrate them in the organizational structure [10]. Among the most notable examples, the STARTS (Science + Technology + Arts) initiative funded by the European Commission is an important first pan-Europe governmental step to support such interdisciplinary actions. STARTS funded programs include: the STARTS Prize that has been awarded to innovative projects at the intersection of art, science, technology, and society yearly since 2016 [18], the Vertigo project that aims to support and fund at least 45 artscience residencies and is developing a web platform [19], and the FEAT (Future Emerging Art and Technology) activity [20] that provides opportunities for different residency formats in the field of emerging technologies.

1.1. The Emergence of Artscience Interaction through Artist-in-Residence Programs

Residency of artists in organizations, especially in their research and development (short: R&D) laboratories or departments, as a mechanism for experimentation and interdisciplinary exchange began to draw a lot of attention over half a century ago. In the late 1960s engineer Billy Klüver initiated a program called *Experiments in Art and Technology* (short: E.A.T.) for collaborations between artists and engineers at Bell Labs (then AT&T Bell Telephone Laboratories, now Nokia Bell Labs) [21]. This program was preceded by a pioneering collaboration on sound in the early 1930s, and by residence of individual artists at Bell Labs in the 1950s. Maurice Tuchman, curator at the *Los Angeles County Museum of Art* (LACMA), developed the *Art & Technology Program* that provided residencies for artists in industrial corporations starting in 1970 [22]. These two residency programs focused mainly on interdisciplinary exchange, providing artists with access to upcoming technologies and industrial applications while creating spaces of exploration for artists, scientists, and engineers alike [23]. In 1965, artists John Latham and Barbara Steveni conceived the *Artist Placement Group* (short: APG) in London. The program aimed at creating change in (corporate and governmental) organizations through "artist placements", which resembled residencies. The idea was to bring artists into organizations focusing on the artistic process inducing change, as opposed to an outcome-oriented strategy. Influenced by ideas of chaos theory, cybernetics, and system theory, Latham theorized a "butterfly effect", meaning that the presence of an artist in such an organization will automatically lead to change in a non-pre-determined way [24,25].

Although leaders in the arts and technology movement and artists of the APG were articulate about their aims and theoretical ideas of how and why these residencies would be beneficial to artists, scientists, and engineers [22,26,27] alike, and how the process would evolve and affect fields and organizations, it was difficult to get the residencies going. Most residency programs went dormant in the late 1970s due to lack of tangible outcomes in terms of contribution to the hosting organizations or immediately visible change processes [24]. Nevertheless, scientific organizations, especially universities in the U.S.A., became interested in the idea of artscience collaboration, and important centers for interdisciplinary collaborations between artists, engineers, and scientists developed. These included early programs at University of Illinois, Ohio State University, New York University, and the Massachusetts Institute of Technology (MIT) [28]; and over the course of the following decades, MIT Media Lab, in particular, developed as a leading group in the field of artscience collaboration. Additionally, an interdisciplinary academic discussion between art and technology in the journal *Leonardo* emerged. However, as the hybrid outcomes of such collaborations are interdisciplinary and thus not strictly classifiable in art, science, or technology, and thus the tangible outcome for engineers was difficult to demonstrate; and the emerging media art as well as other technology art were difficult to contextualize in contemporary art, the movement experienced difficulties to spread [28,29].

In the 1980s organizational studies and business scholars finally started to explore the opportunities of art in organizations. The *Standing Conference on Organizational Symbolism* in 1985 in Antibes, France triggered the first batch of publications on the topic, which influenced the development of the field of organizational aesthetics (e.g., [30–32]). The interdisciplinary symposium on art and economy at the *2nd Buchberger Kunstgespräche* took place in Austria in 1986 [33]. Additionally, at the Venice Biennale in the mid-1980s an interest in art and science emerged, represented in a large percentage by computer art and thus exposing the topic to a wider audience. When the personal computer became available to a broader community in the 1990s, it again spurred increased interest in the junction of art and technology within the arts community as well as among the general public [28].

The possibility of cross-fertilization between the intellectual fields of art and science, and to a large extent in upcoming technologies, was partly what led Xerox to introduce an artist-in-residence program at Xerox PARC (Palo Alto Research Center), their innovation center (the program named PAIR for PARC's Artist-in-Residence) [34]. The idea was in recognition of insights, challenges, and new perspectives that artists can bring to the R&D process, as well as the aesthetic dimension that is produced in such innovative art pieces and the demands of artists producing these artworks. "Unusual art

pieces of today can become core media models not many years from now", says John Seely Brown [35]. Some of the experiments achieved visible realization in the 1960s, making important contributions to the use of new technologies in scientific methodologies, or creating new art forms using technical devices [23]. Moreover, PAIR was designed as an experiment "to keep PARC both a leader in innovation and relevant to the corporation" [35]. As an experiment it was successful as it became a role model for artist-in-residence programs in corporate R&D departments and an essential example that has been referred to in management and organizational studies.

Permeating current conversations about the necessity for organizations and management to solve problems with innovative approaches, to cope with environmental change, and to keep pace with technological developments is a keen sense of urgency for innovation and creativity in economies and policies. Artist-in-residence programs that facilitate interdisciplinary interactions in R&D are a promising opportunity to create fruitful interventions [10,14]. Additionally, scientists and engineers need to look beyond the borders of their own disciplines to approach complex questions in their fields and to make their work relevant within society; and artists have a rising interest in science and technology—both as new artistic media and for their essential implications on society. These forces have fueled interest in artscience interactions from the perspectives of the individuals and society, as seen in the growth of artscience festivals and symposia around the world, in the curation of the Milan Triennale 2019 "*Broken Nature: Design Takes on Human Survival*" and Venice Biennale 2019 "*May You Live in Interesting Times*", in funding opportunities like European Commission's STARTS program and in the "STEM to STEAM" movement in education. (STEM stands for the subjects of Science, Technology, Engineering and Mathematics and STEAM is the abbreviation for incorporating the arts into STEM, an approach especially advocated in education in order to enable personal development and skills beyond rational and analytical thinking.) [36,37]

In his prominent articles in the journal *IEEE Spectrum* about the E.A.T. program [26,27], engineer Nilo Lindgren pointed to resulting innovation as major contribution by the interdisciplinary collaboration between artists, scientists, and engineers, and noted the possibility to change traditional ways of working in artistic, scientific and engineering fields. Both aspects have become important growth imperatives and leadership mandates in the current business environment, so these ideas find a wider audience today. Thus, interest in and realization of artist-in-residence programs grew in the last decade in diverse organizational settings.

Nevertheless, direct tangible outcomes that can be claimed as innovations are still rare. Often, changes in processes and enriched creativity through experiences in artscience collaboration affect outcomes after the collaboration process has finished. ABIs often occur on a personal level as part of learning processes or at interpersonal level because this is where most ABIs take place [38]. Thus, reflections on the effects of ABIs are sometimes connected to ideas of impacts of encounter with the arts (personal and societal) from an art theoretical perspective [39], based on theoretical understanding of what art is and can do, whereas outcomes in terms of personal learning, change, and enriching experiences are difficult to measure. Physical hybrid outputs of art and science are difficult to evaluate, and artworks produced during residency phases are often not directly relevant to the organization's aims. Measurement was difficult even in successful previous programs which yielded directly relevant outcomes in later years, for example, in the development of hybrid disciplines like computer graphics or applications of technologies beyond their original intentions [23,40]. So why should organizations continue to invest in artscience collaboration and pursue initiatives that enable these interdisciplinary encounters?

1.2. Finding an Organizational Perspective on Supporting ArtScience Collaboration

For most organizations, notions of "innovation" and "creativity" are still too vague and not specific enough to justify investment in an artscience collaboration opportunity or a program for regular artist-in-residence projects, if it is not possible to expect measurable outcome. Cases of personal development and innovative approaches through artscience experiences [13] and studies of the link

between learning in artistic and scientific disciplines and individual creativity [41,42] are an important first step, but still leave open questions of relating these effects to the organizational processes and goals. Why is it important to create these opportunities within an organization and what are specific experiences of individuals in artscience collaboration that are valuable for the organization?

Additionally, residency programs must be planned carefully and integrated into the organization so that relevant effects can manifest [14]. This means that space and activities to reflect and integrate outcomes afterwards need to be guaranteed. Intermediaries like agencies, curators, mediators, and program managers are central to the impact and successful incorporation of an artistic residency in an organization [10] and the artscience collaboration process [43]. Professional consultants can fill this gap, though organizations need to be able to reflect on outcomes to allow potential experiences and learning from the ABI process to be internalized in the organization [44].

Drawing from research on artscience collaboration, with its relevance for both artists and scientists, and relating this to organizational needs and goals, especially innovation, will help to take a first step towards a more coherent argument for artscience collaboration in organizations, especially corporates:

- Organizations aim at hiring the best scientists and employees, keeping them motivated and providing them with structures and resources they need to do their job in the best way they can.
- Organizations want to create innovative services and products for their clients and customers, provide them with the best solutions, and make them known to their current and future customers.
- Organizations need to overcome challenges posed by fast-paced technological advances, market shifts and social changes. They need flexibility and agility, and future visions that align with their environment and stakeholders.

Above that, organizations have to cope with internal structures, processes, organizational blindness, change, and cultural issues, which are all aspects ABIs in general can potentially tackle [6]. How can artscience opportunities as specific form of ABIs be related to these issues?

Starting from experiences in laboratories and one-to-one artscience collaborations, connections will be made between individual learning processes through personal experiences in these opportunities and the organizations' needs shown above. Careful understanding and management of how the openness in artistic and scientific/research processes can be intertwined and harvested within this organizational logic, regardless of immediate tangible outcomes, will help to create impactful artscience opportunities that are relevant for artists, scientists, organizations, and their stakeholders.

2. Approach and Data Base

The methodological approach to examining connections in the dynamic and open process between artists and scientists (which is designed to create something valuable for both parties in the first place) developed as follows. First, cases of artscience collaborations were researched and analyzed to understand the processes and effects of these interdisciplinary exchanges and their relevance to the participating parties. How did these interactions benefit artists and scientists and their learning processes? What do they see respectively as relevant? Additionally, as most cases take place in organizations, they were asked about their perception of how the program relates to the organization, their work in the organization, and where they encounter difficulties to realize that relevance in the organization. Program managers, curators, and facilitators were interviewed to contribute their experience and their point of view on these processes as well. An overview of the contributions of artscience projects to individual development and organizational transformation gleaned from the interviews will be presented in Section 3. These findings will then be discussed in relation to the existing literature on ABIs. Second, therefore, research on ABIs was analyzed towards an understanding of how they in general benefit organizations and what organizational theories were used to identify a better connection between the effects of ABIs and organizational needs, especially within corporations. Artscience collaborations within university settings are not so tightly bound to this kind of organizational logic because the individual benefit to the scientists engaged in artscience

collaboration is in many cases more important; and individuals decide differently about engaging in artscience than organizations do. Third, cases of artscience collaboration in organizations were analyzed in order to understand the connection between individual artscience collaboration processes and related organizational benefit. Such analysis has been derived from primary research in this project. In each of these cases interviews were conducted with different parties of the artscience project or program, followed up with official reports and presentations in other media. Five of these cases will be presented as five stories of artscience programs in Section 4 to impart insights into the model with concrete examples. Bringing all these steps together, a more comprehensive understanding from an organizational perspective will be formed to discuss managerial challenges.

The research into the impact and management of artscience collaboration draws on research Claudia Schnugg has been conducting during the past four years, including participative observation of processes and semi-structured qualitative interviews with artists, scientists, researchers, engineers, and managers (including curators and intermediaries) [45], corroborated with BeiBei Song's research and teaching in innovation and leadership, and similar interviews and curation in science and technology art. Schnugg has formally conducted 58 qualitative interviews between October 2016 and April 2018. Forty-seven interviews were digitally recorded and accompanied with handwritten notes, and nine interviews were captured in handwritten notes (further questions during transcription checked with the interviewees for clarification), whereas two interviews took place via email. Hence, two interviews took place in a written form via email, the other 56 interviews took place in person or via teleconference system, and all 58 interviews were followed by thick descriptions of each case. Seventeen interviews took place with artists, 15 with project/program managers and curators, eight with artists experienced in artscience collaboration who later became artscience program managers, and 18 with scientists who experienced collaborations with the artists interviewed or were part of one of the artscience programs. Additional conversations about the experience took place with other contributors to artscience processes observed or managed by the authors which were captured in hand-written notes. Most of the managers, curators, and artists were involved in multiple projects whereas many of the engineers and scientists have experienced only one or two of these processes. From the interviews that represent cases or artist-in-residence programs in organizations, descriptions were written up and checked back with the interview partners. Additionally, Schnugg was following the documents and presentations about the cases and programs to develop a more comprehensive understanding of how the individual stakeholders understand what they are doing and why. The cases and programs cover corporate and scientific organizations, and interviewed individuals come from a diverse background: mostly from Europe and North America, but some also from Australia, Asia, and South America.

The cases discussed by the artists, scientists, and program managers interviewed took place in 18 different programs: at universities, scientific organizations, corporate organizations, and cultural organizations. Most interview partners could report about several artscience experiences with different partners and in diverse formal programs. Only a few of the cases described by one of the artists and two of the scientists did not take place within an artscience program, but were one-time opportunities created by the artist and scientist to collaborate with each other. Most of the cases took place as residencies with a duration of between one and twelve months. Additionally, a few long-term collaborations were created as fellowships for the artist at the laboratory or went on after a first residency phase. This myriad sampling provides a wide range of formats and helps one understand the processes and value-adds of artscience interactions from the diverse and interdisciplinary perspectives involved in such activities. Ongoing discussions of observations and experiences with curators of artscience processes and programs in organizations further stimulate the development of the ideas and interpretation of the material.

3. Value-Added of ArtScience Collaboration from an Organizational Perspective

Organizational scholars have shown that most effects of ABIs happen on the personal level through personal interaction with art or the artist. Thereby, a series of effects were identified through

meta-analysis of case studies. These effects range from individual learning processes, to heightened communication skills, or new insights. Such effects then can induce changes on the interpersonal level like better communication, addressing conflicts, and sharing values; and even reach the organizational level by impacting organizational visions, change processes, and outreach. Beyond that there are certain organizational goals that can be addressed through ABIs without their effects on an individual level. These can be organizational communication through artworks or artistic contributions that are consultative [3–5]. As a meta-analysis shows [38], previous studies also indicated that arts-based initiatives can have impacts on the organization's surroundings or create and enrich the organization's external relationships.

Thus, starting from the individual level, the analysis of the interviews and cases points to substantial contributions relevant to organizational and managerial discussions [45], as well as innovation insights:

3.1. Personal/Interpersonal Learning and Leadership Development

- As art approaches topics and projects with processes and skills that are different from scientific disciplinary processes and skills, these collaborations can help contextualize these topics and projects and help scientists and organizational actors to understand their work differently in these contexts (contextualization), which can even induce meaning to their understanding of their work (meaningful work theory);
- The collaboration and interaction of actors from such different fields, disciplines, and environments helps to create new social and organizational networks; transform existing fields into new ones and engage the actors in them; and accumulate new connections, whether tight or loose (strong and weak ties);
- The aesthetic dimension of artscience collaboration can improve communication of concepts, contexts or phenomena through the aesthetic power of art; additionally, the interdisciplinary discourse between artists and scientists helps to build up diverse communication skills and improve personal communication;
- Collaborative processes of artists and scientists as well as artistic and scientific combination or reproductions of ideas can lead to sense-making processes and support sense-giving processes, thus help to understand different perspectives on issues or interpretation possibilities of data through new ways of thinking;
- Artscience collaboration is one form of interdisciplinary collaboration that can contribute to work processes on complex issues, support learning processes to enhance cross-functional collaboration skills and enhance problem-solving processes for complex challenges.

3.2. Organizational Learning, Innovation Process, and Cultural Transformation

- Artscience interactions can constitute liminal spaces for experimentation, serving as a tangible vessel of exploration (Exploitation vs. Exploration concept);
- Such liminal spaces can help induce or realize change, facilitating discovery of possibilities that the company's core business would not have dreamed of;
- They can also be a platform for sensing internal and external innovation opportunities;
- The engagement of artists increases variance and divergent thinking, enhancing ideation quality and problem-solving potential;
- The interaction of art and science allows collaboration partners to experience the other profession's approach and thus tackle dimensions of organizational aesthetics, such as getting in touch with embodied knowledge, internalized work processes, and understanding of materials;
- The artscience process induces or enables change, enhances the creative process and promotes conditions allowing individuals to be more innovative and more resourceful;

- Artscience initiatives can have a signaling effect of the organization's culture, attracting and retaining the best talent and encouraging employees to behave with innovative mindset;
- The individual and interpersonal learning brought about by artscience collaboration may also accumulate to achieve a shared perception of "how we do things around here", gradually changing without top-down mandate.

An interesting insight emerged from the analysis of the interviews and cases. Instead of arguing that artscience collaboration led to an immediate creative outcome, it uncovered its effects of fostering creativity through personal learning, as well as enhancing other individual, interpersonal, and organizational factors [45] that are fundamental enablers of creativity [46]. This points to an important change in understanding the contribution of artscience to organizational innovation and creativity: the immediate outcome of an artscience collaboration—be it an artwork, a hybrid outcome in-between art and science, or an artistic contribution to a research project—is neither the comprehensive nor the fully representative contribution of artscience opportunities to creativity and innovation in an organization.

Similarly, most research into ABIs has pointed towards leadership development as a key effect of ABI investment (e.g., [47,48]), with the organizations gaining important skills and abilities to cope with new scenarios and complex situations. More specifically, reflections into theoretical approaches in organizational research regarding ABIs show their effects beyond immediate outcomes. These include the contribution of ABIs in sense-making and mindfulness in organizations [8]; their contributions to experiencing meaningful work [49]; their contributions to creative processes and organizational change through liminality and rites of passage [50]; and their relevance concerning materiality in learning in organizational contexts [51], organizational aesthetics [52], and embodied cognition [53–55]. Such literature already reveals the entanglement of effects on individual levels with organizational needs and goals. This indicates the value of the process between artists and organizational members as it makes essential contributions to individual and interpersonal learning, helping staff to cope with organizational challenges, navigate change and achieve organizational goals.

Not surprisingly, these effects are being validated and corroborated by discoveries of neuroscience in the areas of learning, leadership and innovation. For example, psychologists and cognitive scientists uncovering the biological processes of creativity emphasize the importance of "primary process thinking", an unstructured, visual mental activity which can lead to "remote associations" or "long paths of association" by connecting ideas or facts that are not typically related [56]. Neuroscientists and neuro-leadership scholars have found that sudden insights, which are often the beginning of radical inventions and breakthrough solutions to difficult problems, are more likely to occur when the brain is under certain key conditions: a quiet mind, inward looking, slightly happy, and not focused directly on the problem [57–60]. Also known as an epiphany or a eureka or "Aha!" moment, an insight can be understood as "a sudden comprehension that solves a problem, reinterprets a situation, explains a joke, or resolves an ambiguous percept" [61]. By forming and manifesting new combinations of existing memories and data from the non-conscious mind, it emerges quickly into awareness instead of through linear cognitive processing. Engaging with art and learning the artistic process very much lend itself to such uncommon associations and conditions of relaxation, calmness and sensory awareness, which are conducive to creativity, innovation and leadership problem solving even when the individual is not working on a directly-relevant science, engineering or business problem.

In addition, there has been growing recognition of the power of emotions and senses in many aspects of business and organizational life: from product design and consumer purchasing decisions [62,63] to social dynamics [64] and workplace culture [65]. The brain's capacity for perception, cognition, creativity, and collaboration decreases under emotional threat [66]. Practicing direct experience (also known as mindfulness) by being present in the moment and paying close attention to the senses helps regulate emotions [67]. Art is one of the most effective means to train one's sensory circuitry and emotional intelligence, which contributes to workplace wellbeing internally and bolsters brand loyalty in the marketplace.

New world realities call for a new type of leader—one with a sense of meaning, flexible mindset, and a way of communicating with authenticity. The effects identified above demonstrate the power of ABIs in cultivating such leaders. As these effects and values from ABIs surface in the experience of artscience collaboration in organizations, it is a matter of space, reflection, and integration into the organization during and after the experience [44] that relevant outcomes can be harvested. These can range from innovation to organizational culture to the organization's ability to cope with environmental change. Thereby, the individual artscience collaboration process can be as open as needed for the artistic and scientific goals to be pursued, and through careful framing of the format and integration of outcomes and processes in the organizational setting important contributions can be made that go beyond effects on the individual level. The artscience programs shown below are cases where the individual logic of a valuable artscience opportunity is integrated with that of the organizational logic, enabling both to flourish.

4. Five Stories of ArtScience Programs in Organizations

The following five stories are five examples of the artscience programs investigated via interviews with several participants and parties in the projects, and additional informal conversations with the initiators and heads of the programs. The development of the programs has been followed via media and publications after the interviews. The workshops of the program presented in 4.4. also have been evaluated and participatory observation was made of the first workshop.

4.1. Organizational Vision, Experiences, Complementary Thinking Processes, Visionary Approaches to Product Development

Following the footsteps of the previously mentioned E.A.T. (*Experiments in Art and Technology*) program active in the 1960s and 1970s, the initiative was revived a few years ago [68]. Drawing on the rich experience of Bell Labs in the 1960s, it was immediately understood that the contribution of such a program lies beyond direct outcomes of the residencies in terms of artworks or research projects, but in experiences, new perspectives, and the way artists explore ideas and address issues of contemporary society [69]. Additionally, innovative or hybrid outcomes of such collaborations could become valuable only retrospectively. The head of this revived and re-designed residency program Domhnaill Hernon points out that the program is valuable for Bell Labs because artists have a special ability to make theoretical approaches and ideas observable and put them into expressive forms. This contributes to one of the organization's goals to create a new language that allows for sharing emotions. The artistic practice and artistic research process enable new ways to explore relevant research questions and to create a dialogue within the organization and with the researchers and engineers. The focus of the program is on long-term collaboration and interaction. Residency artists are invited to spend a collaborative phase at Bell Labs for twelve months, which can be extended through a commissioned realization of a proposed artwork/project afterwards.

With awareness of this potential, the E.A.T. program additionally finds an important angle to connect it with their organizational vision. Art creates experiences, is entangled with aesthetics, employs different sensory impressions, and—bringing relevance to business—reflects a human-centered perspective on technology, society, and culture. Thus, Domhnaill Hernon [70] credits E.A.T. program's essential contribution to Nokia Bell Labs with the artists' ability to bring the "human component" into the development of technology. It is important to them not only to develop technology for engineering questions, but also to create technology that is relevant for humans and society to express themselves and experience communication as humans.

4.2. Innovation, Creativity, Creative Processes, New Perspectives, Motivation, Exploration of Needs of Future Stakeholders

Noah Weinstein founded the artist-in-residence program at Autodesk in 2012. Named *Pier 9 Artist-in-Residence Program* [71], it hosted (growing) cohorts of over fifteen residency artists and other

creatives, each for four months. The invited artists-in-residence (anyone who has a creative practice to their work) got access and training to use the Pier 9 workshop and were supported in handling Autodesk technologies. As Noah Weinstein explained, the residency was designed as a place for creative and experimental exchange. The idea was to bring together different creative practices and perspectives on projects and technologies, and to create an exchange between the creatives and Autodesk employees. The process was very free, and the artworks produced at the end were presented in a final art show at Pier 9 and as "Instructables" [72]—open access instructions on their webpage to reproduce them.

In this process, artists-in-residence got opportunities to exchange their ideas and work practices with each other and with employees. They were guided by employees to work with the hardware and software at Autodesk to explore their limits, re-arrange functionalities, and alter technologies to reach the artistic goal. The experience of creative processes and artistic perspectives, the collaboration to reach an artistic goal and the creation of an explorative space all worked together to produce new experiences, motivate, inspire curiosity and stimulate enthusiasm, which in the end led to creative processes and innovation [73]. This would leave the tangible outcome of the program as art—which was also important for the artists—while enhancing the work process and boosting motivation of the employees, which could result in innovation. There could be other unexpected benefits too, like new directions in the security department [45]. Although this was a successful concept, there was also an interest in the company to test a new approach to create technologically or industrially relevant outcomes. In 2018, the artist-in-residence program was changed to an innovator-in-residence program that would more directly produce innovative outcomes [73]. The new program invites thought leaders and a diverse group of innovators to use the facilities [74]. The explorative space is still provided, but innovators, start-ups, and private research groups are invited to explore their ideas.

4.3. Social Environment, Organizational Goals, Future Vision, and Experimentation

The *Ginkgo Creative Residency* [75] at Ginkgo Bioworks was created by biodesigner Natsai Audrey Chieza, founder of Faber Futures [76], and scientist and communicator Christina Agapakis at Ginkgo Bioworks. The residency program offers a fully funded three-month residency (the artist/designer/creator is at a position on the same level as the scientists, including pay) and aims at addressing common goals and visions of Ginkgo Bioworks in collaboration with resident artists: explore "innovative ways to design with biology" and "the potential and implications of synthetic biology" [77]. The residencies are offered to engage people in interdisciplinary collaboration to push the frontier of the field and apply critical thinking to design-driven problem solving. Thereby innovation is not expected as direct outcome but rather as collateral benefit through joint experimentation and exploration of the field and through creation of new experiences with new perspectives and processes. Additionally, the founders of the residency program point to the opportunity these projects provide to communicate with a wider audience about a broadly unknown field of research and development, to start a dialogue, and to educate and engage them. They feel this conversation with the audience, which goes beyond traditional campaigning, is necessary due to the newness of this scientific and business field.

4.4. Visions for Communication, Exchange with Society and Next Generation, Contextualization

The STEAM Imaging project created by Bianka Hofmann in collaboration with her colleagues at Fraunhofer MEVIS in 2017 [78], which will be hosted again by the Institute for Digital Medicine Fraunhofer MEVIS in 2019 [79], has been smartly integrated into the science communication of the organization by going beyond superficial ideas of communicating through art. It starts with an exchange between the artist, the scientists and staff at the organization. The artist will get into a dialogue with the scientists and staff to produce an artwork tackling research. In this process, interesting spaces for discussing research, its context, ethics, and possible implications can open up. Additionally, the outcome and the collaboration with the artist are cleverly interwoven with communication strategies and educational initiatives for high school students. As Hofmann [80]

describes, the cutting-edge research and technology the organization is working with needs new models of communication to be discussed outside the research community and understood in a broader society. Contextualization through artscience projects provides an opportunity to discuss with new audiences and create scenarios involving the research to which the audiences can relate.

The interdisciplinary artscience workshops for school students aged between 12 and 15 years old are part of an initiative by Fraunhofer called "Talent School" and based on software and research at the Institute for Digital Medicine Fraunhofer MEVIS. The workshops are developed and realized in collaboration with the incoming artist. They aim to create an understanding of the interplay of disciplines in medical scientific research, including aesthetic dimensions. Above fostering their talents and interests through this experience, these workshops should create a contextual understanding of the science and technological investigation being done and enable an "intergenerational dialogue" [80,81]. Through both the workshop and the residency, which includes the production of an artwork, spaces for exchange, exploration and new perspectives are opened in which experts, artists and stakeholders are invited to discuss and engage. These stakeholders are the broader audience and school students representing the next generation.

4.5. Organizational Culture, Human Resources, and Organizational Mission

The residency program for artists and designers at the private Earth imaging company Planet Labs [82] was initiated and managed for five years (until 2018) by artist Forest Stearns. Artists are invited to spend three months at the organization. They define their interest within the organization and develop an artistic project within their residency phase, guided by the residency manager. The potential of humanizing the organization's scientific vision and the motivational effects on employees are central to this program. The effects on the organizational culture, which encourages employees to think beyond disciplinary borders (or the limits of a given project) and to approach topics in a more open manner, are key reasons of keeping the program going.

Forest Stearns further explains the effects of the artist-in-residence program he experienced in his time as residency manager, on hiring, inclusion, and employee retention [45]. One major observation was that organizations are in competition with each other to employ the best scientists and engineers. The artist-in-residence program in the free and explorative way as it is advertised, has been named by a number of scientists and engineers as one of the reasons that they applied for a position in this specific company—the support for artistic expression and projects is a sign for a certain open culture in the organization, which hopefully also allows scientists and engineers to express innovative thoughts and to realize some of their approaches based on out-of-the-box thinking. Additionally, inviting artists with residency opportunities has been experienced as catalyst for cultural inclusion. The notion of inclusion has become more tangible within the organizational culture, as new personalities and artistic expressions are always experienced and included in the organizational life. Lastly, Forest Stearns found that the artist-in-residence program contributed to employee retention, even for employees who do not actively collaborate with incoming artists. The experience of the art and conversations about the projects can contribute to relaxation and delight breaks.

5. Implications for Organizational ArtScience Initiatives and Managerial Challenges

Investigation into the individual processes of collaborative artscience projects and the stories about artscience programs in organizations reflect general findings of research on ABIs in organizations: that the interaction happens mainly on the personal and interpersonal levels [3]. This is the level where most effects have been found. These effects of the interaction between incoming artists and employees in the organization can be understood from multiple theoretical perspectives relevant to organizational culture, human resource development, innovation and creativity, strategic development, products, and vision [4]. For example, seeing organizations as a set of practices [83] can help to understand the contributions of individual learning and interpersonal experiences in artscience collaboration to organizational needs.

More specific research on creativity and artist-in-residence program has shown that creativity does not spread by only inviting artists into an organization, and that there has to be space for interaction and exchange [84]. Creative ideas and innovation, even completely unexpected output, can emerge from the collaborative process that is based on interaction where "everyone contributes from their perspective and experiences" [85]. The artist's perspective and experiences bring a new point of view into the discussion within an organization, whereas the employees' experiences and perspectives can be fresh and inspiring to the artist. Such artscience initiatives barely deliver final answers or definite solutions to problems, but can open up new opportunities, ask different questions, point to new ways, engage different groups in a new way, and add to personal learning.

Sometimes outcomes directly stem from these interactions, especially when they are set up as problem-solving opportunities, but in most cases the effects of the learning processes on the development of current or future projects of the scientist, the artist, or in the organization can mainly be identified retrospectively. Already Latham argued for system thinking to understand the opportunities for development artist-in-residence programs generate [24]; and organizational theorists point out that systemic perspectives also allow for better understanding of artistic contributions and effects of engagement with art in organizations [86]. Nevertheless, engagement in terms of reflection on the experience after the artscience interaction ended, integration of the effects in work processes and possible projects inspired by it is essential to allow for sustainable contributions [44]. This largely depends on how leadership supports the learning processes and integration of effects [38]. The cases also show that the effects on the individual level need to be related to organizational goals and communicated through managerial arguments to give them space to grow. It is part of leadership and management responsibilities to understand and integrate the process and effects of artscience opportunities on the individual level with organizational needs and goals.

Leadership and management also must be able to communicate the value of the contribution beyond physical or tangible outcomes. Although it is difficult to measure a direct connection between the employees' experience and their future work processes, project ideas, or enhanced ability to deal with complex issues, mechanisms can be put in place to facilitate, document and track their reflections and manifested changes. Such mechanisms not only deepen individual learning, but also encourage connection with and reinforcement of organizational needs and goals. They facilitate attention to and broader understanding of the transformation initiated through ABIs and thus make their impact explicit. A question frequently asked of artscience programs and ABIs in general are their "ROI" (Return on Investment). In addition to whatever quantitative return that may be appropriate depending on the nature and objectives of the program, qualitative return should be considered and asserted. As the corporate world becomes more conscious of its social and environmental responsibilities in addition to profit-making, and frameworks such as "Triple Bottom Line" gain acceptance, measuring a firm's impact on People and the Planet in addition to its Profit, efforts can be made to map the ROI of artscience programs and ABIs to broader bottom-line evaluations.

The creation of successful artscience programs that are also perceived as such internally in the organization is an intimate process depending on the organizational culture, goals, research, and structures (including available facilities). Thus, intense planning, curation, and facilitation are essential for the success of the program [10,45]. This comprises definition of the goal of the artscience program, design of its formats, integration and reflection within the organization, space for employees to engage, communication strategies, selection of the artists, and careful curation of the process. Programs with limited space, resources, and engagement opportunities do not satisfy expectations nor do they contribute much to personal learning, or appreciation of the initiative through participating individuals. Therefore, managers have to understand the specificity and context of their organization—there is no one best way [87]—and understand what the positive notion of collaboration means: "a process of shared decision making in which all parties" take part voluntarily, constructively explore differences, commit to the process, and "develop a joint strategy for action" [88]. Managers also need to be aware of responsibilities and hierarchies within the organization and help the collaborators

to overcome possible structural issues, because trust and the ability to stay true to one's personal perspective on the topic are essential.

Diverse approaches are possible for creating artscience interactions in organizations: artist-in-residence programs, artists as part of the project team or laboratory, long-term one-to-one artscience relationships, short-term collaborations, or even single encounters as quick exchange and input. Artist-in-residence programs can be targeted towards artists who are interested in the organization and its goals as such, in specific R&D projects, in specific department of the organization, or in a team, lab or as one-to-one collaboration. Other opportunities can be fellowships and visiting artist (like visiting researcher) positions. Most important before creating opportunities is to think about the levels on which the contribution of the artscience collaboration should take place. Finesse in the selection and combination of people, themes, projects and relationships is important.

Since artscience collaboration in the organizational setting, and even ABIs in general, are still on the fringe of management practice, such programs often exist in a precarious position. Some of them rely on the backing of an executive leader who intuitively appreciates the value of art, but are subject to cancellation when a more linear, analytical leadership takes over. Some managers may find it difficult to make a business case for such investment, even if they personally would like such a program. When economy goes into a down cycle, programs of this kind are also likely to be the first ones to be cut. This is not necessarily unique to artscience or other ABIs—any "non-core" activities, especially future-oriented with no immediate outcomes, are likely to encounter resistance and receive the "axe" upon the first sign of economy softening. When the approach is novel, its advocate also shoulders more career risk. The better known and more widely adopted the practice, the less risk it poses to the internal champion, and the more it can be institutionalized as an integral activity of the organization. To achieve this, it helps to redefine objectives of such investment and evaluation criteria of its "returns", in light of the findings and insights from our research.

6. Further Research and Future Directions

More targeted research into organizations with artscience programs and long-term developments associated with these initiatives will be necessary to better uncover how connections between artscience programs and organizational needs and goals can be created and manifested, so that such initiatives can gain more legitimacy and strategies as follow-up to ABIs can be devised. Research into the relevance of artscience programs for change or development of organizational culture will help to create in-depth understanding of how these programs are perceived and how they can create an atmosphere of openness or contribute to employee retention as described by researchers and program managers in the interviews. We also believe there are many opportunities for artscience programs to evolve and further develop their potentials, by connecting and interacting with adjacent movements in academic, business and social arenas, for synergistic growth.

6.1. Longitudinal Studies across Disciplines

Based on the initial research on connections between artscience collaboration and creativity, personal learning, social networks, and other effects on the individual level, it will be important to follow artscience initiatives in long-term studies to better elaborate on their connection to innovation and heightened creativity. This will also help to design better organizational structures to integrate these effects and allow for future creative processes.

Historical cases that spawned new fields in art, science and technology, or contributed essentially to the development of hybrid fields, will be helpful to understand the potential of outcomes which are not immediately perceived as tangible innovations. These include the invention of linear perspectives in painting during the Renaissance which fundamentally reoriented Western society from God-centered, dualistic, and medieval worldview to spatial, materialistic realism, and influenced the rise of modern science [89]; Joseph Beuys' Social Sculpture and art-driven transformation approach which anticipated today's open social innovation [90]; the countercultural ideals and bohemian spirit of the San Francisco

Bay Area which gave rise to Silicon Valley's personal computer revolution [91]; and the art project Piazza Virtuale by Van Gogh TV presented at Documenta in 1992, an interactive platform for TV audience, that anticipated forms of interaction on social media platforms [92]. There were, of course, contributions to the emergence of computer graphics and the use of computers in the production of art, sound, and performances that started in connection with experimentations in the 1960s [21,23]. Ideas stemming from these interactions often need further elaboration and contextualization to demonstrate their contribution. This is an area where art historians, science historians, and business scholars can collide knowledge and investigation, breaking out of their disciplinary silos. When art historians alone study the impact of certain art movements or phenomena on society and commerce, they may have limited reach outside their very specific community. Moreover, their specific perspective, knowledge base and data lead to research questions that lie within their field, not pushing them to detect and articulate hidden connections and gradual effects outside their realm. Combining perspectives from art, science and economics history may yield interesting discoveries, connecting dots, uncovering lineage and revealing patterns of contribution art makes to scientific, technological and commercial advances that will be heard by these different communities.

Artscience organizations active since the emergence of the modern artscience movement in the latter half of the 20th century have had a few decades of experience. A conscious effort can be made to reflect upon their journey, compile stories of cross-fertilization, and evaluate and publicize their impact on society and business. If such a study is difficult due to inadequate archiving, lack of continuity and knowledge transfer among staff, or funding constraints, new initiatives such as STARTS have the benefit of hindsight and opportunity to build in such mechanisms from the beginning, with a set of criteria and measurements appropriate for their mission, periodically reviewed and updated to reflect new realities and ambitions.

6.2. Exploration of the "Third Culture"

Additionally, there needs to be further research contextualizing hybrid outcomes of artscience collaboration and spaces to present and discuss them. Artscience collaboration potentially spurs interpersonal learning, overcoming cognitive biases and social dynamics (as shown exemplary above), as the process involves meeting of individuals from different backgrounds with different work processes, skills and perspectives. This meeting generates hybrid outcomes. It also leads to the development of a "third culture" [93], where natural sciences and literary intellect meet, that allows for more fluid exchange between the scientific disciplines and art, and creates new spaces both groups can occupy, where artscience practitioners work towards [94,95]. But how does this relate to specific disciplines and their peculiarities within society and organizations? Whereas artists can play with fiction and challenge existing boundaries, scientists are bound to talk about facts and figures [96]. How would such a development of a third culture expand into organizations and affect their processes and structures? Or would such a third culture help them to better communicate new fields of activities like synthetic biology, or make them more adaptable in coping with technological advances and digitization?

6.3. Implications of "Exponential Technologies"

As artscience collaboration is connected to the latest developments in science and technology, with their contributions to and potential pitfalls in society, economy, and industrial practices, another important research question is to look at how artscience collaboration can help organizations navigate changes and issues stemming from these developments: automation, digitization, replacement of traditional products, professions, and new ways of working. Conversely, exponential technologies such as Internet of Things (IoT), artificial intelligence (AI), machine/deep learning (ML/DL), virtual/augmented/mixed reality (VR/AR/XR), 3D printing, blockchain and crypto currencies may have implications on artscience collaboration itself: both as content to reflect on, and as adoption in its own structure. Such technologies and digitization in general are shrinking or distorting time scales on many levels, from product lifecycle to the spread of political/social movements. Can exponential

technologies be leveraged to create new operating models for artscience programs and ABIs? Will they potentially shorten the long-term time horizon henceforth required for artscience effects to manifest? Can they be harnessed to develop new ROI business models capturing the value of arts?

6.4. New Value Propositions

New social and market forces are both demanding as well as providing opportunities for new value propositions of artscience programs. ABIs from the 1960s already had specific goals such as process insights, artistic exploration of industries, contribution to artworks employing new media, and cross-disciplinary exploration of new technological developments. However, due to difficulties of articulating effects, determining impact or categorizing the outcomes, their value was not fully realized. Recent artscience programs and ABIs can draw upon advances in organization studies, media art in society, and art history to become more impactful and to better articulate the impact. A comparative study between these previous and more recent ABIs, along with exploration of adjacent disciplines and related movements, could reveal how they can be improved in the future to broaden and deepen their added value. Here are but a few promising areas:

Strategic differentiation. As the marketplace becomes increasingly crowded, and supply exceeds demand in many industries, traditional competition-based strategies are no longer effective for sustainable growth. Businesses need to learn to stake out unexplored, "uncontested market space and make the competition irrelevant" [97]. Art, in its essence, finds "differences among things that are similar" [98]. How can its power to create experiences that are unique, exceptional and meaningful be channeled into business strategies? This is an opportunity for new perspectives—like artistic ones—to contribute to broader developments.

Human connection. One major difference art makes is human emotional connection. Consumers today expect more than utility from their purchases. Products and experiences that evoke wonder, joy, hope, and happiness, or help personal expression, can connect with consumers on a deeper level and command a premium. This is especially pronounced with the millennial generation, about to enter its prime spending years, who values experience more than physical possessions. The "human component" articulated by Domhnaill Hernon underlying Nokia Bell Lab's E.A.T. program is relevant to many other companies and industries.

Higher purpose. Keenly aware of the challenges the world faces, due in part to industrial damages and corporate greed, many consumers and young employees alike want to hold companies accountable to their business practices affecting all stakeholders as well as the Planet. Big business is also recognizing that "pursuing shareholder value is no longer enough" [88]. Despite skepticism and challenges in measurement and implementation, frameworks such as Triple Bottom Line (TBL) mentioned above are making inroads among organizations. Environmental, social and governance (ESG) criteria are used in more and more financial investment decisions by asset managers [88]. A new concept takes TBL even further, to Quadruple Bottom Line, adding humanistic values such as spirituality, ethics, purpose, and culture [99,100] as a fourth factor to an organization's reason of being. Art has unique roles to play across all these value domains, but probably the strongest in the fourth bottom line.

Innovation Paradigms. As engagement of artists brings new perspectives and increases variance and divergent thinking, enhancing ideation quality and problem-solving potential, artscience programs can be embedded in the myriad forms of corporate innovation programs beyond traditional R&D labs. An especially natural fit may be the open innovation paradigm, "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries" [101], which may involve both the firm's internal ideas as well as externally sourced views from creative consumers [102] and communities of user innovators [103]. Here, the value of artscience collaboration can presumably be more easily understood and justified.

6.5. Collaboration with Neuro-Leadership, Neuro-Aesthetics, and Other Neuroscience-Applied Fields

In addition to the aforementioned development in neuro-leadership, neuro-aesthetics as a relatively recent sub-discipline of empirical aesthetics is attracting increasing international interest, including in the artscience community. Neuro-aesthetics studies "the neural bases for the contemplation and creation of a work of art" [104], understanding and explaining the aesthetic experiences and sensory knowledge using neuroscience. These neuro-related fields and organizational aesthetics each emerged one or two decades ago but have not interacted much with each other. Bringing them together presents a fertile ground for the development of each—art creates, cultivates or facilitates the aesthetic experience; whereas neuroscience analyzes and measures such experience. Despite its currently somewhat narrow approach reducing aesthetic experience to a set of physical or neurological laws [105], neuro-aesthetics may help validate artscience collaboration and ABIs with measurements and data, shedding more light on their connection with outcomes relevant to the organization.

6.6. The STEAM Movement

Lastly, STEM to STEAM is currently an important discussion in the world of education. How does this movement relate to managerial challenges and organizational strategies in their R&D departments, human resource development, and artscience programs? Might it lead to a new kind of incubator, either university-initiated, independently operated or corporate-affiliated, as a new innovation engine, with interdisciplinary creativity in its DNA? Are there any such platforms already in existence? Might it be integrated and streamlined with artscience programs? How might educational institutions proactively help shape the future of work, rather than merely react to employers' current needs? What are the implications to organizational learning and development, when a new breed of talents educated the STEAM way, which is better suited for tackling complex issues organizations face, enters the workforce? What new thinking will be needed from a human resources perspective, on their hiring, training, and retention? How might organizations redesign their structure to both take advantage of the well-rounded skills of these new talents and cater to their development? These questions may lead to interesting discoveries and potential new opportunities for artscience collaboration.

7. Conclusions

Artscience collaboration programs in organizations as a specific form of ABIs show a lot of potential on the individual level and on the interpersonal level. Depending on their design, they can additionally contribute to organizational goals and needs in various ways. Nevertheless, it is difficult to measure outcomes directly and long-term effects are difficult to determine or foresee. Thus, artscience collaboration programs are not standardized management tools; they have to be developed and realized carefully depending on the organizational culture, context, and needs. Additionally, as individuals only engage in artscience collaboration if they are interested, artists and scientists need to be motivated and understand the value for their personal development through such process. Intertwining the different needs, artscience collaboration can be extremely valuable to all contributing parties, to the organization as a host, to its environment and stakeholder groups, as well as to the development of artistic and scientific fields—as many cases show. More targeted research and broader value proposition will help better understand and demonstrate such value. Neuroscience can be one of the new tools to validate and measure the value on human levels; and related movements in open innovation and STEAM can help guide design of the next generation artscience programs, and further materialize their potential.

Author Contributions: Conceptualization, Methodology, Analysis, Data Curation, and Writing—Original Draft Preparation: C.S.; Joint Further Development after Original Draft of Sections 3 and 5–7, B.S. and C.S.; Validation and Writing—Review and Editing, B.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: The authors want to thank all interview partners for their openness to reflect and talk about their artscience experience. Particularly, they thank the interview partners from the five exemplary stories

presented in this paper who also generously made interviews with scientific and artistic collaboration partners in the residency programs possible: Domhnaill Hernon, Bianka Hofmann, Sabrina Haase, Christina Agapakis, Natsai Audrey Chieza, Forest Stearns, Noah Weinstein, Vanessa Sigurdson. And thanks to the Art|Sci Center UCLA for the first author's short research stay. The authors also want to thank the editor and the reviewers for their encouragement and their constructive and valuable feedback.

Conflicts of Interest: The authors declare no conflict of interests.

References and Notes

1. Taylor, S.S.; Ladkin, D. Understanding arts-based methods in managerial development. *Acad. Manag. Learn. Educ.* **2009**, *8*, 55–69. [CrossRef]
2. Darsø, L. *Artful Creation: Learning-Tales of Arts-In-Business*; Frederiksberg: Samfundslitteratur, Denmark, 2004.
3. Antal, A.B. Transforming Organizations with the Arts. Research Report by TILLT Europe Project. Available online: https://www.wzb.eu/system/files/docs/dst/wipo/researchreport.pdf (accessed on 19 January 2020).
4. Schnugg, C. Kunst in Organisationen. Analyse und Kritik des aktuellen Wissenschaftsdiskurses zu Wirkung künstlerischer Interventionen im organisationalen Kontext. [Art in organizations. Analysis and critique of the scientific discourse about the effects of artistic interventions in organizational contexts]. PhD Thesis, Johannes Kepler University, Linz, Austria, October 2010.
5. Biehl-Missal, B. *Wirtschaftsästhetik: Wie Unternehmen die Kunst als Inspiration und Werkzeug nutzen*; Gabler: Wiesbaden, Germany, 2011.
6. Antal, A.B.; Strauß, A. *Artistic Interventions in Organisations: Finding Evidence of Values-added. Creative Clash Report*; WZB: Berlin, Germany, 2013.
7. Sköldberg, U.J.; Woodilla, J.; Antal, A.B. *Artistic Interventions in Organizations: Research, Theory and Practice*; Routledge: New York, NY, USA, 2016.
8. Barry, D.; Meisiek, S. Seeing More and Seeing Differently: Sensemaking, Mindfulness, and the Workarts. *Organ. Stud.* **2010**, *31*, 1505–1530. [CrossRef]
9. Schnugg, C. The organization as artist's palette: Arts-based interventions. *J. Bus. Strategy* **2014**, *35*, 31–37. [CrossRef]
10. Antal, A.B. Artistic intervention residencies and their intermediaries: A comparative analysis. *Organ. Aesthet.* **2012**, *1*, 44–67.
11. Scott, J. *Artists-in-Labs Process of Inquiry*; Springer: New York, NY, USA, 2006.
12. Klein, J.T. *Interdisciplinarity: History, Theory, and Practice*; Wayne State University Press: Detroit, MI, USA, 1990.
13. Edwards, D. *Artscience: Creativity in the Post-Google Generation*; Harvard University Press: Cambridge, MA, USA, 2008.
14. Styhre, A.; Eriksson, M. Bring in the arts and get the creativity for free: A study of the artists in residence project. *Creat. Innov. Manag.* **2008**, *17*, 47–57. [CrossRef]
15. Hediger, I.; Scott, J. *Artists-in-labs: Recomposing Art and Science*; De Gruyter: Berlin, Germany, 2016.
16. European Commission. Policy Handbook on Artists' Residencies. Available online: https://ec.europa.eu/assets/eac/culture/policy/cultural-creative-industries/documents/artists-residencies_en.pdf (accessed on 3 August 2019).
17. European Commission. Innovation is About Starts: When ICT and ART Connect. Available online: https://ec.europa.eu/digital-single-market/en/news/innovation-about-starts-when-ict-and-art-connect (accessed on 9 August 2019).
18. STARTS Prize. An Overview of All Winners and Nominations in 2016–2019. Available online: https://starts-prize.aec.at/en/winners2019 (accessed on 11 January 2020).
19. STARTS Residencies. Vertigo Starts. Available online: https://vertigo.starts.eu/vertigo-project/about/ (accessed on 11 January 2020).
20. FEAT. Available online: http://www.featart.eu/index.php?id=5 (accessed on 19 January 2020).
21. Patterson, Z. *Peripheral Vision: Bell Labs, the S-C 4020, and the Origins of Computer Art*; MIT Press: Cambridge, MA, USA, 2015.
22. Bijvoet, M. *Art as Inquiry: Toward New Collaborations Between Art, Science, and Technology*; Peter Lang: New York, NY, USA, 1997.
23. Taylor, G.D. *When the Machine Made Art: The Troubled History of Computer Art*; Bloomsbury: New York, NY, USA, 2014.

24. Slater, H. The art of governance. The Artist Placement Group 1966–1989. *Variant* **2000**, *2*, 23–26.
25. Steveni, B. The Repositioning of Art in the decision-making Process of Society. In Proceedings of the International Symposium on Public Art, Singapore, 1–5 March 2002.
26. Lindgren, N. Art and Technology I—Steps Toward a New Synergism. *IEEE Spectr.* **1969**, *6*, 59–68. [CrossRef]
27. Lindgren, N. Art and Technology II—A Call for Collaborations. *IEEE Spectr.* **1969**, *6*, 46–56. [CrossRef]
28. Shanken, E.A. Artists in Industry and the Academy: Collaborative Research, Interdisciplinary Scholarship and the Creation and Interpretation of Hybrid Forms. *Leonardo* **2005**, *38*, 415–418. [CrossRef]
29. Shanken, E.A. Art in the Information Age: Technology and Conceptual Art. *Leonardo* **2002**, *35*, 433–438. [CrossRef]
30. Taylor, S.S.; Hansen, H. Finding Form: Looking at the Field of Organizational Aesthetics. *J. Manag. Stud.* **2005**, *42*, 1211–1231. [CrossRef]
31. Strati, A. Aesthetic understanding of organizational life. *Acad. Manag. Rev.* **1992**, *17*, 568–581. [CrossRef]
32. Strati, A. *Organizations and Aesthetics*; Sage Publications: Thousand Oaks, CA, USA, 1999.
33. Kunstforum International. *Das Brennende Bild*; Kunstforum International: Deisenhofen, Germany, 1987.
34. Harris, C. *Art and Innovation: The Xerox PARC Artist-in-Residence Program*; MIT Press: Cambridge, MA, USA, 1999.
35. Seely, B.J. Introduction. In *Art and Innovation: The Xerox PARC Artist-in-Residence Program*; Harris, C., Ed.; MIT Press: Cambridge, MA, USA, 1999; pp. xi–xiii.
36. Osburn, J.; Stock, R. Playing to the technical audience: Evaluating the impact of art-based learning for engineers. *J. Bus. Strategy* **2005**, *26*, 33–39. [CrossRef]
37. Root-Bernstein, B.; Siler, T.; Brown, A.; Snelson, K. ArtScience: Integrative Collaboration to Create a Sustainable Future. *Leonardo* **2011**, *44*, 192. [CrossRef]
38. Antal, A.B.; Strauß, A. Multistakeholder Perspectives on Searching for Evidence of Values-added in Artistic Interventions in Organizations. In *Artistic Interventions in Organizations: Research, Theory and Practice*; Sköldberg, U.J., Woodilla, J., Antal, A.B., Eds.; Routledge: New York, NY, USA, 2016; pp. 37–59.
39. Belfiore, E.; Bennett, O. Determinants of Impact: Towards a Better Understanding of Encounters with the Arts. *Cultural Trends* **2007**, *16*, 225–275. [CrossRef]
40. For example, in the 1960s artists Kenneth Knowlton and Leon Harmon and scientists Béla Julesz and A. Michael Noll worked on perception with a machine called S-C 4020 at Bell Labs to develop works of computer art. Knowlton and Harmon's work Studies on Perception created a meaningful contribution to the rise of art employing computers and new media at that time and it influenced scientific and technological developments. It "is also part of the history of the theoretical and practical innovations that Bell Labs fostered throughout the twentieth century. It is concerned with the space carved out for graphics research at institutions that were not primarily concerned with visual representation." [21]. For example, a lot of work on screens and visual processing and formats of output fall into this realm.
41. Root-Bernstein, R. Music, Creativity, and Scientific Thinking. *Leonardo* **2001**, *34*, 63–68. [CrossRef]
42. Root-Bernstein, B.; Root-Bernstein, M. Artistic Scientists and Scientific Artists: The Link Between Polymathy and Creativity. In *Creativity: From Potential to Realization*; Sternberg, R.J., Grigorenko, E.L., Singer, J.L., Eds.; American Psychological Association: Washington, DC, USA, 2004; pp. 127–151.
43. Koek, A. In/visible: The inside story of the making of Arts at CERN. *Interdiscip. Sci. Rev.* **2017**, *42*, 345–358. [CrossRef]
44. Strauß, A. Value-creation processes in artistic interventions and beyond: Engaging conflicting orders of worth. *J. Bus. Res.* **2018**, *85*, 540–545. [CrossRef]
45. Schnugg, C. *Creating ArtScience Collaboration: Bringing Value to Organizations*; Palgrave Macmillan: London, UK, 2019.
46. Woodman, R.W.; Sawyer, J.E.; Griffin, R.W. Toward a theory of organizational creativity. *Acad. Manag. Rev.* **1993**, *18*, 293–321. [CrossRef]
47. Adler, N. Going beyond the dehydrated language of management: Leadership insight. *J. Bus. Strategy* **2010**, *31*, 90–99. [CrossRef]
48. Barry, D.; Meisiek, S. The art of leadership and its fine art shadow. *Leadership* **2010**, *6*, 331–349. [CrossRef]
49. Antal, A.B.; Debucquet, G.; Frémeaux, S. Meaningful work and artistic interventions in organizations: Conceptual development and empirical exploration. *J. Bus. Res.* **2018**, *85*, 375–385. [CrossRef]
50. Schnugg, C. Setting the Stage for Something New. Understanding Arts-Based Initiatives through the Lens of Liminality and Rites of Passage. *Z. Kult.* **2018**, *4*, 77–102.

51. Taylor, S.S.; Statler, M. Material matters: Increasing emotional engagement in learning. *J. Manag. Educ.* **2014**, *38*, 586–607. [CrossRef]
52. Taylor, S.S. Overcoming Aesthetic Muteness: Researching organizational members' aesthetic experience. *Hum. Relat.* **2002**, *55*, 821–840. [CrossRef]
53. Reinhold, E.; Schnugg, C.; Barthold, C. Dancing in the office. A study of gesture as resistance. *Scand. J. Manag.* **2018**, *34*, 162–169. [CrossRef]
54. Barnard, P.; deLahunta, S. Mapping the audit traces of interdisciplinary collaboration: Bridging and blending between choreography and cognitive science. *Interdiscip. Sci. Rev.* **2017**, *42*, 359–380. [CrossRef]
55. Springborg, C.; Ladkin, D. Realising the potential of art-based interventions in managerial learning: Embodied cognition as an explanatory theory. *J. Bus. Res.* **2018**, *85*, 532–539. [CrossRef]
56. Schilling, M.A. *Quirky: The Remarkable Story of the Traits, Foibles, and Genius of Breakthrough Innovators Who Changed the World*; PublicAffairs: New York, NY, USA, 2018; pp. 108–109.
57. Schooler, J.W.; Smallwood, J.; Christoff, K.; Handy, T.C.; Reichle, E.D.; Sayette, M.A. Meta-awareness, perceptual decoupling and the wandering mind. *Trends Cogn. Sci.* **2011**, *15*, 319–326. [CrossRef]
58. Bowden, E.M.; Jung-Beeman, M. Aha! Insight experience correlates with solution activation in the right hemisphere. *Psychon. Bull. Rev.* **2003**, *10*, 730–737. [CrossRef]
59. Ohlsson, S. The problems with Problem Solving: Reflections on the Rise, Current Status, and Possible Future of a Cognitive Research Paradigm. *J. Probl. Solving* **2012**. [CrossRef]
60. Rock, D. How to have more insights. Psychology Today. Available online: https://www.psychologytoday.com/us/blog/your-brain-work/201009/how-have-more-insights (accessed on 19 January 2020).
61. Kounios, J.; Beeman, M. The Aha! Moment: The Cognitive Neuroscience of Insight. *Sage J.* **2009**, *18*, 210–216. [CrossRef]
62. North, A.; Hargreaves, D.; McKendrick, J. In-store music affects product choice. *Nature* **1997**, *390*, 132. [CrossRef]
63. Zaltman, G. *How Customers Think: Essential Insights into the Mind of the Market*; Harvard Business School Press: Harvard, MA, USA, 2003.
64. Williams, L.E.; Bargh, J.A. Experiencing Physical Warmth Promotes Interpersonal Warmth. *Science* **2008**, *322*, 606–607. [CrossRef] [PubMed]
65. Sutton, R.I.; Rao, H. *Scaling Up Excellence: Getting to More Without Settling for Less*; Crown Business: New York, NY, USA, 2014; pp. 5–7.
66. Rock, D. SCARF: A Brain-Based Model for Collaborating with and Influencing Others. Available online: https://qrisnetwork.org/sites/default/files/materials/SCARF%20A%20Brain-based%20Model%20for%20Collaborating%20with%20and%20Influencing%20Others.pdf (accessed on 19 January 2020).
67. Siegel, D. Mindfulness training and neural integration: differentiation of distinct streams of awareness and the cultivation of well-being. *J. Soc. Cogn. Affect. Neurosci.* **2007**, *2*, 259–263. [CrossRef]
68. NOKIA Bell Labs. E.A.T. Now. Available online: https://www.bell-labs.com/programs/experiments-art-and-technology/eat-now/ (accessed on 11 January 2020).
69. NOKIA Bell Labs. Experiments in Art and Technology. Available online: https://www.bell-labs.com/programs/experiments-art-and-technology/ (accessed on 11 January 2020).
70. Hernon, D. *Humanising Technology*; Inspirefest: Dublin, Ireland, 2019.
71. The Pier 9 Artist-in-Residence program by Autodesk has been redesigned in 2018. Information on the residency program during the first few years and videos of exemplary residency projects can found on the following link: https://www.forbes.com/sites/katherynthayer/2017/06/30/how-hosting-artist-residencies-helps-autodesk-build-better-3d-software/ (accessed on 11 January 2020).
72. Instructables. Available online: https://www.instructables.com/ (accessed on 11 January 2020).
73. Weinstein, N. Kunst: Kein Garant für Innovation. Available online: https://science.orf.at/stories/2989505/ (accessed on 7 August 2019).
74. Autodesk. Residency Program. Available online: https://www.autodesk.com/technology-centers/residency (accessed on 11 January 2020).
75. Ginkgo Bioworks. The Ginkgo Creative Residency. Available online: https://www.ginkgobioworks.com/creative-residency/ (accessed on 11 January 2020).
76. Faber Futures. Available online: https://faberfutures.com/ (accessed on 11 January 2020).

77. Ginkgo Bioworks. Reflections from Ginkgo's First Creative-in-Residence. Available online: https://www.ginkgobioworks.com/2018/04/11/creative-in-residence/ (accessed on 11 January 2020).
78. Fraunhofer. STEAM Imaging in 2017. Available online: https://www.mevis.fraunhofer.de/de/press-and-scicom/institute-news/STEAM-imaging-under-the-skin.html (accessed on 11 January 2020).
79. Fraunhofer. STEAM Imaging II in 2019. Available online: https://www.mevis.fraunhofer.de/de/press-and-scicom/press-release/2019/patient-bonsai.html (accessed on 11 January 2020).
80. Hofmann, B. Linking Science and Technology with Arts and the Next Generation—The Experimental Artist Residency "STEAM Imaging". *Leonardo* **2019**. [CrossRef]
81. Hofmann, B.; Haase, S.; Black, D. STEAM Imaging: A Pupils' Workshop Experiment in Computer Science, Physics, and Sound Art. *SciArt Mag.* 2017, 26. Available online: http://www.sciartmagazine.com/steam-imaging-a-pupilsrsquo-workshop-experiment-in-computer-science-physics-and-sound-art.html (accessed on 11 January 2020).
82. Arts at Planet Labs. Available online: https://www.planet.com/company/art/ (accessed on 11 January 2020).
83. Czarniawska, B. *A Theory of Organizing*; Edward Elgar: Cheltenham, UK, 2008.
84. Raviola, E.; Schnugg, C. Fostering Creativity through Artistic Interventions: Two Stories of Failed Attempts to Commodify Creativity. In *Artistic Interventions in Organizations: Research, Theory and Practice*; Sköldberg, U.J., Woodilla, J., Antal, A.B., Eds.; Routledge: New York, NY, USA, 2016; pp. 90–106.
85. Jahnke, M. A Newspaper Changes Its Identity through an Artistic Intervention. In *Interventions in Organizations: Research, Theory and Practice*; Sköldberg, U.J., Woodilla, J., Antal, A.B., Eds.; Routledge: New York, NY, USA, 2016; pp. 77–89.
86. Simon, F.B. Künstlerische Interventionen im wirtschaftlichen Kontext. Einige kommunikations—Und systemtheoretische Überlegungen. In *oeconomenta: Wechselspiele zwischen Kunst und Wirtschaft*; Markowski, M., Wöbken, H., Eds.; Kulturverlag Kadmos: Berlin, Germany, 2007; pp. 107–114.
87. Mintzberg, H. *Managers Not MBAs: A Hard Look at the Soft Practice of Managing and Management Development*; Berrett-Koehler Publishers: San Francisco, CA, USA, 2005.
88. Bengtsson, M.; Kock, S. "Coopetition" in business networks—To cooperate and compete simultaneously. *Ind. Mark. Manag.* **2000**, *29*, 411–426. [CrossRef]
89. Coates, G.J. *The Rebirth of Sacred Art*; The Dawn Horse Press: Middletown, CA, USA, 2013.
90. Montagnino, F.M. Joseph Beuys' Rediscovery of Man–Nature Relationship: A Pioneering Experience of Open Social Innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *Special Issue "Business, Open Innovation and Art"*, posted online 23 October 2018.
91. Markoff, J. *What the Dormouse Said: How the Sixties Counterculture Shaped the Personal Computer Industry*; Penguin Books: London, UK, 2005.
92. Media Art Net. Available online: http://www.medienkunstnetz.de/works/piazza-virtuale/ (accessed on 11 January 2020).
93. Snow, C.P. *Two Cultures*; Cambridge University Press: Cambridge, UK, 1959.
94. Buntaine, J. Come Together: Julia Buntaine and the SciArt Center. Available online: https://scientificinquirer.com/2017/11/14/come-together-julia-buntaine-and-the-sciart-center/ (accessed on 20 November 2017).
95. Vesna, V. Towards A Third Culture: Being In Between. *Leonardo* **2001**, *34*, 121–125. [CrossRef]
96. Zurr, I.; Catts, O. Artists working with life (sciences) in contestable settings. *Interdiscip. Sci. Rev.* **2018**, *43*, 40–53.
97. Kim, W.C.; Mauborgne, R. *Blue Ocean Strategy: How to Create Uncontested Market Space and Make the Competition Irrelevant*; Harvard Business School Press: Boston, MA, USA, 2004.
98. Cross, N. *Designerly Ways of Knowing*; Springer-Verlag: London, UK, 2006.
99. Sawaf, A.; Gabrielle, R. *Sacred Commerce: A Blueprint for a New Humanity*, 2nd ed.; EQ Enterprises: Berverly, MA, USA, 2014; pp. 24–28.
100. Taback, H.; Ramanan, R. *Environmental Ethics and Sustainability: A Casebook for Environmental Professionals*; CRC Press: Boca Raton, FL, USA, 2013.
101. Chesbrough, H.; Bogers, M. Explicating Open Innovation: Clarifying an Emerging Paradigm for Understanding Innovation. In *New Frontiers in Open Innovation*; Chesbrough, H., Vanhaverbeke, W., West, J., Eds.; Oxford University Press: Oxford, UK, 2014; p. 17.
102. Berthon, P.R.; Pitt, L.F.; McCarthy, I.; Kates, S.M. When customers get clever: Managerial approaches to dealing with creative consumers. *Bus. Horiz.* **2007**, *50*, 39–47. [CrossRef]
103. West, J.; Lakhani, K.R. Getting Clear About Communities in Open Innovation. *Ind. Innov.* **2008**, *15*, 223–231. [CrossRef]

104. Nalbantian, S. Neuroaesthetics: Neuroscientific theory and illustration from the arts. *Interdiscip. Sci. Rev.* **2008**, *33*, 357–368. [CrossRef]
105. Gilmore, J. Brain trust—Jonathan Gilmore on art and the new biology of mind. *Artforum Int.* **2006**, *44*, 121–122.