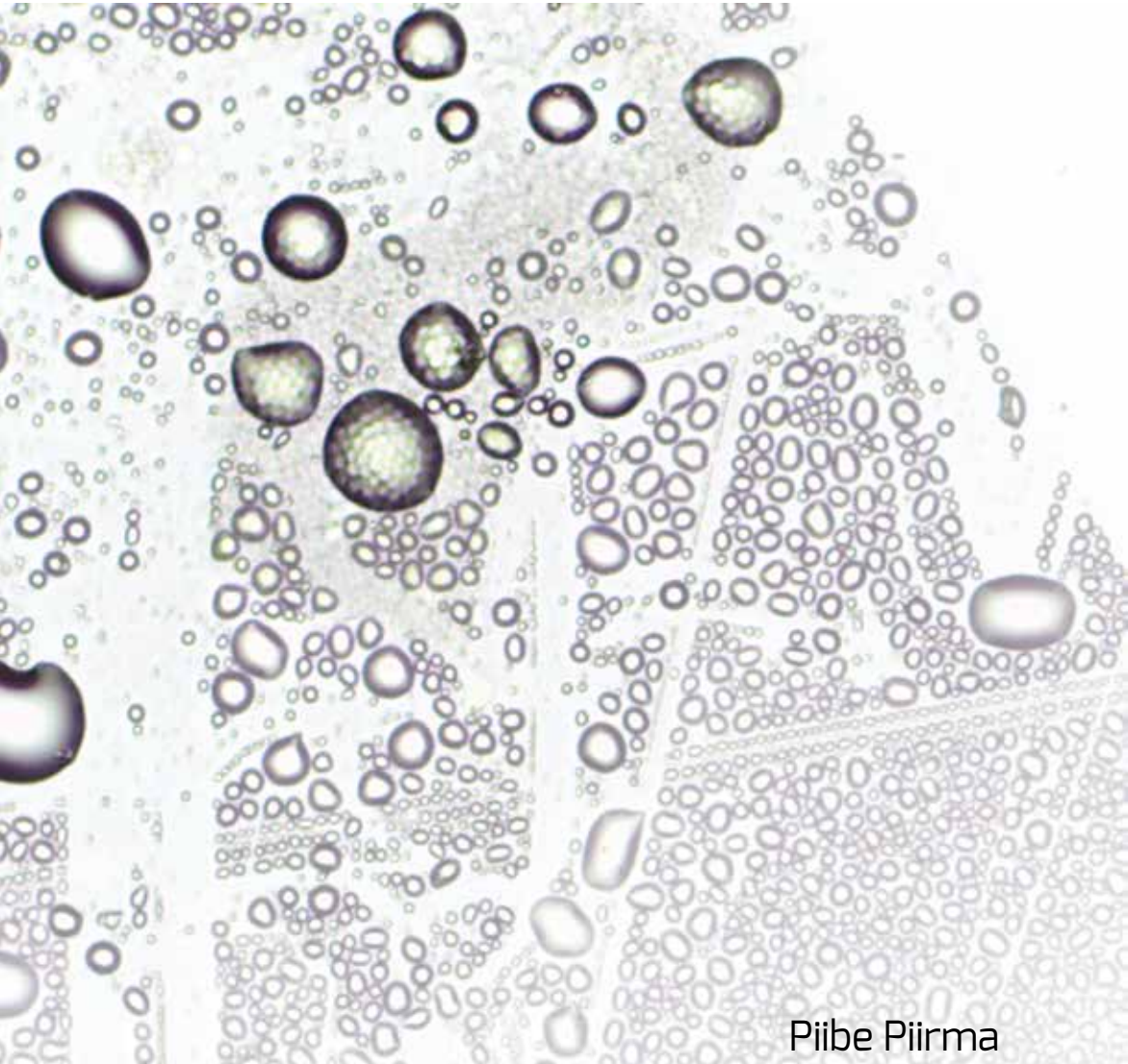

Piibe Piirma

HYBRID PRACTICES

Art and Science in Artistic Research

Doctoral Dissertation
Estonian Academy of Arts
2015

Dissertationes Academiae Artium Estoniae 18

Doctoral Dissertation

HYBRID PRACTICES
Art and Science in Artistic Research

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Acknowledgements

I inherited my interest in technology from my electrical engineer father who, in the 1970s, worked in a large computing centre on a house-sized computer. Images consisting of 0s and 1s printed on large perforated sheets were an important part of my childhood. My practical interest in using technology arose later in relation to my need to use a video camera for art purposes, followed by my desire to use video as an opportunity to create interactive environments. This in turn was followed by my first attempts at using various programming systems. I received a traditional art education at the Estonian Academy of Arts, interested in new media art – a genre that is today quite difficult to define. Its roots are deeply in technological progress and the digital revolution of the 1990s.

While studying for a master's degree in interactive multimedia at the Estonian Academy of Arts, I soon felt that in addition to using technology as a tool, it also offers significant potential for interpreting my art. Since the start of the 2000s I have been involved with video and animation, I created my first interactive video installation for the "Edited Memory" exhibition at the Tallinn City Gallery (the exhibition in the spring of 2006 was put together with Jane Suviste). "The Seven Congregations of John" was an installation based on the Book of Revelation of the Bible and for which I created animations/illustrations using contemporary formats and symbols. The interactive book that had videos alternate on the screen as the pages were turned was created with very simple means but what was most important was a great interest and aim, the desire to study various ways to create so-called gallery art that can be influenced by the viewer.

By that time (2006) we had formed the Estonian Media Artists Union with a group of enthusiasts. Its lifespan was not long but tightly packed with all kinds of exciting adventures. Our goal was to find and bring together Estonian artists who have a voice in the new media art landscape. The period 2006-2011 was full of activities from spontaneous outdoor video screenings, short seminars or workshops at Culture Factory Polymer to festival participation and Estonian media artists' annual exhibitions. The substantive and formal management of the Estonian Media Artists Union was an important stage in my life when I realised that in addition to my creative work I was also interested in the curation, writing and studying of exhibitions and art events, particularly in the Estonian context. Probably thanks to this interest I was included from 2006 in the curation of the art side of the Plektrum annual audio-visual and culture festival where the most recent international exhibition "Ludo ergo sum" took place in the autumn of 2011 (curated by Marge Paas and me).

The main reason that I wanted to continue my work on the doctoral level was the need to understand better my artistic activity. Having researched, experienced and practised the various presentation forms of new media art that failed to fit within the boundaries of conventional art, I found a number of issues to discuss, analyse and resolve. As I have been interested in new media art and been practising it for years, the doctoral dissertation was a logical next step for studying these topics. I find that the need to expand my scope from a narrow field of technology or media art to a broader understanding of the partnership of science and art is inevitable – to a greater or lesser extent all art genres rely on advanced technology.

As my dissertation belongs in the art-based research category, I have been seeking for answers to my questions through three exhibitions. In 2013, two personal exhibitions, "Hybrid Practices" and "Hybrid Practice – from General to Specific," took place, in 2014, I curated the international conference "Art & Science – Hybrid Art and Interdisciplinary Research" and the exhibition "Rhizope" that was linked to it.

I am interested in the complex relationship in the potential coexistence of natural and physical sciences and visual arts, thus my practical experience as a designer and media artist support my research but do not limit it with practical goals or technological media. Hence, I focus on interdisciplinary collaboration; a rather exciting experiment in this study is collaboration with my supervisor, physicist Andi Hektor – my sincere thanks to him. Also, my heartfelt gratitude goes to Veronika Valk, who helped me prepare this dissertation and organise the third event of my practical research – the "Rhizope" exhibition and related international conference.

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1 INTRODUCTION

1.1 *Preludium*

This dissertation deals with a number of important topics, driven by the desire to better understand the mechanisms behind the co-functioning of science and art – i.e. interdisciplinary collaboration. An objective was also to not only explain the context of new media in art, but to find answers from the scientific perspective as well. The main focus of the dissertation therefore lies on the common characteristics of artistic and scientific practice and show interdisciplinary collaboration works.

There is a linguistic nuance. While the English term *Science* clearly refers to natural sciences, than in German, for example, the word *Wissenschaftler* denotes both natural sciences and humanities (Shapiro 2010), similarly to the Estonian word *teadus*, which also includes a broad variety of disciplines from natural and social sciences to ethnography, psychology etc.

The second exciting linguistic nuance arose during the curation of the "Rhizope" exhibition (*see chapters 2.3 and 2.3.2*). In particular, the word *rhizopian research* in some way started to generate new meanings. We found that the exciting neologism is certainly worth implementing. Perhaps the idea to develop *rhizopian research* and related events further is not wrong at all? (Valk 2014: 33–43)

In several cases the term *hybrid art* is introduced to the dissertation. During my artistic practice and theoretical research I find that it is the best word to characterise a complex symbiosis that has arisen in collaboration between science and art. According to emerging practices it can no longer be classified as techno or bioart because various lines of thought have already blended together in a manner best characterised by the word *hybrid*. I also use in several cases the term *artscience*.

1.2 Starting points and early inspirations

I have most of all been inspired by the development of natural sciences, in my practical work I have discussed digital technologies necessary for creating interactive installations but also tried to delve deeper into biology and did lab work with the aim of creating art.

The initial sincere interest in science is without a doubt important but what is crucial, based on what I have realised in my practical activities and conversations with other artists, is art's ability to demystify science, open up complex structures for the public for whom scientific thought is alien, open the lab doors and discuss science in a so-called "different language". A step further from this opening is the creation of broader critical discussions and raising of ethical issues. I do not, however, wish to state that artists' role is only to be the catalyst between science and society, much less say that they are the publishers of science. Instead, I am inspired by the wish to highlight the artist's role as an equal partner in a future society focused on creative thinking.

I published in the web magazine "*Eesti Arst*" (Estonian Doctor) a summary of my interview with Oron Catts in 2013, where he gave quite an on-point explanation as to why the art study involving for example biology is currently important and why it must be interpreted as greater than just a visualisation of science.

> *I asked Oron Catts a question of extreme importance for artists – what is the role of artists participating in fields that they actually don't have a clue about? Can we deal with complex disciplines without the relevant education or prior in-depth studies? Oron Catts thought that of course we must be specialists – i.e. artists must do a lot of homework before setting foot in a lab to start working. But above all, artists must remain artists, just like scientists must remain scientists. Any kind of strange spontaneous hybrid forms is not credible ... And we must not forget that there is*

> *another form who are engineers capable of creating almost anything without any remorse!*
> *Oron Catts is concerned about the future, despite the very vivid sense of imagination of a creative person. He has been cited much in the art world as someone who raises significant questions related to bioethics. This means if engineering takes over all developments only for the goal of profit, we will be facing a big problem – we may have functioning artificial organs but we cannot grasp their role in the bigger context of life. Questions that we are posing now are much more complex than 10 years ago. If cellular biologists assert that they are capable of artificially producing the smallest particles of life, we as artists must be able to think along with them with regard to what benefit this entails in a cultural and broader human context. A genetic mapping programme as it is operating in Estonia, for example, is not really sustainable. An impressive work will be done to map our population fragment on the genetic level but without seeing the broader context. Our body is not only home to our own cells, a large part of life is attributable to bacteria and various other micro-organisms and it no longer depends on the human system but instead the environment and correct decisions made with respect to the surroundings that we are capable of making on a regional and political level.*
>
> *In conclusion – if a pig were able to fly, several issues important to humanity would be resolved! Thus, the art project by Oron Catts and Ionat Zurr (The Pig Wings)[1] manifests evidence that allows us to dream with increasing audacity and shows that poetic questions and their interpretations may have more important roles in the chaos of the intersections between disciplines than we dare to estimate right now. Naturally, a flying pig will not resolve our future concerns but it is excellent that a holistic world-view is resonating more and more in the developments of our culture and science. To what extent we dare to participate in dreaming by risking to be labelled insane in the modern world is another question entirely. (Catts, Piirma 2013)*

I strongly feel that the need for artists to educate themselves in the field is of primary importance – by using high technology tools for creating art or adapting into their works ideas about scientific developments, many artists may not realise why they are doing that. In other words, they may have adopted certain tools but may not acknowledge how technological thinking and science can transform the development of thought, or what kind of potential is inherent in working methods of science.

I have chosen a topic that discusses the merger of the goals and work of science and art for the following reasons:

- collaboration between science and art has good prospects for the future;
- it has so far been described little and inadequately in terms of creating or explaining important terminology;
- my personal practice of art has vividly demonstrated the need to analyse interdisciplinary and transdisciplinary experience, also in the Estonian context;
- it is very important to consider that the technological nature of hybrid art is attractive for the public because it creates an important bridge between "everyday technology-absorbed experience" and fine arts.

The selected course is doubtless complex, therefore I provide an initial highly subjective diagram that I attempted to draw in order to place on a time axis the most important events, ideas and goals related to the development of media art. This diagram raises more questions than it answers, so in the following study I attempt to find opportunities to explain what the important aspects are in describing the background, developments and various hybrid collaboration forms of science and art. This figure contains a version of the diagram by Rama Hoetzlein "What is Media Art?" (2009, 2011) that I added to (*see figure 1*).

Figure 1: *Personal choice of important names and keywords in history of technology and science (2012)*

1.3 My practical collaboration experience

I set collaboration with science labs on the most practical level as my goal in the dissertation. This is because to date, we still lack specific well-functioning collaboration programmes of wide resonance in Estonia. In other words, I approached the issue of collaboration on its lowest level – I started searching for science and art collaboration from the setting of my collaboration goal, after which I contacted scientists at my own initiative and using personal contacts.

I consider the starting point of my practical activities the year 2009, when for the first time I was in contact for the purposes of collaboration with Estonian scientists (Centre for Biorobotics, TUT). Finding contacts is quite easy considering our small country. I must remark, however, that this does not mean contacting without substantial prior knowledge. I.e. for entering all labs I had to take into account that I must do serious "homework" because this was the only way I could be understood by scientists in the definition and explanation of my goals. For finding a common working language I required extensive prior knowledge from the fields that I wanted to associate my future work with (*see chapter 2*).

My first experiment concerned collaboration in creating the robot cow "Holy Cow". It took place at the Centre for Biorobotics, TUT, in collaboration with Maarja Kruusmaa, Madis Listak, Jaan Rebane and others (2010–2011). The robot cow was a sculpture created in the name of an art project, curiously offering scientists as much excitement as myself as an artist. The fact that working towards a rather irrational goal we collectively developed a concept and also achieved the end result – an art project at Vabaduse väljak (Freedom Square) and Tammsaare Park in Tallinn, demonstrated a clear openness on the part of scientists. And an important understanding that both art and science can transmit their message to the society quite brightly through a certain irony, fresh idea and a lens of humour (*see chapters 3.4 and 4.3*).

The Fermentology Lab at the Department of Chemistry of Tallinn University of Technology at the start of 2012 held a workshop for art and architecture students called *"Elu märgid"* (Signs of Life), organised by Veronika Valk, Department of Architecture, Estonian Academy of Arts (Piirma 2013a). It was an important milestone that radically changed my own art practice – I thereafter directed my interest more directly towards the field of bioart that to-date has not been largely practised in Estonia as far as I know. The exciting developments of synthetic biology and theoretical knowledge obtained from the workshop led me to collaborate with Professor Raivo Vilu, who was my mentor when I developed the "Hybrid Practices" exhibition (*see chapters 2.1 and 2.1.2*).

I studied the behaviour of yeast cells, theoretical discussions with Prof. Vilu at the Tallinn University of Technology concluded with more practical work at the Institute of Molecular and Cell Biology of the University of Tartu under the guidance of Prof. Tiina Tamm where through already very real experiments I studied the behaviour of yeast cell colonies (Autumn 2012). From there, in turn, I moved to the next department of the University of Tartu, the experimental lab of the student project ESTCube-1 that resulted in the artwork "Yeast Mission" (*see chapter 2.1.2*).

The preparation of my next solo exhibition "Hybrid Practice – from General to Specific" was also conducted at a science lab (*see chapter 2.2*). This time it was carried out at the Marine Ecology lab of the Marine Systems Institute at Tallinn University of Technology, the advisers were researchers Inga Lips, Karin Ojamäe and robotic scientist Madis Listak. In this project I focused on studying microalgae, starting from the collection, filtration and preservation of water samples. Photo collages, videos and an interactive work were made, each in its own way commenting on both science and bioart and the results of which I presented for the first time at the Hobusepea Gallery in Tallinn (November – December 2013). The exhibition has subsequently been shown in the museum of Kuressaare Castle (March – May 2014), I have also given an overview of it at the international Internet conference Waterwheel 2014 and in the "*s*" photography magazine. (Waterwheel 2014; Piirma 2015; Piirma 2014: 11–15) Furthermore: An important source of inspiration in the field of bioart for me has been becoming a member of the Finnish Bioart Society and the working week held at the biology lab BiofiliA of Aalto University (advisers were Oron Catts, Ionat Zurr, Marika Hellman and Ulla Taipale) (*see chapter 4.4.3*).

1.4 Research questions

The objective of the dissertation is to study the inter- and transdisciplinary creative forms characteristic of hybrid art and to analyse the philosophical, intellectual and technological background related to the co-functioning of art and science. Among other things, I also ask whether artists and scientists can be equal partners and what the potential new avenues and developments of collaboration might be in light of the future.
To find answers through actual artistic practice as well, I have focused my artistic activity on specific forms of cooperation, disciplines and technologies. I describe two exhibitions, "Hybrid Practices" and "Hybrid Practice – from General to Specific" and the curator project "Rhizope. Art & Science – Hybrid Art and Interdisciplinary Research".

I pose the following research questions at the start of my thesis, to which I seek answers through my art practice, situated in a theoretical framework:

1. How can cooperation between science and art be understood? How does this influence my artistic practice and contemporary media art in general?[2]
2. How can the terms *interdisciplinarity* and *transdisciplinarity* be interpreted in the context of new media art?
3. What is hybrid art and what are the most important working methods for this art form? How can hybrid art forms be seen in the Estonian context?

Further analysis, deeply rooted in my own artistic practice, is linked to the following:

1. A large part of today's art whose tools have vastly expanded thanks to science and technology is hybrid by nature. In other words, it spans fields in terms of tools and context that could be considered to be outside the scope of traditional art practices.
2. The development of science is also moving towards a broader cultural understanding because not only artists but scientists also need productive collaboration.
3. The development of science and technology is important in our whole society because it must also be understood and interpreted by artists. In other words, it is not only important to use technological tools but also to understand their nature and why science affects our daily lives to a great extent. I examine what new and exciting shifts could be of such developments.
4. I wish to map collaboration opportunities through practical art mainly in Estonia, to expand similar practices, advance the discussion on whether we also move along with such developments and to study how the broader public views such developments.
5. As reasonable assessment criteria for the collaboration between scientists and artists are undetermined on both the scientists' and artists' side, I find that by discussing this we get one step closer to a potential balanced interpretation of hybrid art that is considerate of various fields. Therefore, a number of scientists are involved in these discussions in different chapters of the dissertation (*see chapters 3.4, 3.5, 4.1, 4.3*).

1.5 Research methodology

The research blends together very different strategies: artistic and cultural research strategies, specialised media art research strategy and scientific research strategies. I have tried to follow the latter closely because the nature of my work requires to some extent understanding of the working methods of physical and natural sciences.
The methodology I use was developed during the years spent on my doctoral dissertation, I owe thanks to many role models and authors whose research has influenced my studies after. Prof. Juha Varto (Aalto University) has helped interpret the various important aspects of an artist's research, presenting some important thoughts in his lecture (spring 2012) about knowledge as an open system in which nothing is final. Nature is a system and science is a structure, neither of which is ever complete.

1.5.1 Methods of theoretical research

As the title of the dissertation includes two different fields – art and science – I attempt to link together two key principles – namely, a quantitative and qualitative approach. In other words, in order to see art and science function together, the specific nature of working methods of both fields must be understood and an attempt made to apply them. The main components of the scientific research method are traditionally the following elements: careful observations of nature; deduction of natural laws; formation of hypotheses – generalisations of those laws to previously unobserved phenomena; experimental or observational testing of the validity of the predictions thus made (Scientific method 2005).

Undoubtedly this structure cannot be fixed in the light of today's science and scientific work cannot be subjected only to these principles. An artist's research involves various different components here due to its specific nature, which I attempt to describe in my dissertation. In general, it could be defined as a non-linear combination that links together the formulation of hypotheses (wording of research questions), quantitative data collection (description of personal exhibition practice and collaboration experiences, interviews with practitioners) and qualitative interpretation of data (feedback on my artistic activity and assessment of the public + personal conclusions). My study is also based on the assumption that the characteristics of the described/analysed environment are constructed based on my interpretation that is personally connected to me as an artist and a researcher depending on the situation and time when it is constructed.

Quantitative Part of the Research

The lab work in the lab of the Institute of Molecular and Cell Biology of the University of Tartu (2012) and the Marine Ecology lab of the Marine Systems Institute at Tallinn University of Technology (2013) carried out in preparation of the exhibitions consisted of collection of extensive data, observation, data processing and experimentation with obtained material. At the same time, while collecting data, I was seeking opportunities for the interpretation of scientific data, established links and definitions within a broader social context. In other words, my aim was not objectivity, volume of studied data, scientific accuracy, proof of verified facts or hypotheses that are characterised by the quantitative research form but rather questions involving communication between science and society, raising of discussions and opportunities to create new qualitative values.
Data collection, though not exactly quantitative, is the documentation of exhibitions, interviews and discussions with practitioners and theoreticians, which have been brought out in many of the following chapters.

Qualitative Part of the Research

In accordance with the principle most characteristic to an artist's research, I constructed my schedule of work based on my knowledge, objectives of work to be submitted, broader attitudes and the wish to find definitions placing the research in a broader social context. In a manner characteristic to qualitative research I have carried out my work by carefully examining other similar cases, following concepts and theories in case of analyses and trying to pose "open-ended questions" with the aim of finding new research opportunities (to give readers a chance to create their own constructions or raise hypotheses).
In my work, I research phenomena rather than facts. To that end, the key components of qualitative research are important: documentation, observation, interview, interpretation, analysis, writing, assessment (Varto 2012).

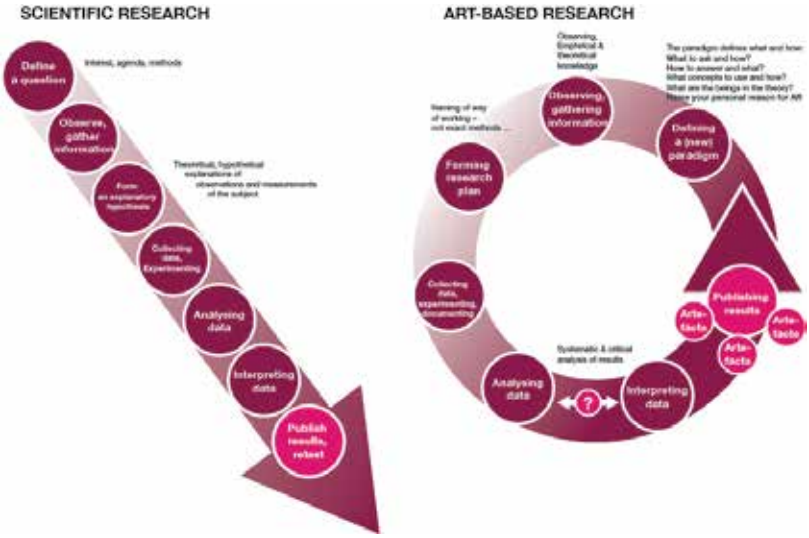


Figure 2: *In order to map my research activity, I created the following diagram: my working plan* versus *scientific research (2012). Partly based on the idea of Hannes Bogacs (2011: 34 - 36)*

I study the questions that I raised through the comparative case analyses and contexts in which I present them. The result of this can be interpretative analysis for which the collection of generalised data can be extremely complicated but where the advantage is the creation of new ideas, cultural values or discussions.
In this dissertation I try to be guided by angles that are classified into four main categories:

- personal experience: preparation and carrying out exhibitions;
- interviews with professionals in related fields;
- examples best illustrating the selected discourse – related to the theoretical background;
- findings from my practice and theoretical exploration – observations for future studies.

Figure 3: *Scheme of planned work (2012)*

1.5.2 Methods of practical research

In the analysis of the practical work carried out as part of my dissertation, I provide a brief overview of personal exhibitions and forms of collaboration.
Through short writings and illustrations I describe my collaboration experiences in the lab of the Institute of Molecular and Cell Biology of the University of Tartu and in the Marine Ecology lab of the Marine Systems Institute at Tallinn University of Technology. I also address the curation experience of the hybrid art exhibition titled "Rhizope" and the conference titled "Art & Science – Hybrid Art and Interdisciplinary Research" during which I had to get involved with event planning as well as the determination of more general concepts over almost three years. I also refer briefly to my first lab-work experience in the Centre for Biorobotics (TUT) – "Holy Cow" robotic installation (2010–2011) – which turned out to be one of the most important inspiration points for my following explorations (*see chapters 3.4 and 4.3*).

First I describe the goals I set for myself when creating each idea and event, and point out how important organisational and formal issues are in addition to the development of the substance. Thereafter I provide an overview of the exhibitions and events that I carried out as part of the doctoral dissertation and follow-up to them. I also provide conclusions I made from these events and on the basis of questions I was asked.

Practical activities also include interviews I recorded with practitioners from various fields that I have used as the source for several ideas and quotes I have included in the dissertation. Interviews were conducted in Estonia and abroad, all recordings and written notes made based on them are in the possession of the author of the dissertation.
In the overview of my practical – artistic – study, I have attempted to keep to the following principles:

- creation of a common system or line of thought that would bridge my artistic activity;
- positioning the artistic research in regards to the creation of broader knowledge;
- positioning my explorations for the individual reader, looking at a specific theoretical or practical form of knowledge;
- finding answers or solutions to questions risen from the artistic and/or theoretical part of the dissertation, or further developing those lines of thought;
- interconnectivity of tacit knowledge derived from my practical exhibition activity and research questions raised.

Figures 4: *Views of the exhibition "Hybrid Practices" (2013)*

2 EXHIBITIONS

The following is my overview of the three art events, which I organised in 2013 – 2014. The preparation period was much longer, starting in 2011. It meant collaborations with people from many different disciplines. Two solo exhibitions, "Hybrid Practices" and "Hybrid Practice – from General to Specific", and a third, my curatorial work for "Rhizope. Art & Science – Hybrid Art and Interdisciplinary Research", have been closely following the development of my doctoral research. My main goal of the first exhibition was to map the area of different fields of science, which might be important in my doctoral studies. In the preparation process of the second exhibition I focused more on the connections between art and marine biology. The third project was important to find a wider context to my research, and during this event we invited 32 researchers and artists to give their contribution by conference speeches, talks by artists and artwork. 21 of the artists were from abroad. In addition the catalogue "Rhizope" was published in May 2014 (Piirma, Valk 2014).

2.1 "Hybrid Practices"
Media art exhibition at the Gallery of Design and Architecture, Tallinn, 11-25 January 2013

Introduction

My artistic practice has brought me to believe that future progress will not only occur through scientists' innovative thinking but through participation by all of us. This lets us believe that almost anything is possible and we can all be the authors of something completely new. We are living in an era whereby the widely used slogan "Science is our culture!" is becoming more and more prevalent.
As throughout the history of human existence artists have looked for fields to comment on, bring to public attention or criticise from an ethical aspect, and I find that I am also entitled to offer the art audience angles that comment on the progress of science and technologies and provide an opportunity for initiating societal debates. I dare as an artist to dream, study, read and try to understand developments that better explain life as a whole to me and I find that artists are also entitled to get involved in all processes of life. At the same time with collaboration in mind, I have contacted specialists of various fields and visited research labs.
At the exhibition "Hybrid Practices" I presented three different forms of collaboration that in recent years I have participated in.
In parallel to my creative practice I am also drawn to broader questions, e.g. how can an artist collaborate with scientists so as to ensure interest by both parties and be mutually beneficial? Is it possible to create a joint unique research language that would be equally understood by artists and scientists? What is my role as an artist in this process?

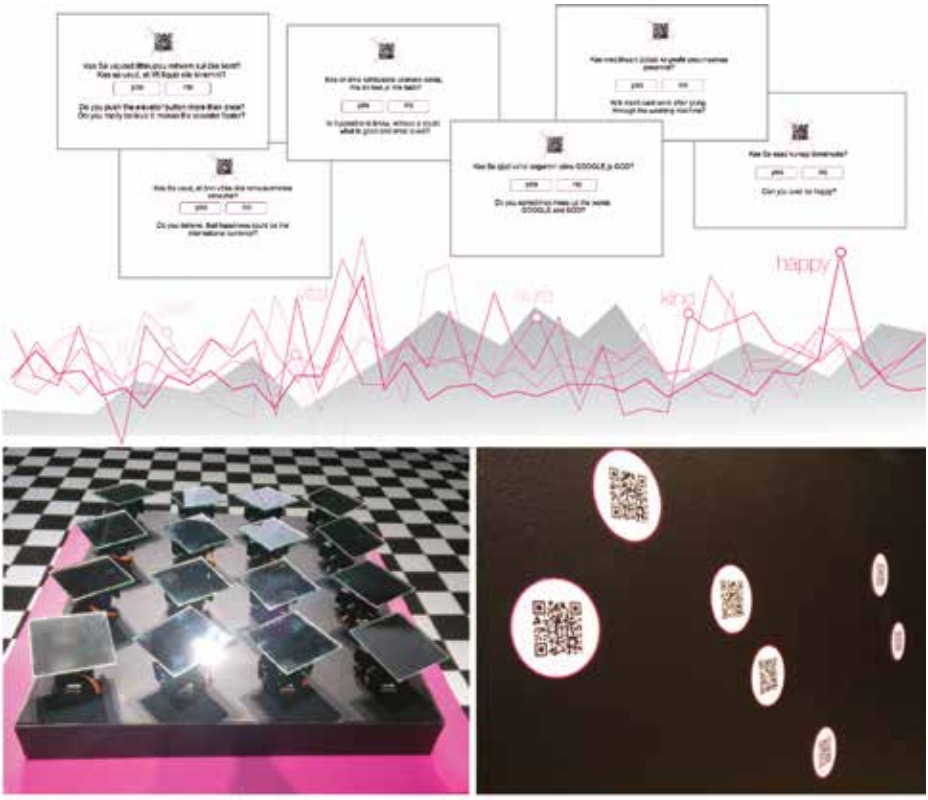
2.1.1 “QR-Quorum protocols”

Questions – personal, banal, as well as pastoral and concerning the pillars of life, have created a new myth – a person and life in general are considered to be a certain information system rather than a physical organism. Millions of people are Googling, which is a perfect example of how we are putting more and more trust into information technology and conclusions made based on its functioning. On the one hand we can call it a flexible administration method of a control society, on the other hand we sincerely believe the vast resource as the truth that offers ever more services that make life easier.
A group of societal and computer science researchers have joined forces to investigate how significant a role social communication plays in our lives. The well-known scientist Johan Bollen, for example, says that the feeling of happiness in social networks (i.e. information based on like and dislike answers) and Internet communication in general can be categorised and it ends up quite significantly impacting the world’s economic pillars – international stock markets. (Bollen et al 2010)

“QR-Quorum Protocols” was an interactive installation, which collected data from the Internet and translated it into physical robots. Sixteen mirrors were moving by virtual data. People could interact with robots by scanning QR codes with their smartphones at the gallery. Using the art installation – related web sites people answered YES or NO to simple questions like *Does kissing burn calories? Can happiness be an international currency? Do you confuse the words Google and God? Is herpes infectious?* and many others. They were the questions that I collected randomly from Google as most often asked or the strangest questions. People made the robots move by answering the questions. The robot mirrors and interactive light reflections in the gallery expressed my attitude towards the simplification of complex questions – if we have already learned to ask short questions and give and receive even simpler answers, perhaps we can see important meanings from the abstract images and reflections on the wall and obtain answers about life?

My overarching goal was to study why people and modern science trust information from social networks or Internet search engines. I also wanted to use randomly selected items from Google Questions to show how insignificant, odd or black and white are the questions on which this research direction is based. I agree that the search engines do indeed reflect the actual situation in society because they have a short memory (Google remembers the last five questions). And search engines are in fact oppressively individual-oriented (I am offered information that the net-machine thinks I need personally; thus I am unable to ever find universal opinions and a universal ranking of questions). And finally: it is hard for me to believe that there are solutions to important questions and that they can be answered with monosyllabic responses – “yes”, “like”, “no” or “dislike”.

Co-authors: *Madis Listak (engineer, Institute of Marine Biology, TUT), Nils Piirma (software and hardware)*



Figures 5: "QR-Quorum protocols" graphs, websites, and photos (2013)

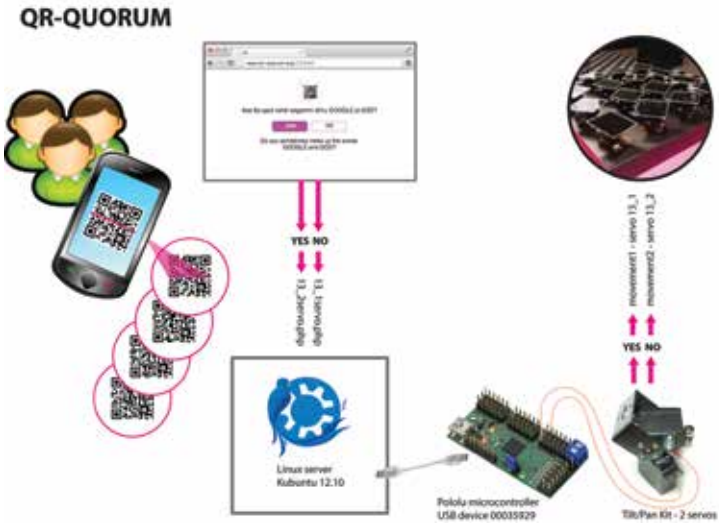


***Figure 6:** Technological structure of installation (2013)*

Figures 7: "Saccaromyces cerevisiae *and the Mission of Yeast" (2013)*

2.1.2 "*Saccaromyces cerevisiae* and the Mission of Yeast"

As an artist I am constantly asking questions about life and its functioning mechanisms. Biology is one of the fields of science that is of extreme importance in that regard because I am a biological creature who is very close to nature and I wish to find out more about my existence, to understand it scientifically and comment on it as an artist. In order to understand biology as a complex system completely, studies must begin with simple organisms. The ideal model for cell biology is yeast whose thoroughly researched genome enables scientists to make several conclusions about all the remaining forms of life. Mainly about people themselves because yeast and human cells are quite similar in structure. But yeast cells are capable of evolving and reproducing vastly more quickly than human cells, therefore scientists can find answers to their questions in quite a short period of time. (Tamm 2011a: 5)
Compared to the human cell, the yeast cell is also preferred because it can be changed and varied depending on the requirements of the experiment and the most important reason for research is that yeast cell experimentation is extraordinarily safe (Beam 2009). I also did my first cell research growing yeast colonies because those tiny units contained surprisingly much substance for creating art.

Yeast and humans are similar because they play games

Evolutionary researchers have noted that in addition to a similar structure, certain common traits can be found in the behaviour of yeast and human cells. For example playing. Regardless of the simplicity of the yeast cell, its particles have been found to engage in activities that can be clearly interpreted as social behaviour. Although, unlike people, yeast cells do not think or have emotions, scientists have found several traits of social behaviour with yeast cells. One interesting experiment is the dynamics of the snowdrift game and studying the behaviour of "cheaters" in the yeast cell colonies. Cooperation as a phenomenon is the central challenge in researching and understanding the evolutionary progress of the entire natural world. Scientists studying cell communication and competition prove by using the hydrolysis experiment that cells cooperate in order to face the cheaters. Yeast cells cannot directly eat the nutritious sucrose – for that they must effectively cooperate with each other in breaking down the sucrose. While the cooperators are busily doing this, cheaters only consume food without giving anything in exchange. Thus, if the population contains more cheaters, it will grow at a slower pace. If, however, the cooperators and cheaters have equal access to food, cheaters will grow significantly faster than cooperators. (Trafton 2009; Gore et al 2009)

Figures 8: *Photos from the laboratory of the Institute of Molecular and Cell Biology, University of Tartu, October (2012)*

The yeast cell snowdrift game example was the reason why as an artist I wanted to examine yeast cells and cell colonies more closely and to find from cell colonies the beginnings of playfulness, interesting visual compositions and proof of the idea that yeast is closer to us than we would think. Through my little experiments I studied how cooperation between cells and game playing works and also how I could shape it into a visually pleasing set of images. Having six well-known game theories as my starting point, I photographed and filmed yeast cells from far and near, conducted easier experiments and adapted to the everyday life of a biology lab.[3]

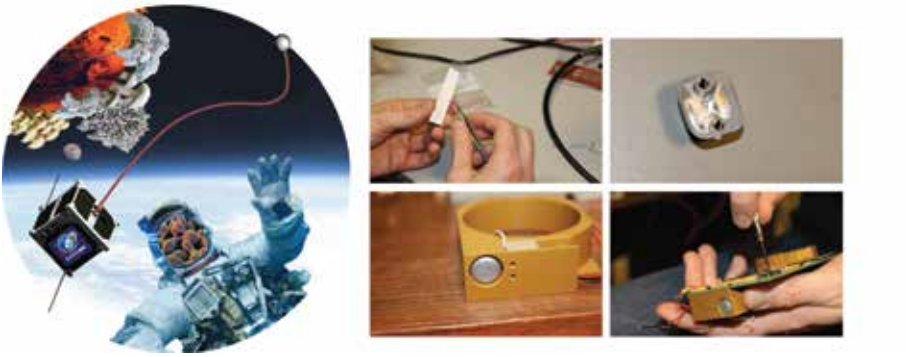
Life on Earth got started from yeast

Approximately 2.4 billion years ago, the ancestors of bacteria populated all the oceans and the process that we call photosynthesis began. As a result, a large amount of oxygen was created that made the expansion of all of the subsequent forms of life possible on Earth. It is called the Great Oxygenation Event.[4] It impacted everything living ... except for yeast.
As yeast does not depend on the existence of a large amount of oxygen, fungi that already existed prior to oxygen now started to rapidly develop. It is quite a mystery – the first fossil molecules have already been found from the pre-oxygen era, a time approximately 300,000,000 years earlier. It has brought up a question in science: from where did yeasts back then obtain a sufficient amount of oxygen to exist, of which unfortunately no trace exists in the ancient atmosphere.

A study conducted by scientists from the California Institute of Technology and the Massachusetts Institute of Technology in Cambridge showed that one-celled ancestors of yeast are so unique that they do not even need much oxygen to live and were capable of living and reproducing in the oceans even before the Great Oxygenation Event. Yeast produced gases necessary to both itself and some ancestors of algae and bacteria even before, thus performing their main roles of preserving themselves and reproduction was nevertheless possible. Therefore, yeast had an important role in creating and maintaining life even before a large amount of oxygen was created. (Strain 2011; Waldbauer et al 2011)

Everything could start from yeast in the future too

We have several very important existential questions ahead of us. Our sustainability is questionable, squandering and waste is not news to anyone. Scientists estimate that our ecological footprint is the size of about 2.5 planets.[5] It points to the fact that, like any system whose natural progress is made towards its own destruction, life on Earth will also end in the future.



Figures 9: *"*Saccaromyces cerevisiae *and the Mission of Yeast" (2013)*

At the same time, in order to continue and progress further, it is not necessary for humans to migrate to other universes or planets, it will suffice if cells move elsewhere. Because a "lucky coincidence" is very small but will nevertheless create an opportunity for new forms of life to be created even without human cells. In order for life to continue in far-away space we do not need much else than tiny cell colonies, favourable conditions and the application of the anthropic principle (fundamental physical criteria that define the whole universe must coincide to the nearest 0.000001%, otherwise life or its observers will not be created). But what if...

Yeast and the space mission

Log file from the Scientist's conversation (how my yeast space mission started):
[12.12.2012 22:16:16] Tõnis E.: hi Mart
[12.12.2012 22:16:29] Tõnis E.: yeast entered into the satellite tether endmass
[12.12.2012 22:17:19] Tõnis E.: Haploid S. cerevisiae
[12.12.2012 22:17:33] Tõnis E.: I put it there myself, Jouni and Roland witnessed it

Yeast has been sent into outer space for research purposes on many occasions, for instance to study how radiation and weightlessness affect biosystems and cellular growth. Also to explore survival in extreme conditions, how immune systems function in weightlessness and microbial infection in general. One of the latest official space missions for yeast started in early summer 2011 when yeast accompanied astronauts on the Atlantis space mission. (Nimon 2011; Barry 2003)

What I wanted to know was: what if we sent yeast into space, in the hopes and dreams of it having the capability to save the world? As we know, Estonia is now a space-faring nation thanks to the student satellite programme ESTCube-1 implemented by the University of Tartu.
I decided to dry a few million yeast cells and proposed collaborating with our satellite builders, so that as part of all the other important activities we could send the yeast colonies on a space mission. And live with the knowledge that somewhere there is a small part of Estonia that is advancing life. They agreed.

The main objective of the ESTCube-1 satellite is to conduct an in-space centrifugal test. It launched into space to study the durability of the 10-metre Hoytether of the electric solar wind sail, a tiny ball is at the end of the tether containing yeast that will circle the satellite in future, waiting for an opportunity to continue its big mission. Yeast cells colonies, added to the satellite started their space mission on 7 May 2013. ESTCube-1 was launched aboard a Vega carrier rocket and successfully deployed into orbit from the space port in French Guiana (South–America). (ESTCube)

Co-authors and mentors: *Tiina Tamm, Kaarel Kruuse (Institute of Molecular and Cell Biology, University of Tartu), Mart Noorma (main head of the satellite project ESTCube-1, Institute of Physics, University of Tartu), Raivo Vilu (Department of Chemistry of Tallinn University of Technology), Veronika Valk (Department of Architecture, EAA)*

Figures 10: *"My Seven Heads" (2013)*

2.1.3 "My Seven Heads"

I based my work on phrenology – a so-called pseudoscience that began at the end of the 18th century, established by neuroscientist and psychologist Franz Joseph Gall (Abernethy 1821; Sabbatini 1997). This failed scientific discipline tried to prove that the various modules of psychology are located in certain parts of the brain and the person's soul is in the same place. Despite the claims that sound naïve today, phrenology is still one of the predecessors to modern neuro-psychology and according to several scientific studies, the brain is still researched on a region by region basis by linking biosignals transmitted by the brain to the person's mental conditions.
The linking of brain regions to different thoughts and actions spurred me to study the scientific articles written on the human brain more closely and to create another piece dealing with scientific subjects.

Phrenology, also associated with unpleasant developments of humanity (data on the shape of the human skull and brain size were linked by Adolf Hitler, for example, to his national politics), is for me mainly a source of inspiration for studying science and its history. The philosopher Alan N. Shapiro has said that he fails to find a reason why we could not treat science and science fiction as equals (2012), and I partly agree with him – everything we try to understand and research in depth, be it hard science or its poetic and cultural interpretation, will benefit us in sensing the integrity of the world if we are sufficiently thorough and objective. And also – we come from a totalitarian society where it was very important to ideologically influence people and now we have entered an era whose significant factors are science, computer science and digital technologies. Are we comprehending the big picture or whole and potential futures or do we approach new developments as another intervention by Big Brother? How can people be spurred to think in more scientific terms without fear for the various dystopian evolutionary scenarios of science? We know that fear is the worst motivator.

The interactive video installation equipped with Arduino and touch sensors comprises two parts – a touch- sensitive sculpture and a video screen. The interactive head-shaped sculpture enabled exhibition visitors to stroke the sculpture and the image and sounds displayed on-screen will change based on the impact on different regions of the head. The animations displayed on-screen reflect my personal stories that one way or another depict my attitudes towards the surroundings.

Co-author: *sound artist and programmer Shawn Pinchbeck (Canada)*

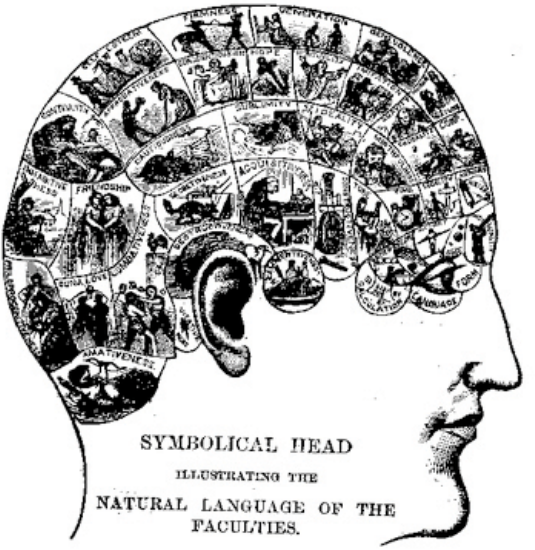


Figure 11: *Phrenology Chart (1883)*

Figures 12: *Technological structure of installation and archive photos (2012–2013)*

2.1.4 Observations and conclusions

My exhibition "Hybrid Practices" constituted an experiment connecting different fields – experimenting with technological possibilities and the creation of communication between disciplines. In general terms, my aim was to focus on science within the limits of my opportunities and abilities, understand it from my point of view and find appropriate forms of collaboration as a part of which I created works whose authorship belongs to all of the parties participating in the project. In the development of ideas, as an artist I still had to supply the initial idea concepts although my aim in the development of the three installations was to adhere to the idea that all parties participate equally in the creative process.
To be more specific, I created exhibition works as part of several disciplines – from robotics and biology to neuroscience and pseudoscience. This exhibition was my first attempt in mapping potential ideas that I could continue working on in the future, thus the overall picture of the exhibition was diverse and demanding with regard to the audience in the framework of each different subject – there was the risk that without reading the science texts the audience would only focus on using interactive possibilities rather than the substance. Nonetheless, the broader question was most important – where do I proceed in creating hybrid forms of art?

Question about the artist's role

I see my role throughout my artistic practice as the leader of the creative collaborative process, focusing not so much on the end result but the work process itself. This was especially the case with the yeast project where the main goal – sending yeast into Space on board of EST-Cube-1 – had not been reached yet at the time of the exhibition. At the same time, I can say that the stories I told were engaging to the audience and I am continuously receiving feedback on sending the yeast to space. Nevertheless, my technical work – lab tests and robotics work and the interactive installation – did not attract much interest among the Estonian audience. The reason probably lies in the technological complexity and also that the expectation of the local art audience is to see a well-functioning, coherent end-product in the exhibition room, rather than an archive-based description of a work process comprised of collected data. The aim of bringing science to the context of a traditional art gallery remained hazy for the Estonian audience, referential texts displayed at the exhibition were unfamiliar in their length and overall not very story-based for the normal audience that strives to get to the main idea as quickly as possible. Undoubtedly the subject is demanding because it not only assumes secondary school education but broader knowledge of science, the world as a whole, the desire and ability to read, understand and contextualise. Therefore, the message transmitted in the exhibition remained somewhat distant – I know this since as the creator I had to be present at the gallery for the whole duration of the exhibition and give guidance or explain my working principles.
However, it would be unwise to believe that the audience should not be educated, therefore I provide the example of a workshop called VivoArts, conducted by American artist Adam Zaretsky in 2009. He organised an event combining studio art and biology during which art enthusiasts were able to get up to date on advanced science and the critical discussions arising from it (Zaretsky 2014). An Irish artist, Maria Phelan, presented her artwork titled "Kiss Culture" in 2009 (exhibition "Infection", Science Gallery Dublin)[6], inviting the gallery audience to kiss the Petri plates placed on the wall. People later found out what kind of microflora live on their mouths and noses (Phelan 2009).
Attracting viewer interest by processing their personal data and providing feedback is a very simple but effective way of interacting with the audience. As people are interested in their mirror image, they are normally also excited by interactive works when they are able to affect the works using their own movements, voice or something else, i.e. perceive their own participation. In case of the described work, in addition to personal bacteria analysis the obtained information is much wider – the audience is also introduced to the working methods and tools of chemistry labs, bacteria nutrient solutions and the entire exciting work process in general. In conclusion, I would say that there is great development potential for creators of similar works in making themselves understood, as well as for the art audience that is by my experience unfortunately still trying to stay away from more complex trains of thought.

Future perspectives

The previous chapters presented the focus of my artistic practice and the consequent exhibitions, pointing to the 21st century shift towards hybrid practices that combine art and science – a shift that is only starting to appear in Estonia. On the one hand it is easy to contact scientists for organising collaboration in our small society, but it is an entirely other matter is how productive and mutually comprehensible the collaboration will be in the practical sense.

In general, my viewpoint is quite optimistic despite the lack of appropriate funding opportunities for such collaborative efforts; I see a large amount of sincere interest in the potential synergy that is equally important for both parties – artists and scientists.
For instance, in terms of new technological solutions – although this was not my aim – growing yeast colonies in the science lab of Tallinn University of Technology based on certain drawings – attracted some excitement among the scientists. The realisation that the microscope, Petri plates and growing of colonies could also be addressed in the context of art hopefully widened the understanding of art itself and that artists were capable of getting involved with societal processes with very different means and ideas.
Thus, I find that my first exhibition describing and probing science – art collaboration was a step that would continue to encourage other creative people to engage in similar collaborations that are not only about presenting combined techniques but creating greater awareness of the world.

Figure 13: *View of the exhibition "Hybrid practice – from General to Specific" in Hobusepea Gallery (2013)*

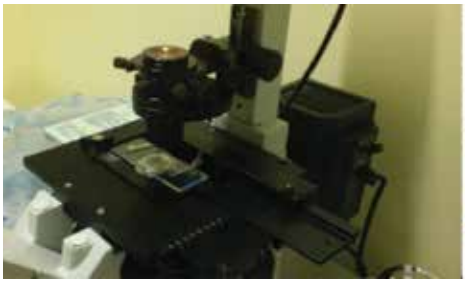


Figure 14: *Working in lab (2013)*

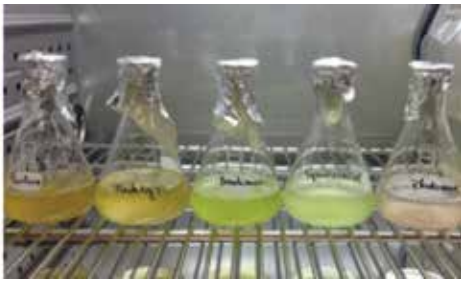


Figure 15: *Collection of water samples (2013)*

2.2 Hybrid Practice – from General to Specific
Exhibition at Hobusepea Gallery, Tallinn, 27 November–16 December 2013 and in Kuressaare Castle, Saaremaa 26 March–25 May 2014

Introduction

"Why is the sea blue? Why do butterflies fly? Why does the sun rise?" are questions children ask to explore the nature and boundaries of life. It is an important step for connecting scientific and creative thinking. Our cultural symbolism has vastly expanded thanks to science and interdisciplinary approaches to research that are continually increasing in popularity. Due to science, we can think of a person as a fragment of the universe continuing to exist and succeed in this vast entity.
"From General to Specific" was my poetic interpretation of the knowledge that I obtained from observing tiny and extremely fragile organisms – unicellular algae. How can you see, study, maintain and care for, how can you translate scientific language into a poetic process to create art? How can you grasp the huge system comprising the world and understand how unique it is? And what does knowledge of marine biology tell our technology-focused society or which fields outside the traditional fields of research are we also going to be able to explore in the future? Those were the key questions that I asked myself while developing the exhibition.

The exhibition was developed thanks to a productive collaboration with the TUT Marine Systems Institute, special thanks to: Inga Lips, Karin Ojamäe and Madis Listak.

Figure 16: *"Metagenomic museum" (2013)*

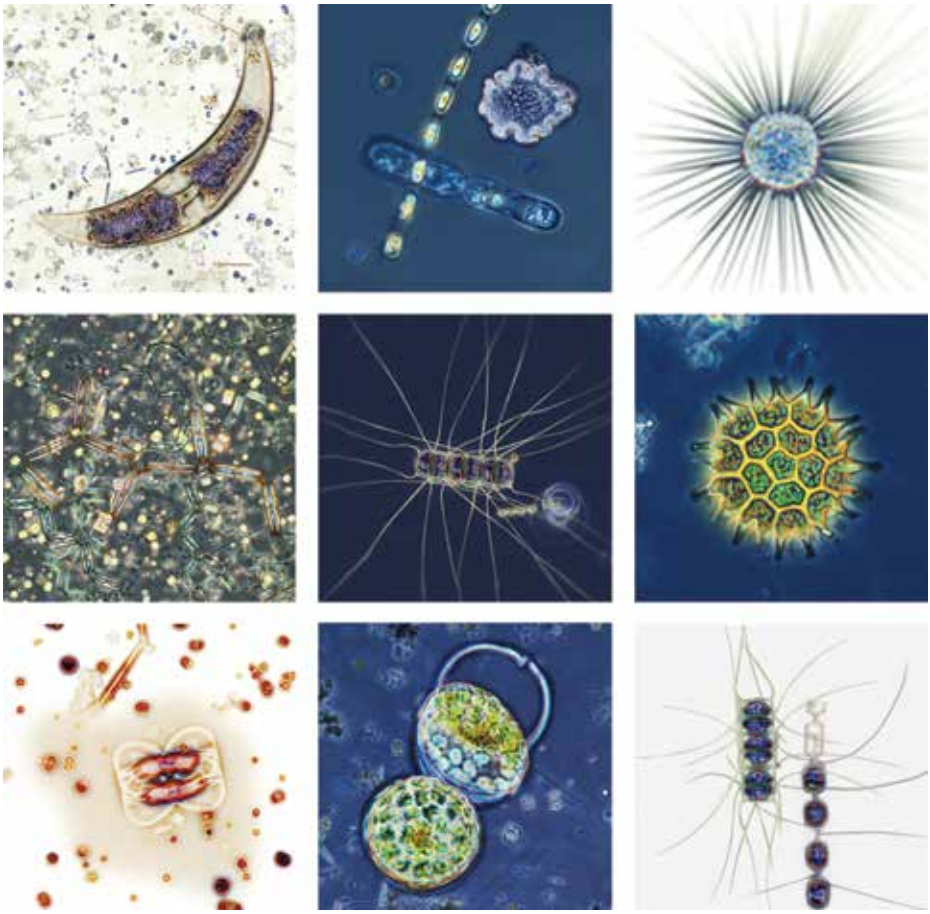
2.2.1 "Metagenomic museum"

Gregory Bateson, an English anthropologist, social scientist, linguist, semiotician and cyberneticist has said:

> *The viable unit of survival is a flexible organism-in-its-environment (Charlton 2008: 122).*

When I started to collect water tests from different Estonian bodies of water, I saw how different they were – not only by their colour, but also by their consistency. The first and most important issue was, how to prepare them so well that they could survive two months, especially thinking about the inappropriate season (October - November). Algae flowers mostly in spring and summer, so the current winter time was not very pleasant for them even in their own environment. Scientists cleaned and carefully prepared water tests for this exhibition, but my wider questions were – how could I save the information of those tiny creatures in terms of the longer future? What can we learn about preparing biological material? And how could I present those ideas at the art gallery?

We all know, that the current state of science allows important information to be stored as extremely small units, DNA for example contains far more information about heredity than stuffed animals, for instance.
I arrived at the strange question: Could the museum of the future consist of just a number of test tubes for example? Like a genome centre that stores vast amounts of information about us? How could I save a vast amount of data no supercomputer or scientific institution was capable of storing or preparing? And I found that the ideas of metagenomics or system biology would be interesting directions to further explore. Because those small bodies with the tiniest of organisms contain much more information than one can expect.
What is most important from the above is what Gregory Bateson means: each living being must understand the simple truth – unable to maintain its environment, it is principally destroying itself.

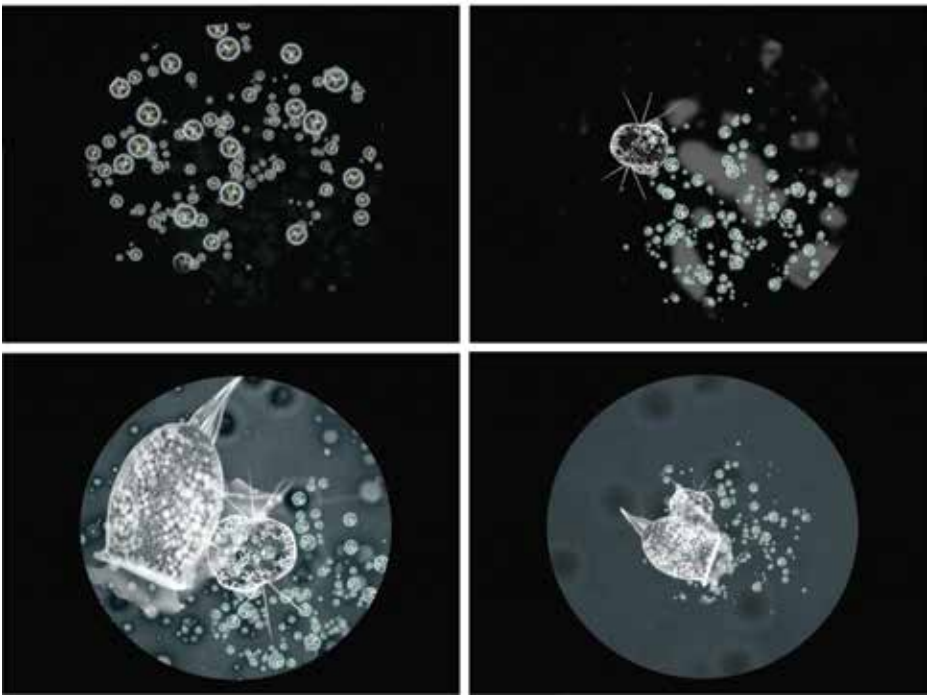


Figures 17: *"Portraits of Voyagers" – microscopic images and photo collages (2013)*

2.2.2 "Portraits of Voyagers"

A teaspoonful of seawater contains far in excess of a million living beings, including plankton. The word plankton is derived from the Greek word *πλαγκτός*, which means "lost" and in a broader meaning also "voyager". Microscopic organisms that inhabit all bodies of water play a vital role in life on Earth. They are the lowest linkages of food chains, primary producers, getting their energy from photosynthesis and producing oxygen. Being only 1% of the biosynthetic mass on Earth, they account for almost 45% of annual oxygen production. But not only that – they can also negatively impact our environment because the concentration of plankton in bodies of water is continually increasing. This harms our future living environment because excessive growth of algae changes the balance of the aquatic environment and thus the living conditions of all other creatures. (Olli 2009: 45–46)

I portrayed a number of photo collages of voyagers whom I have met in our bodies of water. They were collected from different Estonian waters, and microscopic images were captured in a laboratory and edited by me using digital art tools.



Figures 18: *Videostills from the animation "PacMan – Plastid Hunt". Animation is based on research material by Karin Ojamäe, author of audio: Madis Listak (2013)*

2.2.3 "PacMan – Plastid Hunt"

Although the microscopic life forms of the aquatic world look pretty and amiable on the surface, this environment is full of angry and wild creatures. People have yet to know all the strange behaviours and interrelations that take place in this biome but simplistically it could be said that a real mafia is operating in this superficially godly society, even killings and organ thefts take place. (Psi Wavefunction 2010)

Kleptoplasty is the theft of plastids that starts with the cryptophytes, microalgae who fall victim to ciliates. The ciliate swallows its prey cells whole and almost completely digests them with only plastids left. The ciliate then nonchalantly continues to use them to produce energy it needs from solar energy and carbon dioxide. The ciliate itself is coveted by some dinoflagellate species that by themselves are unable to acquire plastids from their original owner and require intermediaries for this purpose. The ciliate intermediary has done a lot of work collecting and packaging plastids and this industriousness is taken advantage of by lazier but ultimately stronger characters. (Minnhagen et al 2008)

Scientists discovered only in 2006 that kleptoplasty as a peculiar and hyperaggressive behaviour that takes place in the food chain has a major role in the algae community (Gast et al 2006). Although microalgae behaving like this are extremely rare, this discovery is completely sufficient to disprove current principles of the functioning of life. Using the parallel of the well-known computer game PacMan, I provided my own interpretation of the peculiar relationships in the algae society, showing that behavioural and game strategies in different worlds are surprisingly similar – the end justifies the means, the stronger and more deceptive prevail and thus stay alive.

Figures 19: *"Roboautotrophs" (2013)*

2.2.4 "Roboautotrophs"

The word "roboautotroph" is a combination of two words – "robots" and "photoautotrophs", it is my mental image of the amalgamation of the artificial and natural world. Photoautotrophs are microorganisms obtaining energy from the sun and from CO_2 and using it for biosynthesis and photosynthesis is a huge source of natural energy and thus useful in many ways to humankind in light of future research.

In cooperation with robotic scientist Madis Listak and marine biologist Karin Ojamäe, I created an installation that consisted of an aquarium filled with blue-green algae, 32 servo motors and LED lamps. The servo motors equipped with mirrors – "robots" – were connected to the aquarium by sensors; they moved in accordance with the microalgal proliferation in the aquarium, creating different moving reflections.

Preparing this installation I posed the following questions:
What if we stopped following the binary system consisting of 0s and 1s established by Alan Turing in our way of thinking? What if our computer world were ruled by biological and chemical supercomputers? What if such a technology could supply itself with energy and replenish itself? What if biological resources could make us quit for good expensive production methods, heavy metal, vast cable arrangements and diagrams? How to understand and resolve the dilemma between two methods of data communications – digital and material-based or chemical communication if Turing's binary system becomes exhausted?

This simple prototype was my first exploration to think further on those huge questions. I started from the simplest and studied the habitat living in the aquarium and tried to translate the information received from it to a digital language that robots could understand. My first prototype – the system of simple measurement instruments – and basic robotic movements in turn reflected my complex questions that could be important for all of us. How can life and artificial life coexist better and more effectively without destroying each other? And are we also ethically prepared for such coexistence?

2.2.5 Observations and conclusions

The creation of the second exhibition was based on my goal of focusing more extensively on the field of bioart, concentrating on issues that concern biological creatures and phenomena. On one hand, I wanted to focus on a specific field of science (marine biology) unlike in the previous exhibition that combined multiple fields. On the other hand I wanted to continue working on collaboration between scientists and artists. My main aim was to find further possibilities to expand the boundaries of art through practical activity, at the same time also encouraging scientists to think along.
The poetic interpretations and thought manipulations of science necessitated explanatory texts in the exhibition room in order to understand my ideas or evaluate the lab work, and the audience was clearly divided in two: those interested in the scientific aspect in art and those who interpreted what they saw by themselves without explanations. And there were many kinds of interpretations.

In the following, I discuss the most important issues raised in the course of the exhibition:

1. Installation “Metagenomic museum”. Considering the need of algae living in test tubes for sunlight and the characteristic of the exhibition room, I had to place the test tubes filled with algae in the window. The test tubes had explanatory labels on about the places where various algae can be found and the species that were not clearly legible from this distance. This, however, added a new dimension to the installation, indicating a mysteriousness of the explanatory texts, the desire to change the exposition relationship to be not informational but poetic.
2. During the preliminary peer review of the exhibition, an intriguing discussion took place on the subject of my interactive installation “Roboautotrophs”. It concerned ideas about the comparison and potential combination of the digital and analogue worlds or the binary and analogue approaches. In this case perhaps one should still consider that the whole biological world is binary by nature and our methods of thinking or logical thought are built on a system of “yes” and “no” answers. This means that the question I asked was incorrect because both the biological and artificial worlds are subject to this logic. Answers could be sought from the realm of, say, biosemiotics, and could be the next sphere I explore by asking questions.[7]

   I will add one more aspect to the idea of comparing nature and artificial life. For that I use as an example here the media art project “Nomadic Plants” by Mexican artist Gilberto Esparza. As part of the project, the artist developed tiny robots that acquire the energy they need from polluted water. (Green 2010; LABoral 2009) The artist’s aim is to refer to the pollution of the surrounding environment as well as to technological capability – even through undesirable developments we have the opportunity to persist one way or another. And perhaps also a wider question on whether humans are in fact the most important species to carry on life. Perhaps it will instead be nanobots or some other artificial organisms that are not as demanding in terms of conditions for existence as we are?

   It is only one example, in reality almost all hybrid art projects ask ethical questions to a greater or lesser extent because they have the key questions of technology, science and art already integrated in them by nature.
   I.e. even questions addressing narrow issues are based on a broader background comprised of our environment and a cautious attitude towards it.

3. An exciting discussion also arose during the preliminary peer review of the exhibition about the nature of interaction. When I presented the installation "Roboautotrophs" in which simple robot systems reacted to algae growth in the aquarium, the following question arose – does it constitute interactive communication or autocommunication within the artwork? Because the human factor can be ruled out for this installation.

   My answer to this could be the following:

- The concept of interactivity is actually not very clearly defined as an active mutual relationship between person to person or person to machine. Indeed, this means collaboration in launching something but parties to the collaboration are not exactly defined by the nature of the subject. There are admittedly approaches indicating that one party is the human but there is a note added that it could be any living creature.
- Assuming nonetheless that in case of interactivity we see one party as a biological creature, this also applies to algae - the distant ancestors of all of humankind. My broader aim in authoring the exhibition was to refer to the fact that while studying human nature is important, one must not necessarily take the human-centric viewpoint.
- Perhaps indeed I must contemplate defining the artwork using another term but in that case I prefer:
  a) a more precise definition regarding interactivity or autoactivity;
  b) a new term that I will independently arrive at in my future research.
- Having later, in the course of writing the dissertation, studied the concept of interactivity, which became a key term in the new media art in the 1990s, I can add Katja Kwastek's assertion that in the beginning interactivity was characterised by the modern technology used to create it. Following that, the strict boundaries have disappeared between analogue and digital techs as well as between active and passive participation. (Kwastek 2013: 36) If one examines the term interactivity in, say, physics, it means a reciprocal effect between different objects; thus we can consider the particles of the interaction to be all objects taking part in the action, even though in the new media art, going by J. C. R. Licklider (1960), interactivity was considered primarily the relationship between man and machine (man-computer symbiosis).

In a preliminary peer review written on my exhibition, Raivo Kelomees asked a question about disciplinary competence: to what extent must an artist have knowledge about what is used in their artwork? In my view, productive collaboration can only be based on mutual understanding, parties participating in the work must be capable of understanding each other on an intellectual level, thus although it is difficult to presume that both parties are perfectly aware of the theories needed in their work and know each other's working methods, both parties must compromise when initiating a collaboration, in other words take a few important steps back to the idea level. Additionally, in such collaboration, even though it is called hybrid, all parties have certain roles. It is important not to mull over who is more competent in which field but combining their roles in the name of a collective goal.

Another question rightfully asked was that why these science thoughts had to be expressed in this art form, would a popular science film or book have been clearer for the audience? My answer to this is that we all have our own resources to make ourselves understood. Art form is undoubtedly complex, contemporary art requires great prior knowledge, an educated audience and ability to focus, just like understanding science requires from the regular person. After all, that is why I have asked the question about combining art and science – how can these two highly complex fields be understood in the context of collaboration, how can we find practical outlets? And in no way do I believe that I uncovered the "final truth" with this exhibition. But I slightly lifted the veil of mystery in front of the Estonian audience to explain what bioart is.

Figures 20: *Autumn Symposium. Lectures of Alan N. Shapiro and Michael Weinstock (2012)*

2.3 Rhizope. Art & Science – Hybrid Art and Interdisciplinary Research

Following is the overview of my curatorial work in organising the international exhibition and conference "Rhizope. Art & Science – Hybrid Art and Interdisciplinary Research" in 2014. The conference took place from 29 May to 1 June 2014 at the Estonian Academy of Arts, and the exhibition from 29 May to 24 August 2014 at the Estonian Museum of Applied Art and Design in Tallinn.

2.3.1 The "Rhizope. Art & Science – Hybrid Art and Interdisciplinary Research" conference

The overarching goal of the three-day conference "Art & Science – Hybrid Art and Interdisciplinary Research" was to discover, examine and analyse new and exciting directions taking place in the research world – activities in which both art and science are components.

The conference asked the following questions:

- What is artscience? How should we see cross-disciplinary and transdisciplinary phenomena?
- How does new knowledge come about through hybrid, art-science forms of cooperation? How to expand the dialogue between science and art and how might artists position themselves in this process?
- How does scientific knowledge spread in society? How to find a scientific language that would meet the cultural expectations of our society?
- What common practices exist?

The English language makes a clear distinction between science, research and scholarship, but the Estonian word *teadus* can refer to all of these and more. It can also denote all of the other, "softer" fields included under academic research. Preparing for the conference and the "Rhizope" exhibition was a long and exciting process that started with a "spring academy" held for members of the Graduate School of the Cultural Studies and Arts to map possible directions to be considered in deciding on conceptual approaches. Our aim was also to get doctoral students to collaborate more. The next key event was a two-day autumn symposium held the same year at the Estonian Academy of Arts, during which we continued our work in discussing these issues, with some of the initial conceptual approaches taking on clearer outlines.[8]

***Figure 21**: Conference "Art & Science – Hybrid Art and Interdisciplinary Research". Lecture of Natalie Tyler (2014)*

Another significant conceptual approach was tied to the Estonian context. In our country, given its complicated history and period behind the Iron Curtain, artists have been interested in scientific development – especially on the other side of the "wall" – throughout the Cold War era. A milestone was the "Biotoopia" exhibition, held in 1995 at the Soros-funded Centre for Contemporary Art, curated by Sirje Helme and Eha Komissarov (Biotoopia 1995, Helme 1996). This exhibition, ahead of its time, brought a number of fascinating artists and researchers together, who all interpreted art-science integration in groundbreaking ways. This exhibition can be seen as a catalyst for our own event "Rhizope".

The new exciting creative practices, hybrid art forms and interdisciplinary studies are so diverse that it would be complicated to agree on definitions for categorising them or to find suitable terminology. For one thing, scientific advances and transdisciplinary cooperation develop very rapidly, and hybrid creative forms are so unique that it takes time for the terminology and evaluation criteria to catch up. Some areas that could be highlighted are bio art, robotics, network(ed) culture, music, architecture, design and urbanism. Scholars from disciplines such as history, philosophy and social sciences were also present at the "Rhizope. Art & Science – Hybrid Art and Interdisciplinary Research" conference.

In addition to the Estonian Academy of Arts Doctoral School, the academy's Faculty of Architecture also provided organisational support for the conference. This represents intramural cooperation, not just in the formal and organisational sense but in terms of the content. In the course of the conference, among other topics, the relationship between the contemporary fine arts and the applied arts were investigated.

Moreover the discussions at the conference raised the question of an artist's position in the academic world. How can we realise the potential of scientific inquiry based on the creative process and how can we overcome traditional barriers that up to now have kept artists away from it? We heard from artists themselves on this subject on the third day of the conference at a session held at the Estonian Museum of Applied Art and Design.

My special gratitude goes to conference keynote speakers artist Simon Penny and architect Theodore Spyropoulos and conference co-moderators Veronika Valk and Carl-Dag Lige.
In addition, thanks go out to curator Dmitry Bulatov from Kaliningrad, who presented conference's film programme at the Estonian Academy of Music and Theatre, "EVOLUTION HAUTE COUTURE: Art and Science in the post-biological age".[9]

Figure 22: *View of the exhibition "Rhizope" (2014)*

2.3.2 The "Rhizope" exhibition

"Rhizope" as an exhibition presented distinctive art projects created by an international group of artists and researchers: in these works, the fine arts and applied art intertwined with biotech and computer technology, network culture, robotics, music, social sciences, history and many other fields.

While conventional wisdom holds that people from the humanities show interest in cutting-edge science, not vice versa, I saw clearly in putting together this exhibition that this was not the case. A marine biologist, sociologist or historian putting effort into an artwork – these were just three exciting examples. It was a pleasure to see that quite a few of the works exhibited had their seed in the topics discussed at the autumn symposium we held – "Art & Science – Hybrid Art and Interdisciplinary Research" in 2012. Thus, I can say that the "Rhizope" exhibition was an experiment in a number of ways – for our doctoral students, a larger international creative group as well as the organisers themselves. First of all, it gauged how much we were able to get people to think with us on art and science topics, and it also generated unexpected paths and outputs.

Biology and the related bioart are fairly over-exploited in today's hybrid art scene (*see chapter 4.4.3*). We therefore expanded on the definition of the word "hybrid", since it may refer to very diverse domains that may not be all that closely connected to biology. Bioart itself has gone through a major change of direction, from gene manipulations and treatment of biological material to broader environmental problems – as critical voices, the artists featured at the exhibition raised many other questions: even questions that were not limited by any criterion or methodology in a given field. In other words, some of the ideas were far out of the box, making them trans-disciplinary in the best sense of the term.

One problematic question is to what point was this an art exhibition and where did it become a scientific "expo"? How did art audiences see the works and science experiments and how did the surrounding environment influence the context of reception? Or how were the visitors able to orientate at all in the sea of complicated artistic and scientific ideas? Were the visitors prepared to read difficult science texts, or was there a threat that a key message was too vague?

A brief look at the exhibited artworks

The following is a short overview of the ideas and artworks that were presented at the "Rhizope" exhibition held at the Museum of Applied Art and Design in Tallinn (2014).

Sara Robinson presented in her installation **"What is 'natural'?"** the three most common methods of generating spalted wood. This work invited viewers to review long-known methods of wood-generating and decide for themselves which are 'natural': the pure decay and light staining commonly found in hardwoods on the forest floor; the laboratory-induced fungal growth that prevents decay; or extraction and reapplication, where pigments are extracted from fungi grown on Petri plates and applied directly to the wood in the fashion of the artist's choosing. Sara Robinson works as an assistant professor at Oregon State University in the anatomy of renewable materials (*Figure 23*).

Juan M. Castro's work **"Fat Between 2 Worlds"** explored the spontaneous transformation of fat into organic structures at the cellular level. Through this installation he asked the following questions: how should we reflect on the possibility of synthesising new forms of life? Can we gain insight by looking at membranes of the past and future? Juan M. Castro is an artist and researcher of out-of-equilibrium dynamics of molecular assembly and chemistry (*Figure 24*).

The installation **"Plankton Music"** was about interpreting water flea behaviour into music. Marine biologist **Lennart Lennuk** expressed his scientific ideas about the behavioural patterns of aquatic life forms, and interpreted this scientific data into an aural idiom that the exhibition-goer could enjoy, making real the experience of behaviour of tiny organisms (ciliates) possible (*Figure 25*).

Kaisu Koski's "Living Anatomy" included a series of self-portraits that explored anatomy teaching and the various models representing aspects of the human body, and their relationship with a living body. The video piece "*Canvass mise-en-scène*" and the animation "Not to scale at all" were included in Kaisu Koski's exhibition collection. Kaisu Koski is an artist, who is currently conducting her postdoctoral research project, exploring various representations of the body in medical education (*Figure 26*).

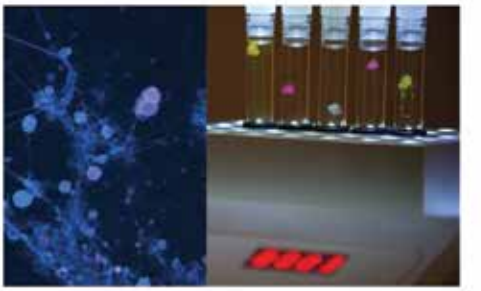
Angelika Böck's series of class plates **"Blanks"** were s good example of using scientific technology for artistic purposes. Angelika Böck has used eye-trackers to make the laws of perception visible and tangible. In this instance, the eye is used directly as a drawing tool in order to perceive perception – observation is transformed into a portrayal without taking the route via hand and canvas. Angelika Böck is a sculptor (*Figure 27*).

"Beyond Humans: Organ-Like Organism Made of Human Cells": Fine artist **Reiner Maria Matysik** underwent surgery where tissue from his body was removed. The isolated cells were used for the production of keratinocyte grafts grown and reproduced in specific cultures. The cell growth was stimulated by a nutrient solution on Petri dishes, and were used for forming a new living entity – the artist used these structures to form a sculpture of his own cells and transformed this into a wet specimen (*Figure 28*).

Artist **Paul Wiersbinski's** video documentation of the project **"TOYs"** was a great example of a hybrid space merging concepts of sci-fi films, where real actors were "controlled" by the audience by using wireless webcams and microphones. The project was designed in order to organise an open scientific experiment and social investigation. It investigated how people used technical devices in order to hide their true identities (*Figure 29*).

"The Rhythm of City" by artist duo **Varvara Guljajeva** and **Mar Canet Sola** was an art piece that pointed out an artistic way for applying geo-located social data as a score. The audience was given a chance to discover and experience an alternative way of perceiving different locations (for example Tallinn, São Paulo, New York, London, New Mexico, etc) through a continuous performance of 10 metronomes. The artists' main purpose was to give an alternative meaning and purpose to the location-specific invisible online data (*Figure 30*).

Figures 23: *"What is 'natural'?"*



Figures 24: *"Fat Between 2 Worlds"*

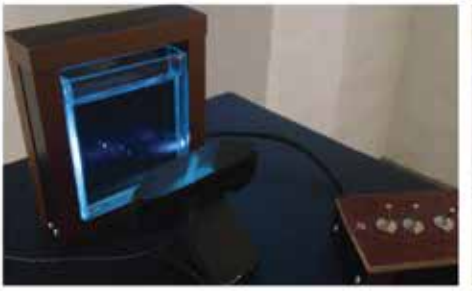


Figure 25: *"Plankton Music"*

Figure 26: *"Living Anatomy"*

Figure 27: *"Blanks"*

Figure 28: *"Beyond Humans: ..."*

Figure 29: *"TOYs"*

Figure 30: *"The Rhythm of City"*

Figure 31: *"Sketches for an Earth Computer"*

Figure 32: *"World Mountain Machine"*

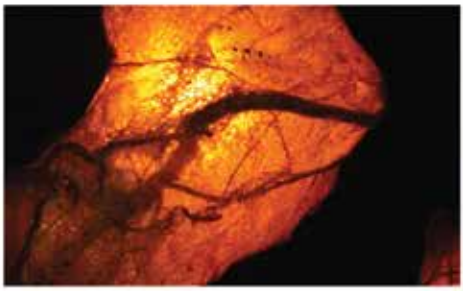


Figure 33: *"Diapause"*

Figure 34: *"Untitled" (wall)*

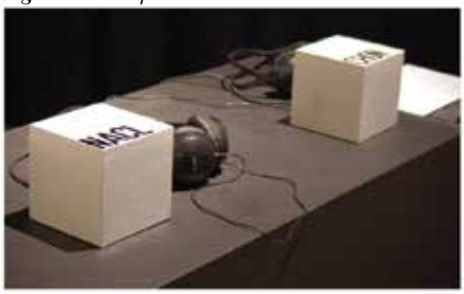
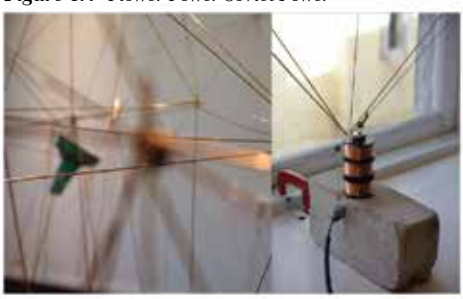


Figure 35: *"Intrinsic Sonics"*

Figure 36: *"I Am Like Dali"*

Figure 37: *"Flower Power Soviet Power"*

Figure 38: *"Meshk – ..."*



Figures 39: *"Irrational Orchestration"*

Figure 40: *"˜ ˜ Kulunka ˜ ˜ "*

Figure 41: *"BCIm – Brain Current Interface Model"*

Figures 42: *"Roboautotrophs"*

Artist **Martin Howse's "Sketches for an Earth Computer"** presented a living "laboratory" study enacted as a possible earth computer, alongside photographic documentation of various attempts to implement a literal, artistic investigation of the links between the earth, code and the human psyche of the viewer. The living "lab" study in the exhibition hall consisted of a single soil-filled container that explored within a restricted environment the various coded and energetic transformations that the earth computer enacted (*Figure 31*).

Ulrich Gehmann's and **Martin Reiche's "World Mountain Machine"** showed architectural morphology as a historical process and translated it into a visual language. The spectator was offered a view of a process that developed over the course of the whole exhibition: the installation created that transcends through different stages of evolution based on the sensory input coming from the venue of the exhibition and methods derived from computational biology and fractal geometry. This generative art installation was a great example of an historian and new media artist's collaboration (*Figure 32*).

In **Natalie Tyler's** installation **"Diapause"**, the cocoon was a metaphor for the emotional, philosophical, and physical states of transformation that occur during life. Three huge cocoon-shaped light sculptures brightened and faded out, reacting to the movement of the viewers. Natalie Tyler is a sculptor and international curator (*Figure 33*).

Sculptor **Sharyn O'Mara's** installation **"Untitled" (wall)** was part of her ongoing series of sited sculptural works. Comprised of optical fibre – one of the most current methods for transmitting mass quantities of information – these fields and forms quietly assert themselves in a world where the means to communicate with one another both personally and globally has never been easier (*Figure 34*).

The installation **"Intrinsic Sonics"** by musician, composer and photographer **Christian M. Fischer** approached two very common everyday materials from a sonic point of view. People could listen to and interact with the materials and manipulate sounds depending on how they shook cubes filled with either salt or wood and equipped with a microphone. He asked: We all know how paper sounds when ripped. But what about other substances that do not vibrate so easily? Is there sonic life inside salt or wood? (*Figure 35*)

"I Am Like Dali" was a collection of short videos in English, Spanish, and Catalan, made by psychologist **Diana Rivera** and film maker **Amanda de Luis**. Each visual *exposé* was about the person one is said to be like, not like, or the person to whom one always wanted to be like. The project was influenced by research in personality psychology, wherein the discussion of self is informed, in part, by past and present experiences, relationships with others, and more current research may ask how it is informed by the technologies one uses (*Figure 36*).

Terje Toomistu, KIWA "Flower Power Soviet Power".
Combining ethnological research of oral history and analyses of popular culture with the use of video, photo, text and illustrative artefacts, this installation brought out the significant marks and artefacts of youth counter-culture of the 1970s Soviet Estonia. Terje Toomistu as an ethnologist and KIWA as a known artist of Estonia wanted to express the uniqueness of the Soviet hippie culture, which vividly reveals the conflicting personal and social 'truths', subjective and 'objective', the psychedelic and the 'rationale', and also illustrates how power simultaneously acts as repressive and productive (*Figure 37*).

"Meshk – the Traces of Collaborative Intimacy in the Whirling Practices of Sufism" by anthropologist and musician **Polina Tšerkassova** and designer **Eldar Jakubov** was a sensory installation created as a collaboration between an anthropologist and an artist. Together they undertook a five months of fieldwork in Istanbul studying with and from the Sufism practitioners. The installation was a collection of field notes – the traces of ecstatic whirling experience were burnt and depicted on canvas. The sounds and voices, recorded during the practice of sema – whirling – were played as part of the installation (*Figure 38*).

Artist **Peter Flemming's** site-specific installation **"Irrational Orchestration"** imagined the idea of electromagnetic activity as physical lines in space, embodied in a temporary structure that can be entered and experienced.
This installation consisted of a large network of metal rods interconnected by strong magnets. Found metal elements in the gallery such as light fixtures and buckets were used as anchor points and acoustic resonators for the structure. Copper wire coils drawing (nearly) raw electricity from a wall outlet, harness the alternating current in order to subtly oscillate the assembly (*Figure 39*).

We presented the three projects at the exhibition in a reduced format, due to material and technical conditions that didn't allow for the full-size display.

Yolanda Uriz Elizalde's "˜ ˜Kulunka˜ ˜" was an installation where sound waves could be seen, heard and touched, with the audience immersed in the sway of their oscillations. Longing for a re-encounter with the tangible, "˜ ˜Kulunka˜ ˜" overcame the overload of audiovisual stimuli by allowing visitors to experience their physical limits morphing in connection with the vibrating surroundings (*Figure 40*).

Maria Tjader-Knight's "BCIm – Brain Current Interface Model" presented a research project, which took place at the focal point where interactive audio-visual installation art and interaction design join today's technologies of non-invasive Brain Computer interfaces (BCI) and neurology. Research for spatio-temporal audio-visual means to distinguish, enhance and network the active intelligent alloys for anti-authoritarian strata of comprehension, communication and well-being (*Figure 41*).

Piibe Piirma "Roboautotrophs" was a prototype of a robotic installation, which was developed thanks to productive collaboration with the TUT Marine Systems Institute in 2013. In this idea for a prototype, blue-green algae were connected to small servo robots, demonstrating in this way how the natural and manmade world interacted with each other (*see chapter 2.2.4*) (*Figure 42*).

2.3.3 Observations and conclusions

The results of the lengthy work process culminating in organising an exhibition and conference and the publication of a catalogue can be best summarised by answering the questions asked during the preliminary peer review held on 4 June 2014. Preliminary reviewers were Hilkka Hiiop, specialist at the department of Cultural Heritage and Conservation of the Estonian Arts Academy and specialist of the contemporary art collection of Kumu Art Museum, and internationally renowned new media artist and curator Rasa Smite from RixC centre of New Media Culture in Latvia.

The questions were the following:

Can the expression of science work using artistic methods also bring about an analytical/ methodical shift from the standpoint of science? *(Hilkka Hiiop)*

This is a very difficult question that I can only answer from my own artistic viewpoint. With regard to interdisciplinary dialogue and productive collaboration, I have realised through my interviews and conversations with scientists and artists that mutual understanding is crucial, although professionally and organisationally it is difficult to evaluate. This does not mean that the work methods or research questions are different but that assessment criteria are subjective biased in one way or another and do not consider the broader context of such collaboration projects. Therefore it is understandable that I view this as an artist and the exhibition venue is also important (Museum of Applied Art and Design) that in turn give this event a certain idea and purpose.
At the same time, I am certain that the persistent distribution and publication of these ideas also opens up excellent opportunities for the necessary substantive discussions and wider understanding to occur.
My view is that new media art that closely interacts with science not only “flirts” with science but is a new deeper understanding that science and art have the same foundation and are interconnected more than ever. This understanding can indeed bring about a shift in both art and science. But we can only evaluate that after some time. On the practical level changes in science and its working methods are noticeable, I addressed the issue in chapter 4.3, “Differences and similarities of the results: *Question about prototypes and scientific/useful models*”.
In science also already during the 20th century substantial changes have occurred, the basic principles of mathematics and physics have in various ways been disproved (for example refutation of axiomatic rules and the rise of quantum physics). And the need for considering the so-called social environment of humanities is also greater than before in these discplines. Although it is hard to predict the future of science and art, I am optimistic concerning collective production of culture. Artistic thinking has one of the key roles in this development, opening up the lab doors for artists is assuredly a broadening experience for all disciplines.

I would like to cite Kurmo Konsa, who has said the following:

> *The postmodern way of thinking denying all rules and restrictions and obvious playfulness is building good psychological premises for the artificial culture to be accepted. [...] The relationship between humans and culture is very complicated. On the one hand, humans create culture, but at the same time culture designs humans. [...] In many ways, the cultural process is similar to natural process... (2010: 79)*

Is popularisation (and if so, popularisation of what) an end in itself or should hybrid art remain in the tight circle of specialists? How important for this artistic creation is the participant/viewer interaction and who is its audience? *(Hilkka Hiiop)*

On the one hand the question is about setting the goal. If it is defined narrowly by giving science an artistic/designed expression, it may indeed constitute popularisation. On the other hand, the representatives on the side of visual arts will certainly not accept the populariser or publisher role. An interdisciplinary attitude presumes equal roles in creation whereby

both parties must carry out extensive "homework" in order for collective meaningful content to be produced. I have mentioned that visualisers and popularisers are more likely to be scientists using artistic tools e.g. to draw charts and diagrams, make drawings. This concerns form rather than substance, though. Hybrid art does not popularise or describe but intervenes. If I wish to popularise something, it is hybrid art itself in its exciting various forms.

Have you thought about the aspect of preservation and musealisation and to what extent (as a curator and artist), do you also document your artworks or curated exhibition collections and by using which methods? *(Hilkka Hiiop)*

On the one hand, this question concerns the entire contemporary art in general – how to preserve or document contemporary, often technologically complex art that uses very different media or nonfigurative art? Documentation is one option indeed but it does not replace or preserve the work in its original state.[10]
In the context of this exhibition I can say that even an exhibition period of three months in duration is quite problematic in my view. Therefore, simultaneously with the preparation of the exhibition, we also engaged in minimising the technological aspects in order to ensure that it would function truly flawlessly during the exhibition period.

Speaking of new media art in general – the issue of technology is acute already because technology becomes obsolete very quickly, its preservation for many years is probably not worthwhile. New and perhaps better solutions will emerge, the old technology may indeed be important to display in the historical sense but it leaves curators with very complicated tasks. Also looking at my own art practice I can say that I have never been interested in reviving my old projects, instead I try to create new ones with more substance.

One very exciting experience concerns the "Rhizope" exhibition. I am speaking about the work by Reiner Maria Matysik called "Beyond Humans: Organ-like Organism Made of Human Cells". (*see chapter 2.3.2*) When selecting the work for the exhibition neither I nor the exhibition jury found it clear what exactly the artist wished to submit. Our correspondence was also quite random and unclear, thus we were of the opinion that this was a wax sculpture. It only became evident when the artist arrived at Tallinn Airport, carrying a bag containing the "semi-living" sculpture that had to be transported to the museum as quickly as possible and placed in 100% spirit in order to prevent it from turning bad (it is a sculpture grown from muscle mass cut from the groin of the artist himself). I was quite shocked and especially worried because I started to wonder how I could transport it back to Berlin in three months. Matysik replied that the only way is to take it to Berlin in hand luggage because it cannot be sent by post. While we were discussing, we found the best solution – the artist is coming back here on the day the exhibition closes to give a performance in the museum during which he packs this sculpture himself and then transports it back to Germany. But how is it even possible to transport such items in hand luggage? It probably cannot be declared as an artwork? The artist replied that when asked at the airport what his luggage contains, he put an apple and piece of bread next to the sculpture and asserted that it was food. It was the only way to bring the sculpture to Tallinn. In my view, it demonstrates emphatically the particular nature of contemporary art forms not only in terms of conservation in the long run but also in terms of presenting works on a simpler organisational level. At the same time, I deem it necessary to add that Estonian Museum of Applied Art and Design also is an excellent venue to present this work because I have never encountered any problem that would forbid the work from being exhibited. I am inclined to believe that in some other places or other countries it would not have been that simple both in terms of organisational issues and raising of ethical questions.

What are the main conclusions (also in terms of terminology use) that you have reached in the light of this event? Which terms do you wish to use when speaking about technoart in the future (trans-, multi-, interdisciplinary, hybrid, complementary, cross-boundary, etc.)? What could be the role of today's art in general in this area of intersecting fields and opportunities? *(Rasa Smite)*

An important term in the context of my whole study is undoubtedly transdisciplinary collaboration that enables not only to collectively create new practical values but also raise new questions. But establishing all exact terms involves a risk of remaining incomprehensible to a certain part of the audience or collaboration participants.

I am certain that this event did not offer precise answers, it was also not our desire to establish exact terms with regard to the discipline, however it broadened the world view of both the actors and the participants. Hybrid art is a term I have emphasised the most in my study and it has also been the clearest for the audience.

An interesting fact also involves the exhibition title "Rhizope", something that took quite a long time to find. It could be a compound word combining "rhizome" and "scope", characterising "binding together", as well as an "opportunity", "reach", "area". When we were working on the text editing of the Estonian part of the catalogue (in collaboration with Bärbel Luhari-Err), she emphasised that the word pair "rhizopian research" is such a fascinating find that should continue to be implemented more widely.

Additionally about terminology: during my prior theoretical study I tried to ask from some well-known practitioners of various disciplines about which terms I should use in my study to be understood. The head of Ars Electronica FutureLab, Horst Hörtner, was very clear in his interview that we should not be looking for new and ever more complex terms because it renders contemporary art even less comprehensible to the audience. He preferred to use the word "art" within its whole wide spectrum of meanings (2012).

Oron Catts also highlighted a problem related to terminology. He mentioned that as soon as he labels himself bioartist, it means excluding himself from the so-called official contemporary art context (2012).

I find that terminology is probably generated over time, some expressions are adopted and also reach the audience, but our role is above all to map future developments and not attempt to label them with new incomprehensible terms.

I answered the question of Rasa Smite about whether I wish to compare the Rhizope events to other similar events held recently in nearby countries as follows:

The unique feature of our event "Rhizope" was focusing on the search for forms of collaboration that differentiated it from other international new media art and artscience conferences and exhibitions.

We had a very exciting and substantive conversation with Dmitry Bulatov from whom I asked which aims I should be setting in the future research of this subject. Should I examine it from the "post-biological", "post-media" or "techno-ecological" point of view? Bulatov answered that actually all viewpoints are correct.

Through practical endeavours both the art audience and academic institutions came to realise that new interdisciplinary or transdisciplinary forms of research are not only empty words disconnected from reality.

An artist asserts her role through an academic study – an aspect that was emphatically pointed out at the "Rhizope" conference by Rosanne van Klaveren in her presentation, metaphorical story titled "Wolf in sheep's clothing" (2014: 99–104).

Figure 43: *Terje Ojaver's installation "Bio-Top" in front of the "Biotoopia" exhibition in Tallinn Art Hall (1996)*

3 ESTONIAN CONTEXT: summaries of interviews with Estonian artists and scientists

In the course of curating the exhibition's part of this doctoral dissertation, above all the exhibition "Rhizope" and its accompanying conference "Art & Science – Hybrid Art and Interdisciplinary Research", it became clear to me that the underlying art-science framework has very specific history and roots in Estonia to be taken into consideration.

Citing Raivo Kelomees:

> *Any discussion of Estonian art of this type must begin with an event called Harku 75. It took place in Harku near Tallinn, in 1975, and it was a cooperative event produced by young scientists and artists, and ultimately a cooperative activity held between artists and musicians. The scientists offered an environment for interaction and exhibition space at the Experimental Biology Institute in Harku. (Kelomees 2014: 13)*
>
> *Harku 75 presented intermedia and multimedia, the event can be considered to have definite parallels with international developments. Due to the fact that the Soviet Union was isolated behind the Iron Curtain, it remained "underground"; such art did not appear at official exhibitions. (Kelomees 1996)*

Kelomees also refers (2014) to later art events, such as "Biotoopia" (1995)[11] and "Tehnobia" (2006)[12], that also attempted to connect with this subject and brought so-called scientific ideas to the viewers. This list could also include the international symposium of electronic art ISEA2004[13] that in 2004 brought a large number of exciting new media specialists to Tallinn and then to Helsinki for a week. Therefore, I view Estonia as a place that has a specific history for developing this subject and also a potential audience in the future. In addition to the aforementioned events, my personal meetings and interviews with Timo Toots, Kärt Ojavee, Taavet Jansen and Maike Lond have demonstrated that regardless of the arbitrary nature of holding such art events and also perhaps the low level of information, the discussion and artistic expression is clearly happening as part of this discourse and has also gained a foothold in our art landscape.

Estonian art scene is in a unique situation whereby on the one hand it is subject to historic challenges, on the other hand experiencing unprecedented openness in terms of the modern times. Therefore, it is necessary to explain hybrid forms of media art (including genre definitions): for instance, I consider the work "Beyond Humans: Organ-like Organism Made of Human Cells" by Reiner Maria Matysik exhibited at the Rhizope exhibition a good and highly specific example. The work itself, a biological sculpture grown in a science lab from muscle mass operated from the groin of the artist himself, arrived to the museum quite unexpectedly, it was transported under the pretences of food by the artist himself, bringing it from the Berlin medical museum as hand luggage and placing it into a jar of spirit upon arrival.
I am not sure how simple all of this would have been in another country but I think it demonstrates Estonia's openness – no ethical issues in relation to that have been raised to-date. Employees of the Estonian Museum of Applied Art and Design agreed with the concept of described art work and accepted all related procedures.

Another testament to the particular openness of Estonia in addition to the favourable geographic location is also my own art practice of recent years during which I have had an extraordinary opportunity to visit various science labs with the aim of collaborative work. That is, collaboration projects based on simple personal contacts and approaches were possible, they did not require huge efforts in writing major institutional cooperation submissions.
In all cases a clear expression of my idea and scientists' readiness to support me were sufficient. It is another question how much scientists got their word in case of such collaborations and what role I had myself as the initiator.

Even a location and place of birth no longer determined by specific geographic points, instead depending on contacts and contexts is a highly notable opinion in the framework of today's global world, I clearly see that we nevertheless very much depend on our geographic location and the specificities of the local culture (for instance, mother tongue).

In this chapter, I analyse the interaction of art and science using familiar art examples in Estonia in recent years. I present brief summaries of the interviews I have conducted with four Estonian artists and three scientists, who took part in the art projects in 2013–2014.
In my conversations with artists I have asked questions about the substance of their work, the potential audience of their works, positions of authors, the place of Estonian contemporary art in a broader context and future outlook. The examples highlighted here are assuredly not the only phenomena in our art practice, but in their own way they characterise these disciplines in which our brightest or best-known artists work. I have asked scientists about their view of interdisciplinary cooperation, inquiring about what the value of art in their work is and what collaboration with artists has given them. It is difficult to underestimate the following ideas that the interviews have given me for placing my dissertation in the Estonian context.

Figure 44: *Photo of the installation "SymbiosisW" (2010)*

3.1 Textile artist in the lab: Kärt Ojavee
Summary of interview with Kärt Ojavee, 6 June 2014, Tallinn

Kärt Ojavee is a textile artist who has for many years engaged in extensive science work concerning smart textiles. Her best-known work "Symbiosis" deals with the concept of smart space and textile, this intelligent touch-sensitive fabric blends together in the best way possible high technology, "soft" electronics and textile art. "Symbiosis" has been exhibited in many places around the world, both in visual arts and specialty textile exhibitions. Kärt's works broaden the societal understanding of future technologies that are integrated in the whole space surrounding us. The most important partner in her art creation throughout the years has been Eszter Ozsvald, design and mechatronic engineer from Hungary. Kärt Ojavee's small business KO! is specialised in the creation of dynamic textiles and development of exciting technological solutions.

The first question in my interview with Kärt Ojavee was about her collaboration with the Centre for Biorobotics at TUT with which I also have had an opportunity to collaborate. How did it begin? Kärt replied that it started very simply – by knocking on the door and asking for help. Perhaps in the context of tiny Estonia, collective work based on such personal contacts functions better than collaboration programmes on an institutional level.
Naturally, she had done extensive preparation work for this, not only from the perspective of potential material and product development but also in terms of wider scientific philosophical and future studies. She emphasised that biomimetics (or biomimicry)[14] was one of the most important areas she carefully studied, in addition to psychology of space and interesting phenomena such as the Internet of Things and Embedded Electronics.

When I asked who Kärt is positioning herself as, a textile designer or an artist, she thought that even though she has not analysed her activities from that angle, her activities have the characteristics of a designer, scientist and an artist. Everything depends above all on the context where her works are placed at any given time. Public space and smart textile in the use of regular people also raise other questions concerning consumption habits that may even be unnoticed in terms of art when these works are displayed in a public space.
Prompted by the question that are artists not incorrectly deemed to be "flirting" with science and not taking into consideration many important scientific aspects in their work, Kärt pointed out another important viewpoint – this is an exclusionary position towards designers. Certain negative attitudes targeted towards interactive installations can be detected as if it was about joking around without grasping the deeper meaning behind the work.

She answered my question about the utility of collaboration in terms of science as follows:

> *I could give an answer to that if I interviewed any of the engineers I have collaborated with. At the same time I think it is primarily mutual complementation, I am talking about my soft electronics and design methods that are not all that different from engineering. They also use design methods, their work must also be very creative. It is information sharing, at the same time I believe the result will not be visible immediately, it may only appear in 5 or 10 years. So it is probably difficult to presently estimate the benefit to engineers or science labs from this collaboration. (Ojavee 2014)*

Without a doubt this is not a work process with a fixed division of work – i.e. engineers carrying out certain work areas and the artist doing their own work. Such collaboration is characterised primarily by a binding together of interests and work because it is not possible to apply a customer-service provider relationship here. The work of scientists, engineers and artists cannot be looked at as specific lines running in parallel that never meet. Kärt also emphasised another important aspect – making technology invisible, minimising complex technological solutions that on the one hand gives her works a very innovative dimension but also significantly stabilises the shortcomings of technology. For example, a technological tool throughout her work has been the use of Arduino software and diagrams that has also led her to the developers of Arduino in her search for new solutions. In collaboration with them, a technological solution has been created that is much fresher, more accurate and better oriented to a specific object.

To the question about the so-called buying of designers by large companies, Kärt Ojavee replied that she highly values the independence that her own small business KO! provides her. On the one hand, it tasks her with the additional duties of funding and other such support, on the other hand it provides sufficient creative freedom of choice.
How to label Kärt Ojavee, though? Artist, designer or scientist? It also caused some difficulty for her because she found that contemporary art does not offer any fixed definitions for her endeavours. For example, the "labelling issue" is especially acute in Estonia in particular. The issue is not considered that important elsewhere in the world. Naturally, the problem with advancing new subjects is setting feedback criteria but it has also mostly arisen here because in foreign exhibitions people ask very exciting questions about the topic and future developments whereas here, often simply praise or incomprehensible attitude is expressed.
Kärt considered productive meetings with important people as a significant extra bonus of participation in foreign exhibitions – for example in Hong Kong she had the opportunity to meet and talk to the media art superstar Jeffrey Shaw.

As Kärt Ojavee has for years worked at the Centre for Biorobotics at TUT and names biomimetics as a persistent research theme, I asked what her relationship with biology was.
I was especially interested in the genres of bioart and synthetic biology that are prominent in both future science and media art developments. Is she also considering these genres? She answered that she is certainly interested in these developments but at present she has enough questions concerning her narrower field of research and she gladly leaves these genres open for herself as hypothetical research opportunities in the future. Audience and consumer studies are also important. Her exact aim is still to map the essence and technological capabilities of interactive materials, as well as broader aspects concerning public space and Internet use. At the same time, she pays attention to the privacy problem that is an issue worth analysing on such all-encompassing technology. Such critical issues are precisely what art projects must prove but Kärt also focuses on the results of this work, i.e. she is interested in how many of these ideas are also worth practical implementation.

Our last important topic of conversation was the issue of resources. It is well-known that science has much more funding to work with than art. Kärt Ojavee said that the science centre has clearly contributed much to her work and it is hard to underestimate the working hours spent on the side of engineers' main jobs. She does not feel it is right that scientists' work in her project is on a so-called charity principle. She is also of the view that if she had had greater material resources at her disposal early on, the results of the work would be much better in several ways. At the same time, no art project is born without an idea from merely preparing funding applications – things become reality through a symbiosis of those various aspects.

Figures 45: *Photo of Manfred Mim and videostill of "Levitating pixel" (2013)*

3.2 Interpretations of science: Taavet Jansen and Maike Lond Summary of interview with Taavet Jansen and Maike Lond, 6 February 2014, Tallinn

Taavet Jansen and Maike Lond have been known as an artist duo for several years. As dancers, performers and media artists they have for almost ten years led the artist group called MIMproject. One of the latest events of this association took place in 2013 when they presented a large-scale survey exhibition titled "100 Years of the MIMproject – The Life and Work of Manfred MIM, 1920–2020" at the Tallinn Art Hall from 22 August to 22 September 2013 encompassing several disciplines.

The exhibition provided an overview, coming together into a very interesting whole, of the developments of science, tricks of analogue and digital technology and very unusual interpretations of science (especially physics-related fields). ""Is it possible to construct the point of intersection of a perfect circle and the sound of a condenser, which is balanced by a single pixel?" Manfred MIM once asked himself. Someone just had to provide an answer" (Kunstihoone 2013).

MIMproject, with its leading members Maike and Taavet, connects together visual artists, performers, choreographers, light artists, animators, sound artists, directors, writers and engineers. The most recent survey exhibition was a collective effort by Taavet Jansen, Maike Lond, Hendrik Kaljujärv, Raul Keller, Andres Tenusaar, Henri Hütt, Andrus Laansalu, Kristiina Kütt, Andrus Aaslaid and Kalle Tikas. (Ibid.)

I asked Maike Lond and Taavet Jansen why they have selected this technology-focused route in particular. Taavet Jansen:

> *For me it is ... my definition of art. I like to think of the artist as a person deeply focusing or zooming in on one particular detail in society to open it up by using their methods. Actually, it does not matter whether it is painting or choreography or any other genre. In that sense, an artist's role does not substantially differ from that of a biologist or anyone else. A person making a wooden sculpture for me is much more boring than a tree researcher looking at a tree on a molecular level and trying to understand what algorithm the tree follows when it grows. In my opinion, an artist's role in society should be exactly like that. (Jansen, Lond 2014)*

Maike Lond:

> *And still the same child-like curiosity that "why does an apple fall down from a tree?". I agree with Taavet, these questions simply get more complex. They do start simpler but I believe we are the type of artists for whom "free expression of my soul" is less interesting than the question "why does an apple fall down from a tree?" (Ibid.)*

Taavet Jansen answered my question on whether in addition to the art value their work also offers value for scientists participating in their projects as follows:

> *In recent years I have met so many bored engineers, bored programmers and bored physicists who find their own work so deadly boring. The work of professional electrical engineers is about developing some kind of product so that it would function and be rock-steady ... and thereafter acting as this product's "psychologist" on why it does not work and what should be fixed. They really want to create a single-use space rocket that flies to the Moon. And it will fly through the air once, after which it will explode and will be a lot of fun! There they could apply their knowledge to make something completely useless and awesome that has no supervision, no legal disputes, etc. (Ibid.)*

How do artists meet scientists? What, after all, does productive collaboration start from? Taavet and Maike called it social engineering where the key issue is partnership based on equal contribution. I.e. they emphasised that they have never had to order or buy in something. They are mainly interested in people who think creatively and think along actively.

MIMproject is a work group based on democracy and people's personal traits but another important side there is independence from institutions, other similar networks and also money that is never the objective. In our conversation we reached institutional membership and the organising of official interdisciplinary university programmes that in their view certainly does not encourage creative groups to work. Their experience clearly demonstrates – empty classrooms and labs are a poor solution, the true interdisciplinarity is of substance and consists of its members. Nothing can be forced, first of all a desire and idea on the grassroots-level must be born, only then the structure and sponsor can follow.

Who is Manfred Mim, a man who has made strange discoveries concerning physics and mathematics for 100 years but most of them are unpublished and lost? Maike Lond:

> *This downbeat Manfred is a literary character who in terms of science is a failure. In that sense, he suited our concept, he never reached the end in terms of art or fully completed anything because he always felt some sense of melancholy or hopelessness in relation to his creations. He also never finished anything in the scientific sense but he was good at what he did in both art and science when he combined those two things. But in separate disciplines nothing extraordinary happened to him ... we found this type all together, at first it was just a name that started to grow a body and soul around it. I think that Manfred is "us" combined. (Ibid.)*

My next question concerned setting the goals. When we speak of strange questions or an irrational world view that is attributed above all to artists, we also see them in science. I used as an example the slogan on CERN's website: "What is the universe made of? How did it start?". (CERN 2015) Is the attempt to explain all of the world's issues at once not a bit odd? Maike and Taavet also believed that perhaps their endeavours resemble that a little. At CERN, photons are bounced and when they collide at a sufficient speed, a mass is created that is much greater than the sum of the particles. In a literary sense, it is the same that happened to MIM, it is a mass much greater than MIMproject's ideas separately. When bouncing people's ideas together, a mass is created that is much greater than single masses. They thought quite often about CERN when they set a goal to create a "levitating pixel" for their exhibition. Even though they had much less money to spend on it than the science centre – 23 euros (Maike Lond).

In a discussion about the working methods of science and art, their differences become evident – MIMproject's results, unlike scientific research, are almost never repeatable or confirmable, Maike and Taavet emphasised that more important was the moment when they happened. At the same time, I must add that at the survey exhibition they clearly referred to the retrospective aspect of these works – they revived for exhibition visitors discoveries and lines of thought created over 100 years (though fictitiously) that nevertheless indicates a so-called digging up of the old. Nonetheless, Taavet and Maike stated that in the future they will

not be interested in redisplaying these works because the majority was sent to the landfill after the exhibition was over. Also, there were not enough incentivising offers to present these works abroad – their redisplay would be a very expensive and time-consuming process that has made anyone interested quickly back off.

Maike and Taavet's activities are continuing just as ambitiously as the abovementioned art exhibition. The "Art's Birthday 2014: MIMproject & Lunar Sound" held in January 2014 – which they themselves called their own little CERN - constituted an artists' performance in which sound generated at the venue was bounced off the Moon, thus creating the biggest known echo machine (MIMproject).

Overall, what artists considered most important was that they never had the compulsion to create, everything is born out of free will and is not particularly limited by orders or deadlines. The showing of the retrospective of Manfred Mim's life's work at one of the most prestigious exhibition venues was also initially considered a joke by them because they did not believe they would be selected at all. They did not care much about our national art policy or the preferences of donors, in that sense I can consider this attitude a quite extensive and transdisciplinary artistic creation on an idea level in the best way possible. At the same time, they resolutely say their activity is not focused on the future because they do not have the stamina to "run along" with technological progress. They consider artistic creation to be an optimistic endeavour and decisively distance themselves from the so-called negative hackerism or dystopian future visions.

Figures 46: *Videostills of the exhibition "100 Years of the MIMproject – The Life and Work of Manfred MIM, 1920–2020" (2013)*

Figure 47: *Installation "Memopol-2" at Kumu Art Museum (2011)*

3.3 Artist-software engineer: Timo Toots
Summary of interview with Timo Toots, 10 April 2014, Tartu

Timo Toots is an artist and software engineer whose best-known work is considered to be the multimedia installation "Memopol", for it's second version "Memopol-2" he was awarded in 2012 the most substantial award of the new media art world, Prix Ars Electronica Golden Nica in Interactive Art (Ars Electronica 2012a).

Since the start of the 2000s, Timo Toots has engaged in photography and creation of interactive installations during which he has had to connect a multitude of disciplines related to technology and art. Free movement between different media is one of the biggest challenges and sources of inspiration that he points out in our subsequent conversation. Timo Toots is also involved in the creation of multimedia installations for Estonian National Museum.

One reason why Timo Toots first studied information technology could be the fact that he was born in a family of scientists – his father is a physicist. Thus, it was clear to him since childhood that he must work with technology. But it also became clear that advanced science does not interest him as much as technology and the interpretation of its nature in a social critical context. His own personality also had a tendency toward creative thought and did not let him stay long between the lab walls or deal with resolving narrow abstract questions. He became involved with DIY (Do It Yourself) who in his own words went down this path partially also due to the reason that the period (start of 2000s) did not offer many other broader or simpler opportunities.

While traditionally an artist is expected to have a certain level of drawing skills, Toots said that he was unable to draw, however he never really needed it either in his artistic endeavours. What was more important was the perception, while studying photography under the guidance of Marco Laimre at the Estonian Academy of Arts, of how important in the interpretation of creative work is the social environment. Also, free movement between disciplines and use of different media in implementing ideas. Speaking about technology, Toots said that the photo camera for him was more important than the video camera because the technological capabilities (start of 2000s) were somewhat bleaker in terms of video quality.

Timo Toots responded to my question about his potential position that he does not wish to force his endeavours into a narrow "box" of contemporary art, even though it may be important for communicating with the audience and generating broad awareness. But perhaps it is most important to understand the path of development for an artist himself as a society member. And it is exciting to look into the future, even though one must also deal with things that are happening here and now. To my question about the very long-term developments of biotechnology and bioart, he responded that it is more important to address things that are "here and now". These are also more comprehensible to art exhibition visitors than distant science news and utopian or dystopian future visions. It is up to the art exhibition visitors themselves to think, connect and create new knowledge. If artworks are incomprehensible to the visitors or contain negative messages, they will generally be unable to connect with them. A happy irony that arises from Timo's works is primarily related to viewing and commenting on the present time because he mainly lives in the present and media art will have continue to have sufficient subjects also for the next ten years. Here also it is possible to create interesting shifts that could give the art audience something to think about – he prefers to create specific works instead of engaging in complex theoretical discussion.

Toots responded as follows to my question on why, after all, is it so that an artist's endeavours are a hobby that mandates them to also do other work on the side:

> *It's the correct attitude! Because if they were together, creativity would suffer – a customer commissioning a project will inevitably set limitations on creativity. Also, using the Estonian National Museum as an example, it is important to take into account stability and relevance in terms of time that certainly is not required by a month-long exhibition. (Toots 2014)*

Toots also highly values the freedom offered by artistic creation – and he wishes to share it by organising various workshops in his latest exciting project called *Maajaam* (Station of the Land). It is not so much an artwork as it is the development of a creative environment in a rural area of natural beauty in Estonia that will encourage the creative people invited there to generate new ideas outside the urban environment.

I see this as evidence of a highly transdisciplinary attitude (*see chapter 4.4.2 - Transdisciplinarity*) – firstly, the use of technology is of another dimension there (3G and 4G mobile and Internet network spreading everywhere), secondly, the re-evaluation of the traditional role of the art audience. I.e., the audience will not be entering a gallery but will participate in art projects taking place in the middle of nature. *Maajaam* is not a place of "producing" art but an environment for promoting creative ideas that substantially differs from the lab or studio environment.

Toots emphasised in the conversation several times that he is after all a happy person whose interests and work are of the same nature.

The creations of Timo Toots have achieved wider international recognition thanks to his best-known work "Memopol–2" that was awarded the top prize Golden Nica at the Ars Electronica festival 2012 in the category of interactive art (Ars Electronica 2012a). He emphasised in our conversation that "Memopol" has undoubtedly opened several doors and continuously brought along new offers to participate in exhibitions, therefore it will never be completed – presentations around the world require the work to be continuously developed further because it is related to time and location specific Internet networks and databases, as well as information technology that is accelerating in development and requires persistent updating.

Toots is mainly interested in technology rather than a wider interdisciplinary collaboration between various disciplines, he focuses on a highly practical goal that seeks for answers to particular questions posed by him and finding the solutions related to the goal that has been set. Nonetheless, he said that above all he values open creative possibilities and pointed out as an example that Internet hackers operating in online environments do not define their endeavours as art, instead characterising them more broadly as practical implementation of creative thought processes. It is a curious paradox – whereas I have previously examined the issue that art needs no definition, such an approach would also eliminate the word art, replacing it with broader creative mindset.

Toots nevertheless compared such websites with art and drew a parallel with naïve art. He compared Internet-based creators with naïve artists. I do wish to assert that there is a principal difference here – naïve artists after all in my view created art quite purposefully, even though they did not wish to enter official art circles. Web hackers though principally do not view their endeavours as art, for them any kind of creativity, even the negative kind, is a matter of lifestyle.

When I asked about the situation of Estonian media art in general, Timo Toots mentioned a clear problem of communication. I.e. we do not know what others are doing, we lack a certain overview of general activity in this field. When I encouraged him to chime in on national domestic policy, i.e. the separation from each other of groups of society who speak different languages, he found that even though it is a notable problem that local communities are acting separately, media art asks far wider questions that do not have to significantly relate to the politics on the agenda. Even institutional membership does not have much of a role although education-based practice would assuredly provide certain opportunities to widen the circle of enthusiasts. It is the artist's responsibility to mainly perceive themselves, whether they belong to a different ethnic group, under a certain institution or acting independently. And in the context of Estonia, we should not examine the number of people engaged in media art quantitatively but rather the qualitative results.

Returning to the issue of bioart, when I asked Toots once again about the potential development opportunities for bioart in Estonia, he answered that is still not something he is currently interested in. I.e. he emphasised that there is not much difference between an artist working in a science lab and a DIYer because both are motivated by a personal interest in the subject. He did not at all rule out the possibility that he will someday express interest in biological lab work but only once it becomes relevant and also technologically real at the time.
His viewpoint was that he wishes to observe with interest, first and foremost, where the progress in free software and hardware leads us.

3.4 Robotic scientist Madis Listak
Summaries of interviews with Madis Listak, 6 January and 6 June 2014, Tallinn

I spoke to robotic scientist Madis Listak on two occasions. Firstly, I chose him as my conversation partner because we had worked together on a number of art events ("Holy Cow," "Hybrid Practices" and "Hybrid Practice – from General to Specific"). (*see chapters 4.3, 2.1, 2.2*) I. e. we have been collaborating in very practical level. Secondly, Listak served as not only technological adviser and executor but also an equal partner in the processes of thinking. Several of the discussions in the following chapters are also based on interviews conducted with him.

I asked what motivated him to collaborate with artists. Listak answered that it was above all an inner curiosity and a possibility to get his mind moving in a new direction and experience something new. But what kinds of similar aspects can be brought out in the activities of artists and scientists? Listak says being engaged in science is very similar to art in the fact that by people often proceed from impulse when they are looking for a new idea, topic or solution. What follows is already methodologically different and is subordinate to criteria for being engaged in science. Everything depends on whether we see the world around us from the standpoint of mathematician or philosopher.

In my discussion, I wanted to understand how to utilise science in everyday life; how I can better understand it as an ordinary person. Listak says that besides definite principles and rules, scientific inquiry also has a faith in authority (such as Newton), which is somewhat inexplicable because they do not lead to an absolute truth.

> *For instance, we would not be able to go from our homes to the shop using only mathematical and physical science... There are so many variables in real life that we can't predict and control, and thus, while this knowledge may be recorded in databases, we still can't manage to establish precise rules. The same goes for the anatomical view of humans. E.g. the human heart – we know how it works, down to the details, just like we do the stomach and liver. But how does a person as a whole work? Not all that much has been learned in this area. An explosion in permutations takes place, making it impossible to describe a complicated system using just one method. The other aspect is that the role of system components is constantly changing along with the quantity that must be treated medically. If a steam engine has a broken part, it will not self-heal. But a person can, and thus the description of the entire system has changed. The principal feature is the battle between two world views, which actually pervades all of society. The truth lies somewhere in between. And art could be one medium used to assemble these systems that either aren't compatible or poorly compatible. Moreover – following mathematical rules with exacting precision does not lead to new questions and knowledge. An accidental error or misunderstanding can spawn a new understaning, most ideas take shape through discussion and misunderstanding – this is the paradox of creativity. (Listak 2014)*

Listak finds that art is an important direction that allows things to be examined in another way:

> *What does art do? Art has two tools known in philosophy as well. One is that it generalises some facts and the other is that it highlights something ... if we look at some random muckup and then a painting that is considered important, the difference between good and bad art may be the fact that a good artwork omits the insignificant and has amplified important things. Art is not just a good painting or photography; thanks to its ability to generalise or highlight something, it is able to show us things from a new angle. This could be one role for art, and art could help bring various sciences closer to people. (Ibid.)*

As to form – creating art is probably cheaper than being engaged in science, but in today's science, we sense more and more administrative pressure for greater productivity and work speeds. In art, it is possible to experiment broadly, but scientists are very dependent on

funding and grant proposal writing. Apropos of this, Listak asks a justified question: maybe many things have gone undiscovered for this very reason? A second important aspect is marketing. For people at the biorobotic centre, the "Holy Cow" project was originally a marketing project, some new thing far removed from science. But in the big picture, it made the centre exciting for students, who are an important resource for any research centre. And in even a longer term perspective, the cow would open up new research directions with regard to the exciting tangents between robotics, sociology and psychology. (Listak 2014a)

Summing up, Listak's advice to scientists was as follows: the main thing that scientists have to learn from artists is how to rapidly prototype their ideas, get feedback as rapidly as possible, and not to allow too long a idle period during which they may not even discover anything. (Listak 2014a)

3.5 Marine biologists Inga Lips and Karin Ojamäe Summaries of an interview with Inga Lips and Karin Ojamäe, 21 January 2014, Tallinn University of Technology Marine Systems Institute

I chose Inga Lips (senior researcher, director of marine ecology lab) and Karin Ojamäe (junior researcher) as my interviewees because I had collaborated with them on the exhibition "Hybrid Practices – from General to Specific." (*see chapter 2.2*) Besides exchange of marine biology related knowledge and developing the exhibition idea together with me, they provided a substantial contribution to practical preparation of the exhibition, cleaning and documenting the water samples I had collected and allowing me lab time for working on the exhibition.

What does "interdisciplinary" mean for biologists? Above all that algae, which were being examined in this case, are a part of the surrounding environment that must be treated through different branches of science – such as marine ecology, meteorology, genetics, and molecular biology.

The exhibition we participated in together had been the topic of several discussions at the Marine Systems Institute. Scientists believed that the most important thing was to be visible outside the walls of the lab. It is understandable that people want to see and touch things, the direct communication with people offered by the manifestation is important. But what took place in the art gallery was more of an experiment in human relations and education, not so much science itself. It was also an experiment in the sense that we saw how microalgae survive outside the lab.
The exhibition hall can be entered by one and all, but unauthorised personnel can only get into the lab when they have a reason to go there – they have to incite interest in the researchers. There has to be synergy, an understanding that together something new and exciting will be born. When we discussed on the topic of what alternative explanations and the wrong views of science could lead to, Lips opined that scientists do not all publish their results, and thus she didn't find that science could use an outsider for the wrong purposes. Growing algae and other cultures in a test tube has its own rules that may not be transgressed. It's another matter that many technological means and materials are readily available online, but this can't be controlled by artists or scientists.
If I bring up the SymbioticA Lab, where scientists and artists meet to pursue cooperative work, I encounter a certain perplexed attitude – scientists are rational minded and find that such activity should have quite definite goals. Their question is whether it is really necessary to get together and philosophise?
As for definite goals – technologies for application – scientists do not believe that it would be possible to survive on algae, e.g. using them for food, because the human body has evolved on the basis of a different energy programme. The same holds for biodiesel – it could be theoretically possible but practically it hasn't yet succeeded.
In discussing division of specialised competence, it turns out that scientists are very open, they are motivated to share knowledge with artists as well. At the same time, both interviewees note stress that what is important about their work is not so much observing algae but seeing how they act in water, the whole process as a whole. Even though they concede observing algae is also extremely enjoyable. (Lips, Ojamäe 2014)

3.6 Observations and conclusions

Through previously described conversations I held, I received many answers to my questions about the current situation of the Estonian new media and artscience. My selection of conversation partners was made based on the desire to find the brightest examples from whom we could learn in our small country.

From the conversations, I provide the following ideas:

- The prevailing trends in Estonian media art closely follow what is happening abroad – development of free ideas, wider practices of theoretical and experimental science, as well as DIY movements that must yet to be mapped due to this rather arbitrary development and that depend little on national borders (Timo Toots);
- In the Estonian context, collaboration between science centres and artists is at quite an early stage – collaborations arising from knocking on the door have reached remarkable results. A small society also enables suitable partners to be found using personal contacts (Kärt Ojavee). At the same time, interdisciplinary programmes established on an institutional level do not assure productive collaboration. Thus, so-called spontaneous creative associations arising from necessity also have a very important role (MIMproject);
- Science and art has a lot of questions to resolve at the present time or retrospectively, thus my questions about biology as a potential future direction for hybrid forms of art remained on a somewhat hypothetical level because all interviewees emphasised the importance of the current problems;
- Estonian media artists undoubtedly have a great need to place themselves in a global context – though it is not an end in itself, it is important to be "visible" in scientific research, as well as in the wider art perspective, i.e. extensively present your work here but also find outlets beyond our national borders;
- The blurred criteria of artscience enable this to be viewed in the context of both applied and visual art, feedback from foreign exhibitions can be much more substantial than from Estonia (Kärt Ojavee). It is a direct indication of the lack of this kind of practice in Estonia. This, however, can only be promoted through practical work that the author of this study has undertaken to accomplish;
- Scientists are open to new ideas and taking part in intriguing projects if they yield practical benefits for the scientists – communication with science centres, also new ideas and questions are important to open the new possible perspectives (Madis Listak, Inga Lips, Karin Ojamäe);
- When it comes to generating new ideas, it is important where perspective is placed. So are possible errors and new kinds of questions that aren't governed by rules and provoke to find "different" kinds of thought trajectories (Madis Listak);
- The main thing that scientists could learn from artists is how to better and faster convey ideas to the public, how to get feedback that is as salient as possible and not to be idle too long, in a state where nothing is discovered. (Madis Listak)

To sum up: what is unique about Estonian hybrid art practice, what could be highlighted on the basis of the abovementioned interviews? First of all, Estonia is a small country gripped by exciting internal developments – in the sense of technology, many research centres are connected to major international centres. Secondly, collaboration between scientists and artists is simple in the organisational sense, because contacting researchers is not hard – everyone knows one another. Thirdly, artists need to aim their activities outside national borders because this is the only proper way for wide distribution of their inquiry. And the best examples of domestic high technological and scientific competence already exist; it's a separate question of whether and how they could implement international cooperation so that Estonian artscience would reach the international stage. Here Estonia's experience could be compared to that of neighbouring Latvia, where a number of significant international events have come into existence at the initiative of the new media art centre RixC in Latvia (RixC 2015). Unfortunately for Estonia, there is currently no specific new media centre and artist-scientist initiative at this level, although in the recent past the Estonian Academy of

Arts E-Meedia Centre and the Centre for Contemporary Arts Estonia have held a number of trailblazing events (such as Interstanding 1995, 1997, 1999, 2001). I nevertheless find that precise description and archival of activity in the field of new media art lies ahead. One key problem is probably material possibilities as well.

3.7 Future studies

The future progression of my dissertation is related to both the theoretical research and personal art practice. The collected material (archives, interviews and articles) enable me to continue to analyse the intersections of science and art in even more detail (writing articles, and monograph about the Estonian context in artscience development). Additionally, I wish to use the acquired knowledge to investigate more closely the collaboration between scientists and artists in Estonia through my artistic practice. One of the more specific aims is also related to organising workshops and collaboration programmes between our science centres and creative groups. Secondly, the potential future endeavour is also the continuation of the "rhizopian research" subject and events related to this term (Valk 2014: 33–44).

There are several reasons for future endeavours, in the Estonian context I am mainly motivated to act due to the need for clearer objectives, expansion of opportunities and educating the audience. On the other hand, I see from practical experience that the science centres are more open than ever, hence there is a favourable opportunity to use these resources. To date, my practical experience has mainly been based on personal contacts and in the small society of Estonia this model continues to work, but I am more interested in initiating relevant collaboration programmes, creating new groups of enthusiasts, initiating important discussions related to art and science.

In my practical work I will continue in the field of marine biology because it is one of the areas that have inspired me most in studying science. It is also most directly related to the bioart genre that I am interested in and I consider it crucial to widen its appeal in Estonia. While bioart is a rising trend elsewhere in the world, it is still barely worth mentioning as a genre in Estonia. I find that knowledge about biology and microalgae as well as their potential future uses is a practical task that should be investigated by both scientists and artists.

Conclusion about future studies:

- Writing a monograph on the subject "Art and Science" in Estonian context;
- Organising workshops and collaboration programmes in Estonia;
- Potential next "Rhizope" exhibition/conference;
- Continuing solo exhibition practice;
- Popularisation of artscience and bioart in Estonia.

4 ART AND SCIENCE IN ARTISTIC RESEARCH

4.1 Science, technology and the socio-cultural context: *optimising the complex*

Philosopher John Dewey says the following about modern science:

> *Science represents the fruition of the cognitive factors in experience. Instead of contenting itself with a mere statement of what commends itself to personal or customary experience, it aims at a statement which will reveal the sources, grounds, and consequences of a belief [...] In emancipating an idea from the particular context in which it originated and giving it a wider reference the results of the experience of any individual are put at the disposal of all men. Thus ultimately and philosophically science is the organ of general social progress. (1980: 239)*

Through radical changes that took place in science itself at the start of the 20th century, the realisation has been reached that using the long-established principles of science as basis is only one of the possible solutions for learning about the nature and the world.

> *Physical scientists until that time had believed that mathematics and physics can be verified: in the first case by using the rules of mathematical logic, in the second case only based on empirical observation. However, in 1931, the Austrian mathematician Kurt Gödel published his incompleteness theorems, according to which even a very simple mathematical theory can include statements that are impossible to verify. Around the same time, quick progress in quantum physics took place, forcing many physicists to revise their thinking about physics itself. It was found that it makes sense to use in future research simplified models that are not interconnected logically-mathematically, also taking into account ideological and aesthetic aspects. (Hektor 2012)*

The physicist and Nobel Laureate Ilya Prigogine (1917–2003) also points out the acute need for changing the research and evaluation criteria of the world as a self-organising system with irreversible development. Examining the world solely from the artificiality standpoint without taking into account cultural and social changes is not very helpful in connecting the two cultures, science and art. He asserts that science traditionally examines an object through the subject or scientist's building of an artificial world inside the real world and thus an Aristotelian holistic approach is absent, which ought to be implemented once again on a new level. (Tucker 1983) An anti-naturalist research method distinctive to natural sciences however leaves out a large part of natural sciences themselves.

Thus, it is the narrowly focused creators between whom it has been astonishingly difficult to establish communication. Although the need for comparing ideologies, potential or partial combining or blending of research programmes has been mentioned a lot in modern times, I have to say it does not work particularly well in practice. In other words, through art projects examining science it is clearly seen that the so-called home discipline dominates, next to which the other involved disciplines remain in the background or wither and it is hardly real blending.

How can an artist understand and apply the potential contained within the "precise language" of science and apply the approaches of humanities and physical sciences in his or her practical work so as to bridge the gulf of mutual failure to understand and take equal care to account for all disciplines that are included in his or her artwork?

Dealing with complexity inherent to hybrid practice

By contrasting (or rather comparing) scientists and artists, there can be found from both sides views according to which the efforts and actions of the other side seem complex to them. There is a fundamental reason for it. While scientists are confused about the issue of subject because they generally do not deal with it in their work, artists are confused about the in-depth knowledge of scientists, delving so deep into the objects that for the outsiders such studies are years of thematic research away.
But modern times force us to expand our approaches, whether they are simple or complex. It is simple to think on a basic level that a world view consists of many components and we must be able to position ourselves in this whole but it is complex to apply this knowledge so as to create any new values based on it. It is clear that science tries to clarify things, simplify them and ask new questions. At the same time, it could be said that art also attempts to separate the important from the unimportant, to abstract, create something unique, initiate broader discussions, be visible and understood also in the societal sense.
What is complex in both cases, however, is that neither of these approaches is suited to describe the world and the whole truth. Neither qualitative studies nor quantitative experiments, statistical data analysis, in-depth studies, great generalisations and "reasonable" or rational approaches lead us closer to how we should actually proceed. One reason is definitely the changes that occurred in the scientific progress described above that decisively separated the physical sciences and humanities, their logic, methods and distinctive characteristics.

I once again return to the conventional approach to science and technology, providing a shortened excerpt from the interview with Madis Listak:

> Me: *[...] when the word science is uttered, the broader public is of the view that physics is above all. Today's science began from the laws of Newton.*
> Listak: *They say it because at times physics gets so complex that perhaps only a few hundred people in the world or so can understand something like a superstring theory, for example [...] At the same time, the string theory has no reasonable evidence or experiment that would confirm it. There is faith and faith in science is one type of faith, if you look at it this way [...] All of this scientific knowledge has this feature that they apply from one boundary to another boundary and as to what is outside that boundary, we are unable to say whether it is the correct or incorrect knowledge because we simply do not know. But regular people do not understand that and think that if a scientist says something, it must be true [...] If, however, another scientist later says the opposite, they will get confused [...] Scientific knowledge also has some kind of rules – the result must be repeatable [...] Also, in case of a good scientific result you should have some kind of a theory of why it is like that, then you can claim – this is science!*
> *But with such scientific knowledge and methods could not be used, for example, to go from our home to the shop [...] I, as a robot builder, can say it – it is very hard to do, i.e. adapt a robot to the real world. And to try to do it so that using mathematical logic they would be sufficiently intelligent [...] As there are so many variables in the real world that we cannot predict or control, we could write it down somewhere in a database but it is very hard to create such rules, even based on statistical data it is very difficult to mathematically prove why for example self-driving cars and self-flying planes are capable of working. (2014)*

I here continue the discussion on technology as one of the key phenomena of our time. On the one hand, technological progress and its main goal – extending human life and simplifying human existence – has been the "holy grail" for decades, on the other hand we could ask: what does this give us in terms of understanding the world as a holistic system?

> Listak: *[...] one article discusses the computer pioneer Konrad Zuse (Schmidhuber 2006). The issue what the man thought like this: we know that we can build quantum computers that work with elementary particles. Using elementary particles we are able to transform information into 1s and 0s, which is how regular computers operate [...] He attempted to count how many elementary particles exist in the Universe. He obtained a number, it was* 10^{92}*. Then he asked the next question: if we could view*

> *all of these particles as one large quantum computer, it would be interesting to know how many operations this computer has performed since the Big Bang? And then he obtained the other number, 10^{122}, it was the next colossal number, a little bigger than the number of elementary particles he found. And then finally he asked – but what does this computer calculate? But that was something he was unable to answer. (Listak 2014)*

Indeed, observing the previous line of thought, it seems like the research has no "reasonable" aim that a researching scientist in his level of concentration may not take into account. Simple becomes complex because the world examined in this line of thought lacks the dimensions containing the information, time and relations in existence everywhere.

Ever since contemporary science come into existence, the question of the interrelationship between naturality and artificiality, which I also addressed in the previous chapter, has been important in scientific research.

Contemplating over this duality in the modern day context, it would be important to point out the idea of Italian media theorist, writer and educator Pier Luigi Capucci. He argues that artificiality and naturality cannot be considered polar opposites (1993: 3). This sounds somewhat different to the idea of Prigogine I referred to earlier that scientific research is building an artificial world inside the real world, according to which still two different worlds exist. Capucci asserts that we cannot explain issues of the world only from the human viewpoint – based on theories, technologies and artefacts. This is a mistake that both physical sciences and humanities make by excessively basing their analysis on the human world as a provider of the viewpoint, benchmark or creator of culture. As the human-centric world produces artificiality, it is in fact also produced by the nature, thus technological progress can be considered as one type of evolution. Each organism and type produces artificiality, it is a result that occurs between the present and the future, in that sense it constitutes one world. Capucci says the following:

> *The dimension of the artificial is pertinent to all living species because the reasons which form the basis of this dimension are the same: to cut out an individual ability to survive, an individual existential dimension, within the environment and to tend to improve it (1993: 3).*

One might nevertheless to think that survival can only be one objective in learning about the existential nature of the human and the whole world. However, the technological progress can also be considered to be a growth process (an evolutionary process) that increases in complexity.

The singularity model of USA computer scientist, inventor and publicist Raymond Kurzweil, widely criticised by scientists, talks about a technological evolution, future development of the computer world and the birth of an artificial superintelligence. He lists a number of reasons derived from the observation of the process of technological progress of why we ought to believe that artificial intelligence will soon achieve dominance in our world. His idea is based on calculations related to evolutionary progress that he compares with technology development. Kurzweil is therefore claiming that biology and technology have comparable evolutionary processes. (Kurzweil 2005)

While the first stage of evolution DNA (RNA) took billions of years, the development of the world after the Cambrian explosion already happened in consideration of prior information. Hence, the evolution of animals took 200 times less time. An even faster stage of development followed, the so-called biological revolution. Kurzweil argues that technological progress is also based on the preceding information. The first stage of technological progress took tens of thousands of years – tools made of stone were created, the fire and the wheel were invented. But it took many-fold less time to invent the printing press. I.e. acceleration is notable in all processes. It took half a century to adopt the telephone but mobile phones were adopted in only eight years. He brings out another important aspect in this context – (computer)technology progress is accompanied by very rapid drop in prices. Ambitious future theory, which has been subjected to abundant criticism from scientists, is hard to define – it has been called science fiction as well. But in this context, it is the bold perspective that is important, as is the author's ability to tie together fields that are not considered in the sense of traditional science to co-exist. (Ibid.)

But "predicting the future with a ruler" has a principal fault – it does not take into account the fact that the world and the human do not stand still. People's mental capabilities are in a constant state of change, people themselves (partly also because of technological improvement offered to us by information technology) are constantly changing. (Listak 2014)
There is nothing inherently wrong about explaining the world through the terminology of cells, molecules and atoms or mathematical formulas but a fact that could prove to be a serious impediment to scientific progress is the fact that it does not correspond to our society's cultural expectations, in addition to the time factor there are several important societal, social, political and economic processes.

Professor of cell biology at the University of Tartu, Toivo Maimets, in his conversation with Veronika Valk has pointed out the following idea:

> *We could deal more with processes and dynamics than concrete elements ...*
> *For instance, more and more data are being gathered about hereditary effects not encoded in DNA. It's possible that one day DNA-based genetics will prove an exception to the general genetic theory, just as Newton's model of the universe turned out to an exception in physics. (2012: 202)*

How, then, to understand science, define it according to its era, if we must continue to deal with problems concerning the more detailed explanation, classification of our own objectives and resolution of specific problems? And how to find new questions that are scientifically substantiated and also scientifically and academically accepted? How to connect different systems rather than handle them separately, which still fail to tell us much about the entirety of human existence? When talking about creativity, an important component in creating contemporary scientific knowledge, Listak brings an example of expert systems in exact sciences. He says the following:

> *I noticed one such fact that when I try to write a system using mathematical means where all rules are consistent with each other and I can categorically deduce that all assertions are correct, the system does not contain false assertions, then such an expert system is incapable of creating any new knowledge [...]*
> *There are no contradictions. (Listak 2014)*

In other words, the application of creative problem-solving that is becoming widely used will bring us these contradictions that we need for the formulation of our research questions and our future work. When Albert Einstein was asked how scientific discoveries are made, he responded that everyone knows that if something is impossible, someone will emerge who is unaware of that and will make a discovery. Fortunately, we continue to have these "unaware people" today. Art, according to Listak (2014), should be one such medium or resource for connecting systems that connect poorly or not at all with each other.

From the previous line of thought, it can be concluded that art does not only offer science its own abstract vision but also offers a "mistake", "asking an incorrect question" that the expert system does not recognise and that prompts the need for asking a new scientific question.[15] The principle of a creative solution to a problem may also arise from a mistake, different interpretations of one question and differences in comprehension, the absence of important resources for work and research or the ignoring of an existing expert system. It is a paradox of creativity. And science, having had a privileged status until now, must take it into consideration.

Guided by somewhat widespread opinions of speculative nature (which despite their ubiquity have a somewhat speculative nature) that scientific work should feature ALL directions and phenomena that we perceive, we should nevertheless be cautious in terms of organising knowledge.

Why do we not include esoteric and paranormal phenomena in scientific work?
Because **a)** they have not yet "matured" to the extent necessary, hence they may reach fatalism, randomness or chaos in their development, **b)** any knowledge that cannot be substantiated is non-scientific knowledge, veritable knowledge must be related to a potential rational explanation arising from practical activity. (Kaevats 2009)

But is it really like that? Assuming that in addition to studying the object, subject or the relations between them, important factors include also time, process, system dynamics and information, we cannot unfortunately only be guided by rational proof. It must be also considered that the fact that science itself has substantially changed – if we look at university studies and societal requirements as an example, we see that new courses and disciplines are added all the time, combining fundamental knowledge according to broader requirements. The rector of the University of Tartu, Volli Kalm, emphasised in one of his interviews with ERR (Estonian Public Broadcasting) in 9 April 2014 that the need for seeing new perspectives is in a direct causal relationship with differences in people's intellectual traits and the knowledge that the technological world is not capable for everything after all. We can already see exciting combinations of collective and highly practical objectives of disciplines – e.g. combination of chemistry and architectural restoration, collaboration between the medical field and information technology, combining geopositioning with territorial planning, involving designers in creating complex technical systems, etc. All of these (and many others) are new subjects; according to Kalm the fundamental knowledge obtained from traditional sciences, especially physical sciences, are nevertheless of major importance.
However, if we instead contrast scientific knowledge or verifiable knowledge and non-scientific knowledge i.e. unsubstantiated and unknown, we needlessly declare several very important questions as taboo. Hence, we must also take into consideration as lines of thought the questions that at first cannot be defined from a verifiability standpoint.

What is complex and what is simple in science? And how an artist can approach science? It can be proceeded from Max Weber's view. He poses quite a direct question about the practical value of research: What positive aspects does science give us for practical and personal life? First of all, science develops the techniques for mastery of life, both with regard to external things and people's actions – and this technique is calculation. Secondly, science develops the methods for thinking, leading to professional skills and training. Third, science leads us to clarity and value. Science must be "supplemented" by ethics, philosophy, art and religion. (Weber 1918)

The establishment of such a hierarchy is undoubtedly a question of viewpoint because both sides complement each other and they must be addressed as mutually complementary, not as prior and subsequent phenomena in scientific work. In other words, exact sciences is not something that offers humanists only "calculations" and art is not that only deals with evaluating value systems or the visualisation or dissemination of science – the perceptive characteristics of exact sciences and humanities are the same.
It is simple to divide research of the world into different units but it is complex to view it as a holistic system enabling thinkers who "speak different languages" to reach a collective result. In addition, a viewpoint that describes well the collective objectives and outcomes. Both – art and science – aspire toward optimising and levelling knowledge through approximation, even though they contain attitudes, methods and instruments for presenting complex acquired knowledge. Orkan Telhan, a Turkish-based artist and designer, who visited Estonia in the year 2013, said in his interview with Veronika Valk:

> *I design approximations. I have borrowed this term from a well-known synthetic chemical biologist, Luigi Luisi, who considers most research on artificial life – such as human-made equivalents of DNAs, ribozomes, protocells – to be synthetic 'approximations' of life. By calling something an approximation one often assumes that it is about mimicking what living things 'naturally' do. Biological design is about mimicking the 'real' thing – the synthetic cell tries to mimic the real cell and so on. Some branches of science might be focused on replicating nature, but design can be about imagining what lies beyond the natural life if certain realities are suspended or re-interpreted. I think of design as a way of knowing. Design for me is a pathway to knowledge – again not to explain how things are but rather how else they can be considered. Many designers pose the question: "What if?" today. "What if we use this and that in a different way?" I rather prefer the question: "What else?" (Valk 2013)*

4.2 Collaboration between Art and Science: *Common goals*

> *Science gives us order in thoughts, morality gives us order in actions; art gives us order in the apprehension of visible, tangible and audible appearances (Cassirer 1997: 243).*
>
> *There are no topics that remain inaccessible to the formative energy of art [...]*
> *One of the biggest achievements of art is that it helps us see everyday things in their real nature and the right light (Ibid., 229).*

In this chapter is intended to raise questions related to collaboration between artists and scientists from the perspective of a visual artist. Such collaboration can be thought of as a general paradigm shift in the modern society but also by focusing more narrowly on set goals. One very common assumption about the activity of these fields could be the following, schematically described:

ART ASKS QUESTIONS <=> DESIGN SOLVES PROBLEMS <=> SCIENCE PROVIDES ANSWERS

The quote at the start of the chapter states that art shows us everyday things in their "real" light. This could mean the primacy of humanities and physical sciences as "assistants" in seeking answers?
The diversity of contemporary interpretations and activities enables to argue against such categorisation. Indeed, in these developments we can undoubtedly also note the often unconscious attempts by creators of culture to imitate the epistemological foundations of natural sciences but what is most important for all parties is the complete understanding of the described world. (Reill 1994) Neither party will probably agree to the underestimation of their role – it cannot be that the scientists' work is regarded as only giving answers that can be retrospectively verified to strictly focused questions and the artists are portrayed as mere visualisers of scientific accomplishments.
Therefore, I dissect the entirety through an approach based on creative practice, a manner that applies to more or less all scientific and creative practices. This could be described schematically as follows:

THINKING <=> SEARCHING <=> DECIDING

This course of action enables methods of both physical sciences and humanities. The entirety can be addressed as follows:

1. analysis by fragment;
2. as well as by its compounding or disintegration; through aggregation and/or separation of particles;
3. through the symbiotic relationship between 1. and 2.;
4. through a novel approach.

Thinking, research and drawing conclusions (or finding solutions) are applicable to everyone seeking for new scientific knowledge. A programmer thus justifiably thinks that their work should not be underestimated; his creativity, i.e. writing code does not in fact differ much from telling a literary story or creating an artwork.

In other words, creativity and creative practices are what incite:

- the asking of new questions;
- asking for new possibilities and methods that lie outside the fields we engage in ourselves;
- find solutions for which a rigorous scientific way of obtaining proof may not exist but that are of a pioneering nature;
- involve so-called "external observers", i.e. partners from outside a specific discipline.

Based on interviews conducted with scientists and artists I provide some opinions that both artists and scientists have voiced regarding the complementing of each others' work.

Artists' role in collaboration with scientists is to:

- ask questions expanding scientific approaches;
- ask questions that differ from the opinion of scientific expert systems;
- ask "wrong" questions, thereby indicating the obstacles that a researcher deeply focused in their own discipline may not perceive;
- publicise and interpret scientific messages, be the so-called demystifiers of science;
- pose questions within the discipline, between disciplines or before the broader public about the ethics of science and culture;
- be the catalyst in creating a new situation to research;
- thereby create opportunities for cultural and scientific development in terms of a more united approach to the aggregate.

Scientists' and engineers' role in collaboration with artists is to:

- invite artists "down to earth" from their grand visions, i.e. restrict grand ideas to problems that can be narrowed down and resolved;
- show the option that "verifiable knowledge" can be an important link between artists, scientists and the broader public, i.e. general understanding starts through the precise definition of the problem and mapping of potential working methods;
- show that the result may also offer a completely functional solution in addition to the aesthetic experience or raising new questions with inchoate boundaries;
- interpret artists' ideas in the name of scientific knowledge, thereby finding new research questions;
- be the catalyst in creating a new situation to research;
- thereby create opportunities for cultural and scientific development in terms of a more united approach to the aggregate.

Both artists and scientists are working towards knowledge, after all, be it expressed through or resulting in a cultural artefact, event or new finding, system, methodology or discipline.

> *Art and science are both manifestations of the human drive for knowledge; they provide their practitioners with a feeling of resonant connection to the complex processes that underlie our environment. And though they ultimately express a different view of the universe, they aren't mutually exclusive—rather, they mirror each other in fantastically interesting ways. We live in a moment of unprecedented change in the way that both art and science are practiced, and those changes are happening in parallel with one another. How we adapt, collaborate, and express our changing environment may ultimately reconcile the "two cultures" and turn us on to a new level of engagement with our hypersensory, interconnected, and evolving world. (Debatty et al 2011: 9)*

How actual collaboration manifests itself, what ideas and results this collaboration has in terms of culture and science or more broadly in terms of the society can be studied by observing actual activities?

Here it should be noted though that the aim of collaboration is above all to create something new, not a categorisation by scientific field or technology, or defining art through that:

> *The qualitative difference between art and science does not simply consist in using the latter as an instrument for knowing the former. The categories employed by science stand in so obtuse a relation to the inner-artistic categories that their direct projection onto the extra-aesthetic categories inevitably wipes out what the investigation was supposed to explain. The growing relevance of technology in artworks must not become a motive for subordinating them to that type of reason that produced technology and finds its continuation in it. (Adorno 1997: 264)*

4.3 Differences and similarities of the results: *Question about prototypes and scientific/useful models*

> *Beat Gerber, our main partner in the artists-in-labs project, suggests that an artist can be a catalyst and liberator for science [...] He suggests that collaboration would create many interesting synergies and perhaps produce answers which conventional research might not be able to find, as both artists and scientists work in the area of possibilities. (Scott 2006a: 7)*

The impetus for writing this chapter is the understanding that even if an artist carries out their work in a science lab, the result of their work will be different from the results of scientists' work. The most existential differences lie in the raising of questions and in the precision of resolving them, the time spent on research and development and the repeatability of the result. Therefore, I notionally classify the results of artists' work as prototypes and the results of scientists' work as scientific/useful models.
I first approach the issue through personal practice, after which I search for an answer to the question of whether results are after all as different as we deem them to be in theory.
I also provide the stereotypical understanding of the difference between science and art, the interaction between science and art and how I find additional dimensions to it through practical endeavours. This chapter was written thanks to my collaboration with scientists of the Centre for Biorobotics, TUT, and an extensive conversation with robotic scientist Madis Listak. (2014a)

About the purpose and time. Robotic installation "Holy Cow"

I use as a basis my first practical experience I gained from working at the Centre for Biorobotics at TUT. The project was the "Holy Cow" robot, created in collaboration with Prof Maarja Kruusmaa and robotics engineers Madis Listak and Jaan Rebane in 2010.[16]
The purpose of creating the robots was to conduct an urban event, its substance was the humorous commentary of scientists and artists to the politics then on the agenda – exchanging Estonian kroons for euros. We developed the robot concept together, thus it was not merely my undertaking as an artist but rather a collective desire by an artist and scientists to express themselves through an art project.
Already by nature this robot did not have a lot to do with advanced theoretical science, scientists also did not approach it as a science project. However, the adventurous will of the bioroboticists to publicly show their work this way and contribute their time and material resources into this project was quite unique. Hence, one could say it was an interdisciplinary work already at the initial stage. It also included art practice in addition to the joint development of the concept (my work in creating the sculptural object), engineering (development of the technical portion of the object) and wider public action and notification. The work process took the whole of 2010 that was a sufficiently long period for an artist but quite short for scientists. Why? Speaking of results, I notionally classify the results of media artists' creations as prototypes, scientists' works however as clearly defined results corresponding to scientific models. This is the black-and-white belief that forms the starting point of this discussion, not however taking much into consideration in the way of differences between the aims of visual and applied art or theoretical and experimental science.

Nonetheless, by simplifying the question one could state the principal difference between the results of art and science – in the former case, frequently fragile, little tested and poorly, unstably functioning systems are developed in order to rush them for publication. For these, the presentation of a fresh idea and the precise timing of its publication matters more than reliability. E.g. in the given example, the period when Estonia joined the Eurozone was important (1 January 2011). In the case of scientific work, however, the wider public is not that important, testing takes a long time and the end result or work process itself is devoted to developing a reliably functioning end result or resolution of a so-called scientific model or developing a useful model. Deadlines are certainly important but these do not depend as much on events taking place, politics on the agenda or surrounding societal and social processes.

***Figures 48:** "Holy Cow" project (2010–2011)*

In creating the robot cow, scientists also came out of their comfort zone and we spent the last days intensely working towards a common goal. We transported the robot in the morning of 27 December somewhat hurriedly to Vabaduse väljak (Freedom Square) in Tallinn where we organised an urban event (Piirma, Centre of Biorobotics 2011). Here, completely different aspects came into play than scientists experience in their day-to-day work – social participation, a lot of cameras and journalists, even manipulation with public notices, also the fact that on that date, i.e. three days before Estonia officially joined the Eurozone, it constituted illegal currency exchange. This prompted Eesti Pank, the central bank, to hold a long meeting in order to reach a definitive decision regarding us. They later described our actions in their book "*Euro tulek Eestisse/*The Launch of the Euro in Estonia", demonstrating the fact that they nonetheless saw our actions in a positive context. (Kell et al 2011: 86)

In our conversation with Madis Listak we analysed our collective work precisely in terms of this result and practical benefit. He pointed out a very important fact that binds the results of art and science together – in science also there is pressure to produce quick results and be publicly visible, it is a reality today. And this was also an important catalyst for the described collaboration that took place. A wide-ranged and at the same time cheap experimentation is what science could learn from art. Developing the robot sculpture was for scientists a challenge that provided a new dimension to their activity because in addition to public interest, producing attractive outputs for science centres has another goal – attract new students to the centre who will thus realise that lab work does not have to be a boring years-long process to figure out a narrow problem. As the Centre for Biorobotics was at the time a rather recent initiative, it needed publication in every way. Listak also adds that later the robot sculpture has been a good presentation exhibit in various events held at the university, for example it has also been presented to the Commissioners for Science and Research of the European Union.

Setting goals may indeed be different according to the stereotypical belief – artists present visions and commentary without fixed criteria of development, the work process is impulsive, rash and very multi-directional, scientists on the other hand present thoroughly developed and extensively tested results. For artists' work, often the only milestone is the time of the exhibition or art event and the preceding work process cannot be tied to a fixed schedule. Scientists, however, work according to a fixed plan – setting the purpose of the work, research, development, testing, publication and description of results. Listak emphasises the side of experimental science where development of little-tested prototypes can be even quicker and where publication is equally important as in art. He also introduces the idea that even if at that time scientists did not classify our robot sculpture as scientific work, it would have enough substance to reach very new and unique special disciplines of robot science – e.g. the blending of robotics and psychology or robotics and social science. These could have been exciting subjects of research that unfortunately were not pursued due to lack of resources. Generation of such borderline research projects is certainly a new and exciting direction that is attractive both in terms of funding as well as broader research.

Science-art comparison and interactions

One potential stereotypical diagram is introduced by Jill Scott in the book Artists-in-Labs, according to which she characterises science as cold and hard, art as warm and soft. This opinion assuredly also influences work results (2006b: 26).

COLD/HARD/SCIENCE	WARM/SOFT/ART
Reliable	Mutable
Well-defined	Ill-defined
Comprehensible	Not comprehensible
Sharp	Flaccid or spongy
Precise	Imprecise
Difficult	Easy

On this diagram we see that opposite keywords are used. I do not wish to analyse all these terms one-by-one here but in such classification the most perplexing is the last comparison whereby science is difficult and art is easy. It is obvious that the authors of the diagram have based it on the artist's position, a better understanding of the nature of art. Still should be asserted that art is not at all about simple concepts or solutions because art due to its indeterminate nature renders it instead more complicated than one may have thought. The deficient evaluation criteria also reinforce my opinion. Hence, this diagram is simplified and incorrect, also in the context of interdisciplinary and transdisciplinary collaboration practices I clearly see that such a black-and-white view cannot be considered as an absolute truth. (*see chapters 4.4.1 - Interdisciplinarity and 4.4.2 - Transdisciplinarity*)

From my experience in practical collaboration I can say that almost all those provided terms are interconnected, therefore I present my own idea based on Scott's diagram and my latest artscience practice.

COLD/HARD/SCIENCE	WARM/SOFT/ART
Reliable – *mutable for wider audience*	Mutable – *reliable for art society*
Well-defined / *area of many possibilities*	Ill-defined / *area of many possibilities*
Comprehensible – *not comprehensible for wider audience*	Not comprehensible – *more comprehensible for wider audience*
Sharp / *new undefined questions*	Flaccid or spongy / *sharp in terms of art audience*
Precise / *new undefined questions*	Imprecise / *new undefined questions*
Difficult – *easier to understand*	Easy – *difficult to understand*

In this context, Listak reiterates the art and science separation problem. He clearly sees that the so-called foreign field is "cold" simply because it is unknown and has not been sufficiently focused on. Nonetheless, in spite of separation of fields there are people who understand these fields as coexisting, both among artists and scientists. In other words, the border is not between fields but depends on personal understanding by people. And these subjects should be taught as coexisting already from primary school because a forced choice is the biggest mistake in the history of humankind. Even though an inevitable time constraint does not allow us to sufficiently focus on everything, we must understand that all of science starts and ends with philosophy, it is a thought experiment or speculation containing personal choices and also a so-called gut feeling or deep personal experience that allows very thorough and extensive research projects to happen. (Listak 2014a)
Returning to the issue of scientific models and prototypes, can say that in addition to the difference in time spent on the end result, another important difference is in the audience, the so-called end consumer.

When an artwork is made public, regardless of whether it is presented in a gallery context or other public space, the audience will accept mistakes, unpredictability and rashness. In a gallery, the idea is accepted rather than an ideally functioning end result. At the same time, the audience will not much care about lengthy scientific texts or articles accompanying the created work. Timo Toots in his interview also emphasised that a short-term art project also enables an artist to continue to develop it in the course of an event. But when creating stable long-term multimedia design solutions for museums, he must take into account aspects that he normally ignores in his exhibition practice. (*see chapter 3.3*) The end result of art is mostly perceived and interpreted rather than accepted as scientific knowledge, it often asks more questions than it provides clear answers. If Scott argues that an artwork is easy to understand, based on my experience I believe the opposite. Each visitor is an individual who may understand an artwork in their own way and an artist mostly cannot direct that through complex scientific texts or convenient technology demonstration.

Listak in his own way also comments on this line of thought:

> What *scientists have to learn from artists is how to quickly prototype your ideas, get feedback also about your mistakes as quickly as possible that otherwise may remain invisible. A scientist should not allow themselves an excessively long research period during which they may not discover anything at all. (2014a)*

In this context, it is important to add that a scientist can allow themselves long time of work after which even the realisation that it has not yielded the necessary results or yielded negative answers is valuable. The specific nature of artist's work, however, requires constant publication and a lengthy work process without results does not justify their endeavours as an artist. Hence, artists can be a good example to follow for scientists in this respect. (Ibid.)

Another important aspect is also the visualisation and publication issue. According to a widespread belief, the nature of the work of artists is visualisation and publication of science. In a certain way this could be true if the goal is set in such a manner and we are talking about designing scientific results in the sense of applied art. However, this cannot be classified as collaboration by substance but rather a relationship between a customer and a producer and this relationship is beyond the current context.
When speaking of visual art, the artist certainly does not attempt to dynamically fit into the world of science by offering his or her own skills and knowledge for disseminating it. Artists not only use ideas and technologies from science but enter science labs with their own "inverted" ideas to engage in continuous research just like scientists. The artist's aim beyond a thorough understanding of the nature of things is also critical commentary, raising of strange questions and discussions, showing things in a different light. It is participation in a wider social and cultural context where both science and art have their specific place.
In this context can be introduced the idea that visualisation that could be the domain of art in this light is more characteristic to the world of science (charts and figures through which work results are introduced). Scientists who have to explain complex things based on specific principles perhaps seek out particular shapes more than artists do. Artists on the other hand in their work seek out poetic metaphors that may have a greater impact on the audience but considerably fuzzier boundaries.

Summarising the "Holy Cow" experience, I can say that the best answers are produced by practical collaboration, hybrid forms of collaboration and persistent discussion on the topic. The citation provided at the start of this chapter containing the role of artists as societal catalysts, was significantly added to during this thought experiment – artists are not only catalysts in the society but also creators who can teach working methods to scientists or find new goals that differ from their traditional work, rendering their pursuit more efficient and closer to the philosophical principles. Thus, both artists and scientists are working in a wide field that can have an infinite number of results.

4.4 Significant directions and keywords

The development of human thought is moving in the direction where one pillar is the belief that any research is incomplete if the achievements of other fields are not taken into account. Pioneering times make scientists and scholars seek new platforms that would bridge the current classifications and create new interdisciplinary fields. According to Wittgenstein, scientific fields ought to be treated as phenomena based on family similarities.

> *[...] we see a complex web formed by similarities partially overlapping and traversing each other (2005: 62).*

At the same time, the attempt to find common denominators to scientific thought is incorrect. It is above all the thinkers of humanities who increasingly emphasise: this will not progress us on the path to studying life and multidirectionality of thought. It is also important to consider that the diversity of thought or the blurring of genres (Geertz 1980) does not only happen between fields but also within disciplines.

Hence, the concept of discipline must first be defined. Science is structured according to fields regardless of current societal non-disciplinary problems. We understand discipline as a field placed within certain boundaries, structuring the knowledge within the field but also realising its coincidental nature, cultural causes and social associations.

> *Etymology shows clearly that discipline is tied to order and power; discipline is a set of rules that helps to distinguish claims held as truth from false ones, ousting the latter from within its confines (Tamm 2011: 19).*

The new media art practitioner and designer of the art, computer and engineering curriculum at the University of California, Simon Penny, says, however:

> *As disciplines form and elaborate, they necessarily build an administrative and institutional superstructure around themselves. As personal power and vested interests come into play, these structures crystallise, they become resistant to change, increasingly unable to adapt to new contexts. Yet new contexts continue to arise and the academy must accommodate and explore them or become moribund [...] In order to understand and analyse collaboration between disciplines, its parties must above all be highly aware of their own limitations, the rules and methods within the field, as well as the historical, epistemological and ontological reasons for its formation and development into what it currently is. Perhaps this would also help better the so-called "home discipline" into a broader context of interdisciplinary cooperation. (2014)*[17]

Which discipline is the basis of this study? What is the basic knowledge, methods and cultural background that forces me to ask about interdisciplinarity and transdisciplinarity in particular?

My research area is new media art, a term coined in 1994, when many artists, critics and curators introduced the phrase to describe a new art direction. But the roots of new media art go back to the 1920s when Dadaists became active, aspiring toward an interdisciplinary aspect and aiming to implement new radical ideas and create new art practices (Tribe et al 2006: 8).

Media art (be it based on either digital or analog technology) could be called a breaker of boundaries between science and art from the outset because ideas, tools and work groups have always been hybrid – media art works link together science, technology and cultural issues into forms about which we can rightfully say that the creators are equally interested in science, its working methods and resources, as well as the contact points between science, technology and culture and more broadly about the critical positions related to them. And there are probably no scientific fields or technologies that they have expressed no interest in. Both my practical work as an artist as well as the boundary crossing nature of media art thus allows me to address this art genre in particular called new media art.

Let it be said that the definition of media art or "new media art" is not easy. The easiest keyword of media art is the medium it uses. It is in fact also important for all modern art. The terms digital art, computer art, multimedia art and interactive art are also in use as synonyms to new media art. The newer genres of media art, such as net art, bioart, generative art, software art, hacktivism, etc. however clearly refer to the complexity of defining the field of media art and its close links to science, as well as all kinds of social processes. However, Katja Kwastek challenges this definition, arguing that the definitions advanced to this point are based mainly on objective technological aspects or certain discipline, and that new media art as well has been reduced to an electronic medium, without taking into account how society itself changes over time. This is a generalizing umbrella term, and the meaning of it is exceedingly vague. (2013: 28)

Based on the above, an apt summary might be that when it comes to new media art, two perspectives are key:

1. artists' interest in physical science and technology;
2. societal, cultural and environmental links that not only address general aesthetic issues but pose critical questions about the development speed and ecological problems of technological processes.

The broad scale of approaches complicates the subjecting of this field to all kinds of specific terms, definitions or methods. Interviews conducted with various media art practitioners also showed the belief that today's visual art may not even require categorisation, specific terms or definitions but instead we should revert to the level of ideas. The most significant example of this could be the creation of a new approach to media art – hybrid art. (*see chapter 4.4.3*)

Nevertheless, media art theoreticians find that media art, like other art genres, requires critical discussion and this unfortunately cannot be done without drawing boundaries – in that case we are risking incomprehension. Even though the development of modern culture and science clearly show that the drawing of boundaries between fields runs counter with many problems that are important in the sense of society, human understanding is based on the objects, artefacts, symbols and media in their use, whether it is a disciplinary, interdisciplinary or transdisciplinary view.

Therefore, in the following chapters two ways of thinking and research that are important in the context of new media art – the interdisciplinary and transdisciplinary approaches will be addressed. The highlighting of these concepts does not mean that these are the only options to comprehend the complexity of knowledge creation. However, it provides some lines of thought for understanding and interpreting hybrid forms of creation and science. Otherwise three types of "malformations" can occur:

- the objective between and across disciplines may remain a mere slogan, an empty call because there is no dialogue between disciplines or it is built on incorrect or unequal grounds;
- any kind of academic approach is blurred and dissolves into hybrid forms of action that are not sustainable;
- the interdisciplinary or transdisciplinary field goes so far with its definitions and institutionalisation that it seals itself off within the limits of the new discipline, thus no longer being between or across disciplines. Hence, it risks once again remaining closed for other fields of research. (Torop 2005: 311)

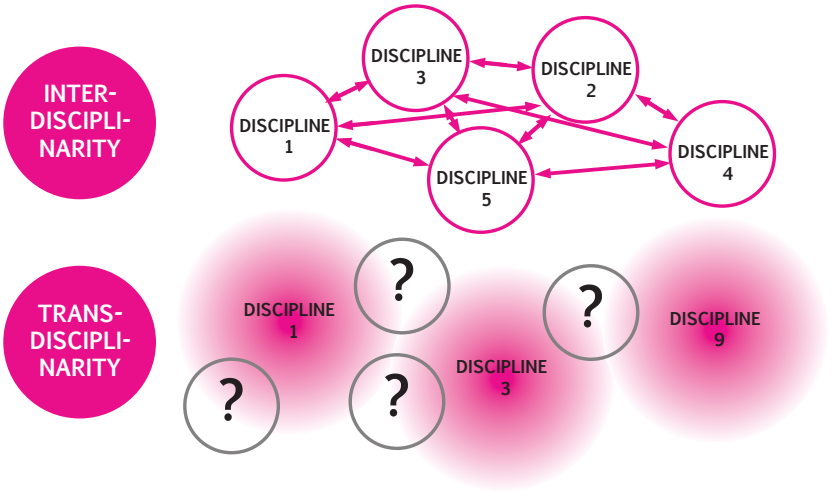


Figure 49: *Interdisciplinarity* versus *transdisciplinarity – classical postmodern approach*

Figure 50: *Interdisciplinarity* versus *transdisciplinarity by Robert Frodeman*

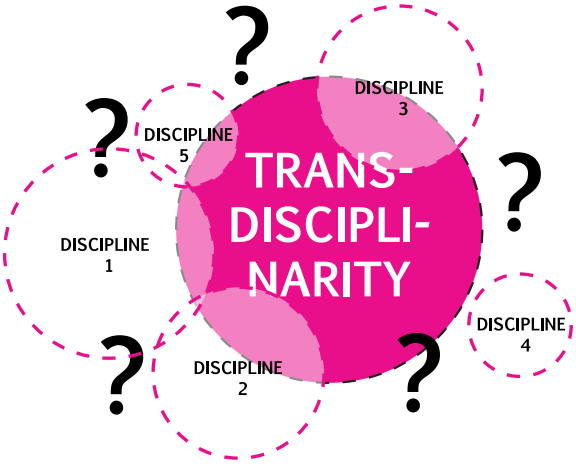


Figure 51: *Interdisciplinarity* versus *transdisciplinarity (based on the idea of A. N. Shapiro)*

4.4.1 Interdisciplinarity

Whichever prefixes we use with words about collaboration between disciplines (inter-, trans-, multi, etc.), we can recognise that the world around us is continuously becoming more diverse. The multitude of creative and scientific genres has substantially expanded our cultural approaches, the way science asks more and more complex questions about the world, the thoughts of the representatives of creative disciplines are also affected by the multitude of options that is characterised by the modern world. As for knowledge in general, anthropologist James Clifford declares:

> *All knowledge is interdisciplinary; knowledge does not naturally fall into disciplinary forms (2003: 60).*

The need for mutual understanding is felt by both scientists and artists. A creative study, be it within the boundaries of a discipline, between disciplines or cross-disciplines, is a highly unique and hybrid phenomenon that needs observation, analysis and continued practice that is more careful than before.

What is interdisciplinarity in terms of today's art creation?

Interdisciplinarity as the combining of academic disciplines into a single study is a concept increasingly used in all instances where the finding of something new and unique and the crossing of boundaries between fields is considered important. This concept in more general terms is linked to the 20th century but its historical roots lie within Greek philosophy. In short, the interdisciplinary approach is related to the aim to create more perfect knowledge because in order to resolve important problems, staying within specific disciplines in a traditional or conventional manner is not enough.[18]

The reason why different fields must once again be connected lies in the changes that occurred in the history of human culture whereby the comprehensive worldview was gradually dismantled. The 19th century was most important as philosophy and science as fundamentally different genres grew apart. People themselves had become more self-aware than before and more distant from religious principles. The differentiation of different genres was also affected by historically impactful changes in the scientific and technological progress starting back in the 17th century. (Kaevats 2009)

The separation of disciplines therefore happened thanks to the deepening specialisation of science and culture. In-depth focus required immunity with regard to other fields, also the overlooking or very shallow consideration of religious, political and social impacts.
On the one hand there was nothing bad in institutionalisation and in-depth focus because such attitude in the aforementioned eras was necessary from the viewpoint of evolution of human thought. But it destroyed a certain complete picture that we have been attempting to put together again the whole time since. I am not trying to argue that we should return to the era of religious principles or the philosophising of the antique era, rather that the main goal of all fields of research in raising general questions should be understanding that knowledge is a complex system consisting of opportunities within the field as well as ones crossing disciplinary borders. With regard to collaboration practices between artists and scientists, two significant questions arise:

1. How do seemingly incompatible working methods and evaluation criteria fit together?
2. How can interdisciplinarity remain between disciplines if it has the potential to create new disciplines that once again clam up within its own boundaries? (Torop 2008)

In analysing collaboration between scientists and artists should start from the pointed question regarding the seemingly mutually incompatible working methods. As the traditionally widespread opinion is that scientists research objects, artists study subjects, the former address research questions rationally, the latter irrationally, then how can we even expect that such collaboration could be based on equal partnership and mutual understanding?

The two speak different languages, after all, and have different goals, the clear boundaries of scientific research are opposed to the indeterminate ones of the artists.

Actually, the view of opposing goals is obsolete and the connecting of different thought models and research methods brings us closer to raising questions important for the modern world and finding resolutions. If we look for resemblances in the practical activities of artists and scientists, we can say that they are similar in several ways. Stepping back from the comparison of working methods towards the roots, we see that both deal with raising questions and studying issues, they have ideas, theories and hypotheses that they carefully investigate and develop in science labs and in studios. And it may not be that important in posing initial questions or finding pathways to solutions whether those questions were asked with a view to a rational or irrational goal.

As far as dialogue and productive collaboration between disciplines is concerned, I have realised through interviews and conversations with scientists and artists that the need to speak each other's languages is mutual, even though it is difficult to assess them professionally and organisationally from the perspective of one specific discipline. In other words, the fault is not in the difference in working methods or ideas but in subjective evaluation criteria that fail to account for broader contexts – the viewpoints are always biased one way or another.[19] Thus, the answer to the first posed question is that there are no equal evaluation criteria but discussion about changing relations undoubtedly helps the progress of general understanding. Observing practical forms of collaboration (e.g. architects and physicists or designers and mechatronics), the criteria can nevertheless be set based on the objective. It is more difficult to find similarities in visual art and natural or physical sciences to evaluate. Perhaps the evaluation of events and artefacts through broader cultural values could be of assistance here. Because both science and art are part of culture.

Media art has significant role in the development of interdisciplinary collaboration. As Simon Penny said in his article "On interdisciplinarity – in theory and in practice":

> *The fields of Media Arts and Digital Cultural Practices have provided a highly charged context for the development of interdisciplinary pedagogy, combining as it does, practices and traditions from historically, culturally and theoretically divergent disciplines. There is ongoing discussion about the relative merits of interdisciplinarity, multidisciplinarity, transdisciplinarity, even antidisciplinarity [...] Interdisciplinarity has of late become a mantra of universities because, presumably, it has been noted that significant innovation originates form outside disciplines at least as often as it originates from within them. (2014)*[20]

The keyword "borderless collaboration" is undoubtedly valuable in the eyes of a society focused on modern innovation but in regard to practical forms of collaboration of interdisciplinary collaboration one must admit that new (inter)disciplines are potentially created. If such an interdiscipline is able to progress further into a specific discipline with new borders, it will have disappeared in the context of interdisciplinarity and consequently closed for other disciplines. But the current time and diversity of thought, as well as technological progress, enable the creation of more and more initiatives and ideas, therefore there is no reason to believe that the evolution of collaboration would stop. The continuous creation of new fields probably further complicates the establishment of evaluation criteria but so long as people are still capable of creative thinking and viewing past the lab or studio, finding new directions is nothing to be afraid of and it should not be feared that one day the work between disciplines will have been fully mapped and forced within the boundaries of disciplines. This in turn leads me to address the next concept which is transdisciplinarity.

4.4.2 Transdisciplinarity

Collaboration between art and science permits highly specific characteristics to be discovered that do not fit into the boundaries of conventional scientific research or the practice-based study of an artist. In what way it is important and novel both in terms of focus on disciplines as well as greater inclusion than before – in terms of collaboration where as lines of thought the scientific, societal, political, ethical and aesthetic world views are in harmony?

The diversity of lines of thought and potential solutions, as well as the fact that engaging in science can involve many intuitive ideas and until now uninvolved groups of society leads to analyse the term that is called transdisciplinarity. This concept was first made public by the Swiss philosopher and psychologist Jean Piaget in 1970–1971.[21] It was an idea about research as a complete system, permitting new directions and extraordinary discoveries, which was not supposed to become the "science of sciences", rather an open vision which "will not be limited to the interactions or reciprocities between specialised researchers, but will locate these links inside a total system without stable boundaries between the disciplines." (Piaget 1972: 144, Nicolescu 2007: 142) However, scientists and thinkers were not yet ready to accept the key essence of transdisciplinarity: in addition to the words across and between, today the word beyond is used instead for transdisciplinarity because the space between and beyond disciplines is filled with information that should not be ignored.
Transdisciplinarity is a concept that according to a post modernist interpretation should mean limitless collaboration – i.e. the extraordinary fusion of disciplines, a situation where the boundaries of different scientific and creative genres can no longer be separated and in which one is capable of delving into issues that are outside the borders of specific fields of research.

The American professor of philosophy and religious studies, Robert Frodeman, who has done extensive research on interdisciplinarity, nonetheless shows that transdisciplinarity is part of possible interdisciplinary forms of collaboration and is equal to cross-, multi-, post- and antidisciplinarity. (Frodeman et al 2012)

My aim is to show next that transdisciplinarity cannot be addressed formally (*Figure 47*) nor as part of a narrow segment in the entirety of interdisciplinarity (*Figure 48*).

Contemporary art practice shows that transdisciplinary research is not the blurring of borders between disciplines, an extraordinary freedom of thought or a complete denial of traditional methods of research but a mutual complementing of different fields of research in settling and addressing questions across disciplines. Transdisciplinary collaboration is a more radical activity than interdisciplinary collaboration but it is not the opposite of interdisciplinarity or disciplinarity or a part of it because the main goal of all approaches is the same – continuously deepening understanding of the world. It is rather an addition to previous approaches, a successive stage that delves deeper into the substance than previous approaches.

The concept of transdisciplinarity in terms of its historical evolution is related to the rise of biology and bioinformatics, hence the concept is largely addressed by many new media and bioart projects, discussions of transdisciplinarity continue to grow at relevant conferences. This prior knowledge would appear to give the concept fixed boundaries. Still, it is important to emphasize that when we are speaking of transdisciplinary collaboration, we cannot talk of definite new media or bioart phenomena; it is better to deal with hybrid art phenomena, in which case we have a case of true transdisciplinary collaboration, which will be analysed in the following sections (*see chapter 4.4.3*).[22]

The Romanian physicist and philosopher Basarab Nicolescu formulated cross-boundary research in 1985 when he found that the time is right for discussions over the re-integration of natural sciences and humanities as a single entity. B. Nicolescu:

> *Modern science was born through a violent break with the ancient vision of the world. It was founded on the idea – surprising and revolutionary for that era – of a total separation between The knowing subject and Reality, which was assumed to be completely independent from the subject who observed it. This break allowed science to develop independently of theology, philosophy and culture. It was a positive act of freedom. But today, the extreme consequences of this break, incarnated by the ideology of scientism, become a potential danger of self-destruction of our species. (2007: 142)*

Nicolescu plainly claims that the ideology of science that has developed until now is leading us to self-destruction. Thus, transdisciplinary collaboration must be understood as a new, more formulated level of collaboration between fields where the goal is not only to learn from each other but also to gain an in-depth understanding of the close relationship between the object and the subject. It is important to take into consideration that the world is not only comprised of contrasts and cannot be subjected to black-and-white simplification – it is difficult to grasp reality and its understanding must be based on many different aspects.

Crossing borders

In the following discussion is attempted to explain the substantive meaning of transdisciplinary collaboration.
The American media theoretician, essayist and interdisciplinary thinker Alan N. Shapiro emphasises in his interview that today's transdisciplinarity is of a border-crossing nature and senses boundaries to a greater extent than one might think.[23] The question is about categories: do we engage in addressing formal or substantive collaboration, do we only attempt to find methods to conduct our own work or seek for all possibilities to find cross-border problems and solutions. (*Figure 51*)

As the three previous figures show (*Figures 49, 50, 51*), there are several alternative approaches. A postmodernist approach loses the boundaries between disciplines once and for all and according to Robert Frodeman transdisciplinarity as an approach is on an equal standing in understanding all disciplines and relations between disciplines. Alan Shapiro emphasises that in assessing collaboration between disciplines, one must take into account that they all have specific boundaries – the key is rather in the deeper understanding of their substance than before and also in the re-evaluation of the relationship between subject and object. Research questions may be outside the scope of disciplines but in order to find solutions to them all parties must gain an extensive understanding of each others' fields.

How should an artist orient the values during artistic creation? Media artist Horst Hörtner, director of Ars Electronica FutureLab, also emphasises that focus is the key to crossing boundaries:

> Wh*en speaking of practical development, we see the ever increasing creation of forms of collaboration between art and science because different parties are interested in each others' disciplines, however this requires delving deep mutually into each others' fields in order to initiate critical discussions on a high academic level (2012).*

With regard to transdisciplinary focus, Nicolescu brings out three main methodological postulates:

1. **the ontological axiom:** there are different levels of understanding reality;
2. **the logical axiom:** The passage from one level of reality to another is insured by the logic of the included middle;
3. **the complexity axiom:** reality is experienced through a complex structure with each of its levels existing because all other levels are existing. (2007: 146)

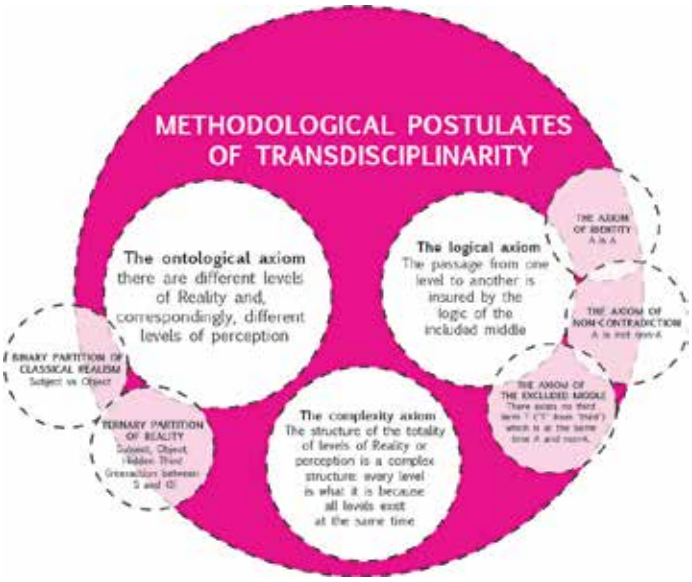


Figure 52: *My interpretation of B. Nicolescu's treatment of the methodological postulates of transdisciplinary thinking.*

Therefore, Nicolescu highlights the most important, without excluding the many different levels and interpretations and deviations of these three pillars because transdisciplinarity means a constant "openness". Also, a system in which hierarchies cannot be distinguished, "completion" or the documentation of a complete knowledge, the existence of a one and only reality.

In the following is focused in more depth into the logical axiom because the general framing of the subject and direction – connecting art and science leads to discuss which common resources artists and scientists have. It is bizarre that the way of our thinking, be it scientific or not, is based on classical logic that does not enable any doubts or contradictions. We also think that way when it is impossible to find a logical explanation or solution.

> H*owever our habits of mind, scientific or not, are still governed by the classical logic, which does not tolerate contradictions. The classical logic is founded on three axioms:*
>
> > *The axiom of identity : A is A.*
> > *The axiom of non-contradiction: A is not non-A.*
> > *The axiom of the excluded middle: There exists no third term T ("T" from "third")which is at the same time A and non-A.*
>
> *Knowledge of the coexistence of the quantum world and the macro-physical world and the development of quantum physics have led, at the level of theory and scientific experiment, to pairs of mutually exclusive contradictories (A and non-A): wave and corpuscle, continuity and discontinuity, separability and non-separability, local causality and global causality, symmetry and breaking symmetry, reversibility and irreversibility of time, and so forth. (Nicolescu 2007: 150)*

In other words, the answers to scientific questions do not always necessarily have to be "yes" (A) and "no" (non-A), there is also an option that is in between those (T – included third). For knowledge, a "third", "fourth" or "fifth" level of understanding and interpretation is always possible. In that sense, we can no longer understand the world according to logical explanation. According to the definition of knowledge – for knowledge, the "third" is always a possibility – knowledge is always open. The assessment of this value is another matter. Although we need to use our brain to understand reality, the processes of understanding outside of our bodies and the blood circulation are important. A holistic approach highly characteristic to the evolutionary process permits aside from the mere recognition of contrasts to also accept a more dynamic approach – the logic of the included middle.

Nicolescu is of the view that because transdisciplinarity should be assessed by taking into account all of the prior reasoning, options and various levels of reality, this phenomenon cannot be attributed an objective or subjective value – the object and subject are in such a close mutual relationship.

Yet how do these new terms fit in with the context of new media art? Can truly transgressive ideas be called provocative? Or does this yield true benefits in forming our general understanding of the world?

John Brockman is an American scientific author who highlights in his book "Third Culture Beyond the Scientific Revolution" (1995) an acute need for awareness of scientists' provocative ideas. The three cultural forms together – science, technology and art help improve the understanding of this time and society, he is guided in his "third culture" idea by the sharp conflict between humanities and physical sciences described in the work of British scientist and novelist Charles Percy Snow titled "The Two Cultures and the Scientific Revolution" (1959).

American artist and author Stephen Wilson also points out the importance of all possible included fields:

> *Technology/ science/art research is still marginalised as a fringe activity. In a techno-scientific culture, artistic probing of the world of research is a critical, desperate need. We need people looking at these fields of inquiry from many frames of reference, not just those sanctioned by academia or commerce. (Debatty, Wilson 2007)*

The physicist, astronomer and Executive Editor of Leonardo Publications, Roger Malina emphasises that in today's world we could present a metaphor of the world consisting of five important components or the world of five cultures. It comprises 1) art, design and entertainment, 2) science, 3) technology 4) world-views 5) situation – locality. (Malina 2006: 21–23)

Hence I concur with Alan N. Shapiro that the attempt of various scientific institutions and universities at formal interdisciplinary collaboration is insufficient.

> *We have to face the fact that the existing classification of knowledge is obsolete. Interdisciplinarity in itself is more or less worthless. It is only an indication, a sign, that something is very seriously wrong. If, in order to obtain valuable knowledge, we need to span several disciplines, that only shows that what we really need is a major project to rethink what the categories of knowledge should be.*
> *It is not only necessary to broaden science; it is also necessary to make science more accessible, and to increase citizen participation in public conversations about science. (Shapiro 2010)*

The public is increasingly interested in subjects like: human cloning, climate change, sustainable existence, etc. – these are by far no longer only scientific but issues of general culture. Questions that were previously only of interest to science are placed into social context and require investigation on a broader level. It also requires intervention at all levels, because as said, knowledge is open.

4.4.3 Hybrid art

Artscience as a term is now complemented by the expression “hybrid art”, first mentioned as a title of the Ars Electronica festival held in 2005. The starting impetus for the choice of topic was to study the explosive influence of technologies on society, and try to bring various cultural forms and their blurry boundaries closer to one another. (Ars Electronica 2005)[24] Hybrid art, according to its established definition, is related to the connecting of technology and art. But the lack of exact definitions of today’s lines of thought allows the use of the word “hybrid” in terms of art in very many directions, not connecting technology to art in the most direct manner.

The most essential trait of this art form is the combining of disparate research fields in the name of creating new cultural value. Even though the word “hybrid” may refer to confused muddle, hybrid art practice can nevertheless be evaluated as a positive attempt to account for something, not to create an ultimate intermingling. In the preceding chapter, was also described the nature of transdisciplinary inquiry, under which the accrual of new thought trajectories does not make the picture more muddy, but rather merely requires more effort.

Which phenomena could be analysed with regard to hybrid art directed to the future? Although from a wider perspective digital technology and natural sciences have probably inspired all creative people, next will be provided some subjectively selected notable examples – pertaining to exciting artists and collaboration labs. Inspired by these lines of thought is essential to move toward bioart as an art genre that is becoming increasingly popular. As the term “hybrid” comes among other definitions also from biology, it is understandable that one of the very definitive directions of hybrid art is bioart. This is an important art current of the future in the sense that scientists also see more of a need to treat biology as co-existing with other forms of scientific inquiry. Thus the art examples in the second half of the chapter are devoted to bioart. (*see chapter 4.4.3*)

Poetic interpretations and remarkable artists

The artistic work of Argentinean artist and architect **Tomás Saraceno** is described by a lively interest in science, especially physics. At the same time, his creations are related to future values and potential architectural applications that he says he creates because of his desire to exceed reality. One of his most recent exhibition “In-Orbit” took place at K21 Ständehaus in Düsseldorf, 2013–2014. “In-Orbit” is a multi-level large-scale installation covering 2500 square metres offering visitors a chance to “walk on clouds”. Saraceno has dealt with issues of expanding space for years in order to find new viewpoints in approaching space, state and geographical borders, as well as transcending principles of gravitation and physics. On the one hand, such thinking is aided by globalisation as a broader social phenomenon, on the other hand the overpopulation and urbanisation issue and the search for alternative options in architecture. His artwork also contains a poetic interpretation about airborne cities as important visions in culture that, if interpreted more broadly, could also refer to the redefining of cultural artefacts, their ephemerality.

Utopian visions about the expanding of space were also demonstrated at the exhibition “14 Billions (Working Title)” in Helsinki Taidehalli (2012), that I visited. Saraceno among other ideas presented his vision about spider webs as important structures that best illustrate his serious devotion to science and technology, the issue of space study and social theories. This enables to think of biological evolutions developing over millions of years as pillars whose systematic and rational functioning must also be taken into consideration when creating the human environment. The fact that Saraceno has for years partnered with several architects, biologists and engineers and has also been involved in NASA science projects, adds substantial weight to the idea of the value of artists’ work in contemporary scientific work.

Figures 53: *From the left: Tomás Saraceno "In-Orbit" (2013), "14 Billions (working title)" (2010)*

Figures 54: *Agnes Meyer-Brandis "Moon Goose Analogue: Lunar Migration Bird Facility" (2011-...)*

The German artist **Agnes Meyer-Brandis** was invited in 2007 in Germany to participate in a 0-gravitation flight after which she created the piece titled "Cloud Core Scanner". Perhaps it is difficult to call the result an artwork because it was an actual device that had to record video of the smallest microparticles and microgravitation.[25] But on the other hand, the event probably became an important influence in her subsequent creations. Interest in the sky and everything taking place there is manifested in the artist's project "Moon Goose project" (2011- ...) and "Moon Goose Analogue: Lunar Migration Bird Facility", for which the artist has attempted to connect dreams and science, poetic *sci-fi* visions and reality.[26] Inspired by the animal behaviour theories of Konrad Lorenz and her own flight experiences, as well as a fairytale about moon geese, she started dreaming about geese flying to the Moon. She trained over a long period of time 11 geese for the space mission, creating special training conditions and space environment simulation and control centre for them. An extremely enjoyable documentary was made about her training of the geese that the author of this thesis was able to watch for the first time at the Ars Electronica exhibition of 2012 in Linz, Austria. (Ars Electronica 2012)

The artist's idea to connect fiction and reality by doing it through English bishop Francis Goodwin's story from 1638 talks about artists' special ability to bring the most bizarre ideas in front of the public; to ask about the plausibility and feasibility of stories, as well as about the age-old problem – probable impossible and the possible improbable.[27, 28]

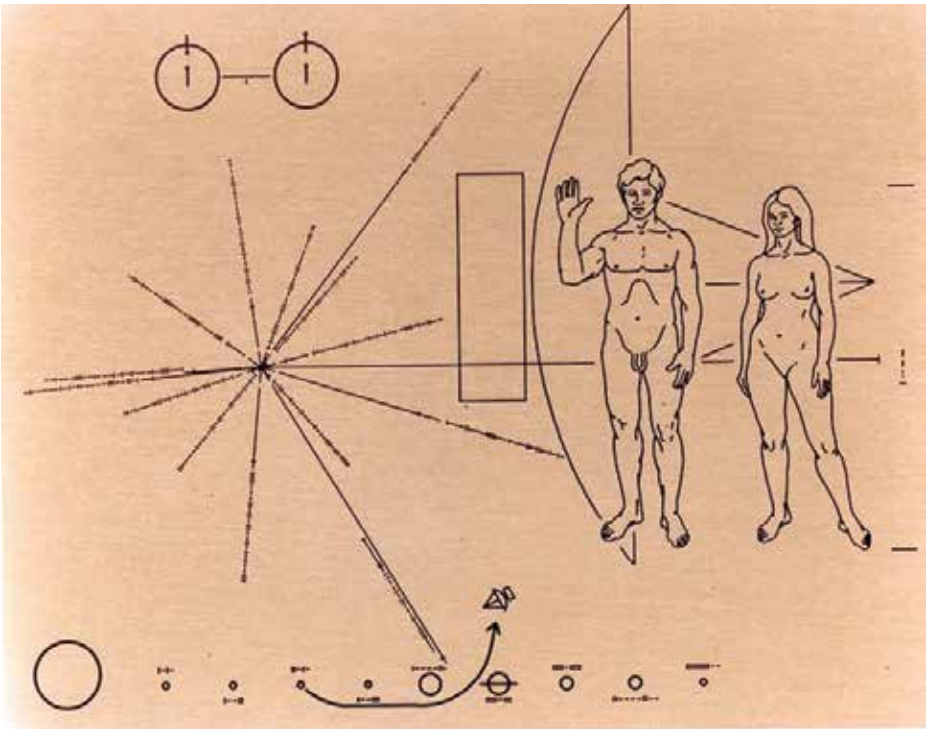


Figure 55: *"The Arecibo Message" (1974) as an illustration of the Joe Davis' artwork "Poetica Vaginal"*

It is difficult to express the work of **Joe Davis** in a few sentences, an artist and philosopher who has been called also a pioneer of bio- and hybrid art. Indeed, no idea is beyond the reach of his innovative thinking, the directions and disciplinary boundaries of his years-long work are only vaguely distinguishable – molecular biology, bioinformatics, laser technology, astronautics and telecommunication are just a small part of the genres that could be listed here. Joe Davis is asking why in a situation where other wildlife is able to establish simple connections without tools of high technology, do we have to use such complex systems in order to find paths that existed in the universe since the beginning of time (Joe Davis "Bacterial Radio")? (Ars Electronica 2012b)

His attitude towards science is somewhat brazen, doing exactly what a creative person is encouraged to do in certain situations. He is criticising those obstacles that go unnoticed by top-level science, highlighting problems across disciplines that are relevant with regard to the future. One of the most notable examples of his numerous art projects is "Poetica Vaginal" (1980), dating back many years. During the Arecibo Observatory mission (1974), a signal was transmitted to space that described the human being. But in the view of Davis it left out the most important – information about women. Illegally using MIT's Millstone radar, he transmitted as his own addition audio files to the space about vaginal contractions of ballerinas to the Epsilon Eridani and Tau Ceti star systems because he found that this was a much more suitable message to potential recipients (e.g. aliens) than human existence will have been transmitted. (Time Blimp 2011)

Joe Davis has also been a key figure in the DIYbio movement, comprising amateur biologists, biohackers and bioengineers without a specialised education whose broader goal is to intervene in scientific processes using scientific tools in terms of broader thinking and in terms of criticism. (*see chapter 4.4.4*)

Hybrid Art and Bioart

Where science is an important source of inspiration for artists, it must be emphasised that all levels of science are included in their work. Although the word "hybrid" allows the assumption that it may be any kind of artistic work looking in different directions, this chapter is addressed in more depth bioart whose aims are clearly cross-disciplinary and that has the chance to be in a pioneering position in a transhuman and posthuman society. This form of artistic creation has most often been linked to the term "hybrid art".

The appearance of bioart gives artists a new medium and material through which to express their ideas. It also provides new metaphors, language and opportunity to intervene in the societal and cultural developments.
The bioart concept was born far earlier than the term "hybrid art". In 1997, bioart as term was mentioned by Eduardo Kac in relation to his art work "Time Capsule".[29] At the time, it seemed clear that bioart mainly deals with living material on the level of cells and genes and in fact, the first bioart related works originating from 1980s also affirmed this. By 2014, it could be said that bioart is positioned somewhere between natural sciences and art, it cannot be precisely defined in terms of material (genes, cells, bacteria) or concepts (study of the human body or some other living organism). Through practical examples it becomes clear that bioart can also address other genres of natural sciences in addition to biology and any kind of particles from nature, the mutual relations of "naturalness" and "artificialness", environmental issues, etc. Bioart has become an autonomous part of artistic thinking:

> *... This would imply that the use of living material in art is not an example of new possible applications of this material in addition to all the various scientific applications. Rather, it has become an autonomous artistic medium, in same way as the classic marble in classic statues an autonomous part of the artistic meaning, as is also true of oil paint in a painting and video in media art. (Zwijnenberg 2009: XXII)*

Thus, in the case of bioart we can see the split between two directions:

1. the study of people and nature on a cell and gene level – lab work and all kinds of manipulations on a microscopic level;
2. broader study of the relationship between nature and culture, environmental issues, study of everything natural – practical experience, study of landscape and environment and the creation of concepts based on that.

Hannele Lehto (University of Helsinki, Finland) emphasises that in terms of time we can also discuss the development of bioart in two ways:

> *I have devised two definitions for bioart: a narrow and a broad one. The broader definition is connected with the historical dimensions of tens of thousands of years, and the evolution of bioart. According to this broad definition, bioart explores the dialogue between culture and "nature" in the interface of art and science. The criterion in an encounter and interplay between art and science. The narrower definition, of this millennium, concerns the new paradigm, and according to it, bioart is a new inter-disciplinary and inter-art paradigm that uses organic substance as the material of art, and methods of bio-technology and medicine as instruments of expression. (Lehto 2013: 6)*

The treatment of the microlevel can be seen in, for example, an interactive work by the English artist duo **Howard Boland** and **Laura Cinti**, "Living mirror" (2013).
This is an interactive art installation that creates images in real time, utilizing special pulsating light-controlling properties of magnetic bacteria. The behavior of the bacteria is rendered unique by their ability to align themselves to the Earth's magnetic field. Living Mirror is a very vivid demonstration of the harmonious functioning of Earth. The work was completed in collaboration with Howard Boland and FOM Institute AMOLF researchers and received the DA4GA (Designers & Artists 4 Genomics Award 2010-2013) in 2013. (DA4GA 2013)

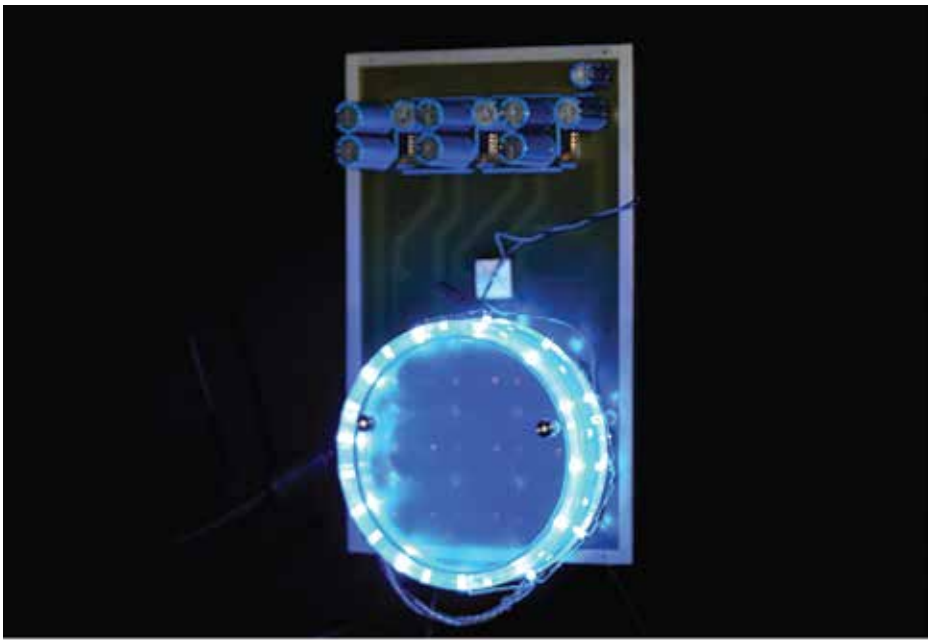


Figure 56: *Installation "Living Mirror" by Howard Boland and Laura Cinti (2013)*

Figures 57: *Photos of the artwork "Proxy – 2010" by Andie Gracie (2010)*

The contrasting of artificial and natural material can be seen in the work of the Spanish/ British artist **Andy Gracie**. Having studied numerous scientific disciplines, he shows particular interest in astrobiology and robotics. "Proxy – 2010. Robotic Investigation of Organic Samples" is a robotic installation where two robots are studying the biological material collected by people. Inspired by the robots sent to Mars in 2004, "Spirit" and "Opportunity", he named his robots "Essence" and "Possibility". While robots are typically created to replace people in difficult conditions, the artist has reversed these roles – the work of robots is in safe gallery conditions to find nematodes and tardigrades brought to them made of natural material (e.g. minerals), which are collected by the people. Nematodes and tardigrades are the most used living organisms in space studies, especially in Mars missions. (Debatty, Gracie 2006)

The British artist team "Boredomresearch" (**Vicky Isley** and **Paul Smith**) have created "Realsnailmail" (2008), an installation through which the artists ask how people communicate (Isley, Smith).[30] The large sand and grass box placed in the gallery contains large Roman snails equipped with RFID chips whose extremely slow progress in sending messages directly refers to our dependence on the geological time established by nature. And this does not have much to do with Internet speed and ever increasing human contacts.

Figures 58: *From the left: "Realsnailmail", and photo from the exhibition "Gateways" (KUMU Art Museum, 2011)*

Figures 59: *From the left: "E. coli - One Third of All Turds", "Demented Naturalists" (The Workhorse Zoo gallery – 2002)*

The absurd situation provided by the artists allows the exhibition visitor to experience a so-called "slow time" and a clear message saying that today's need for speed is overrated. A thought by Paul Virilio that could apply here is that speed and time that we are used to experiencing as certain units on a watch or in a calendar, are today defined rather as personal moments and dreams selected by the individual.[31] Despite everything, in this installation existence lasts for billions of years.

Broader questions about the essence of nature and people are asked by the artist duo **Adam Zaretsky** and **Julia Reodica** in their installation "The Workhorse Zoo" (2002). Artists demonstrate in a gigantic terrarium "workhorses" of molecular biology to whom humanity owes its current biological knowledge: bacteria, worms, plants, frogs, mice, fish and other living creatures that are used most often in scientific experiments. Zaretsky spent a week living in this room, carrying out performances and experiments on various subjects to show that people are part of the animal kingdom. Artists refer to what happens behind the scenes of nature research: the fact that nature cannot be studied without victims and also to the necessity for critical observation of biological evolution.

> *"The best thing about this art is that it gives you an escape from anthropocentrism. There is so much more in the world than humans," says Mr. Zaretsky. He explains that biology attracted him "because it is messy and hard to control. Art and technology weren't wet enough. I like life ..." (Wolfson 2002)*

About the Artist's Role in Researching Biological Material

> *One of the best-known bioart pioneers, George Gessert, who started working on it back in the 1970s and 1980s, has said that artists' ethical principles do not permit them to cross the lines that scientists, doctors, farmers, businessmen and soldiers cross on a daily basis. As evolution is something we all share, artists with a sense of responsibility are very welcome because thinking as a natural activity shapes our future. (Zwijnenberg 2009: XXVI–XXVII)*

I next describe recent initiatives that have inspired my dissertation in one way or another. Collaboration labs SymbioticA (Australia)[32] and BiofiliA (Finland)[33] are initiatives born under the leadership of the artist duo **Oron Catts** and **Ionat Zurr**. In short, these are labs offering an extraordinary opportunity to biologists and artists to interpret and create solutions to collective ideas. Even more importantly – ask questions with a view to the future. Are we ready for "semi-living"? On the one hand there are clear economic and environmental objectives for expanding resources, e.g. need for producing artificial meat or leather because they do not directly harm nature, on the other hand scientific progress may lead to consequences we are not ready to accept. And artists' questions focus mainly on the latter.

I briefly describe my experience in the BiofiliA lab as follows:

> *The BiofiliA laboratory, located in the Otaniemi campus of Aalto University is exceptional because it is the first such laboratory in the region that was created precisely with a view to collaboration between artists and scientists.*
> *I had an extraordinary opportunity to be one of approximately 20 artists who participated in the bioart workshop and who had the privilege to familiarise themselves with the technical and practical possibilities of bioart during the week spent at the lab. I was able to find out how to separate a DNA strand from a sample taken from my own cheek and shape it into a visually pleasing necklace, experience through experiments what electrophoresis is, how the* E. coli *bacteria contained in faeces can be made visually attractive using fluorescent proteins, what the exciting life of mouse myocytes looks like, what the principal differences between the development of plant and animal cells and much, much more.*
> *The originators and implementers of the BiofiliA idea are well-known bioart pioneers Oron Catts and Ionat Zurr (Australia – founders of the SymbioticA lab), Finnish scientist Marika Hellman and Finnish-Spanish curator Ulla Taipale.*
> *The week spent at the lab served as compelling proof that dreams for the future and creative thinking are similarly productive for today's artists and physical scientists. Broader philosophical and ethical thought, analysis of biology as a discipline closely studying humans, artists' practical lab experiments and the popularisation of bioart as a continuously evolving form of art are only a small part of what the BiofiliA artists-scientists will be involved with in the near future. Particular focus is also on the fact that accessibility to everything is a feature of the high technology era – lab equipment ordered online, scientific self-assembly labs and unethical developments in unpredictable directions must be a focus area for all of us because without conscious and cognizant societal indicators we will be facing very serious problems in the future that are currently difficult to name. (Piirma 2013)*

This workshop was organised by **The Finnish Bioart Society**, that is an initiative born in 2008, involving artists interested in biology and natural sciences.[34] Bioscience, biotechnology and bioethics are the most important issues that are dissected. It is difficult to give a disciplinary definition to this society because it involves many people from very different disciplines. The list of interests of society members is long – bioart, theatre, film, music, video, performance, scientific art, visual art, sculpture, environmental art, design, zoology, botany, ecology, environmental science, comparative psychology, genetics, philosophy, creation of culture, art history, engineering, etc. Finnish Bioart Society holds seminars, workshops, meetings and art exhibitions during which all of these important genres are

Figures 60: *Workshop in BiofiliA laboratory in Helsinki (2013)*

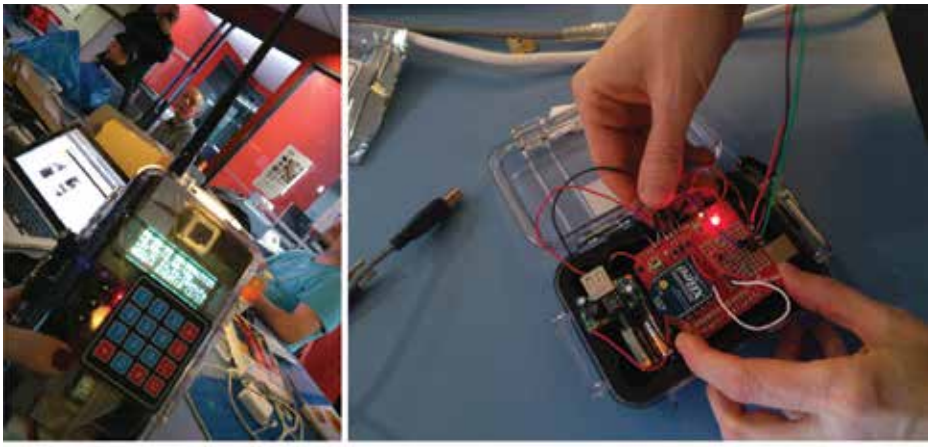
discussed to a smaller or greater extent.
One of the most important sites for conducting the society's activities is **the Kilpisjärvi Biological Station** in Lapland which served also as one of the first impulses for the creation of the Bioart Society. A feature of the station located in the north of Finland is undoubtedly also that thanks to the support of the Bioarctica Residency established for creative people they have the opportunity to experience local extreme nature conditions, see the so called peripheral areas.[35]

Why is it important? Because as was referred to before, artists and scientists are not only faced with the study of new materials and development opportunities but also the placement of biology and all other scientific fields into a broader environmental and societal context.

Next example also relates to the study of special environments. **Arctic Perspective Initiative (A.P.I.)** is a creative group founded by **Marko Peljhan** and **Matthew Biederman**.[36] The aim of the group linking together art, science and culture is research of the polar people and Arctic area and the distribution of simple open-source technologies among them. Keeping in mind autonomous culture, traditional knowledge and sustainable development, the artist duo has lived among Inuits in Alaska, studied their culture and also determined what kind of technological tools they require. Sharing, learning and mutual openness are keywords that the creators of the A.P.I. group have kept in mind. At the end of 2012, they presented to artists at Aalto University in Helsinki special self-made walkie-talkie type communication devices that they created for Inuits and gave advice to those interested on the most practical hands-on level on how to create a specialised radio system that successfully functions in difficult conditions whose special characteristics are its simplicity, independence and open source code. The organiser of the workshop was The Finnish Bioart Society.

Having worked in the remote parts of Alaska for years, studying people and their living environment, Peljhan and Biederman emphasise in their work that knowledge and values based on Inuit traditions are very distinct although the Inuit language does not at all lack the words we use for traditional science. In other words, the culture has more in common with Western culture than one may have thought. At the same time, artists are of the opinion that while northern people's culture has been scientifically studied, it has not been entirely understood – i.e. all contexts affecting their lives have not been considered. Therefore, the artist's mission is above all to map the locals' problems and needs and offer technological and telecommunication-related tools that would be accessible to local people but would change/affect/harm their authentic culture the least. This, according to the project leaders, can only happen in a very close collaboration and in-depth understanding of this cultural fragment, considering the geopolitical and socio-political and intellectual aspects pertaining to the local culture.

Figure 61: *Kilpisjärvi Research centre*



Figures 62: *Photos from the Helsinki workshop, Aalto University (2012)*

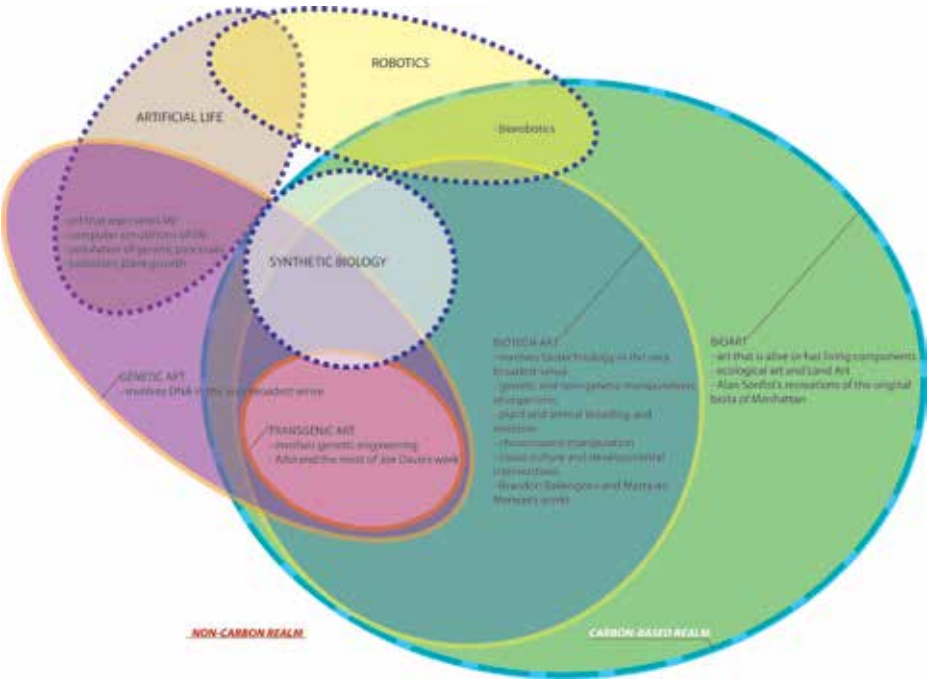


Figure 63: *Pier Luigi Capucci's view of the mutual placement and relations of art forms addressing life. The figure first originated in 2008 but was revised in negotiation with Capucci in 2013 by Laura Beloff*

Understanding Hybrid Art

The critical public voices sharp counter-arguments against hybrid art. First, the understanding of hybrid works is problematic: should they be evaluated from the scientific, artistic or some third point of view? Many of these works requires a certain special competence from the scientific and contemporary art standpoint. The disciplines are also blended together in a manner that complicates defining of art itself from within.

About the special competence: if we are guided by the idea that any research, including art research, focuses on the systematic presentation of questions asked and their explanation to the public, it is perhaps a too narrow viewpoint and mindset oriented to a certain result. In my view, the creator of hybrid art is instead guided by an opportunity to find several ways of interpreting these works. The understanding of bioart as a new genre is one half of it – but even contemporary scientific texts do not include final answers to questions in our increasingly complex culture. A broader aim of raising new questions, launch discussions and find genres to be addressed is more important. In other words, bringing the invisible to light, not discussing whether artists' actions with regard to science are justified or not, or what the boundaries of art and science are that should not be crossed. The schematic overview of Pier-Luigi Capucci and Laura Beloff about art forms addressing biological life illustrates how many potential genres can apply to art and how melded together these genres are. (Beloff et al 2013: 9)

4.4.4 Citizen science, collaborative work and societally shared authorship

Certain scientific achievements based on several historical examples have started from small discoveries, practical needs or scientific hobbies. Without underrating the work of large science centers, one could state that it is not the only prerequisite for making groundbreaking discoveries. The individual spirit of inquiry has always played a very important role.

Undoubtedly we must start with history – the contribution of multifaceted genius Leonardo da Vinci to developing the collaboration between art and science in the 16th and 17th centuries. Estonian statesman, academic and philosopher Ülo Kaevats (1947-2015) has said the following about the achievements of Leonardo and other Renaissance greats:

> *The works of Leonardo da Vinci, a universal genius, the masterpieces of Michelangelo and Rafael, Reformation that started in opposition of the ideological strictness of the Lutheran Catholic Church, the New World discovered by Columbus, the Copernican heliocentric universe theory and the objective analysis of political power initiated by Machiavelli, each individually are major achievements. But if grouped together, these historically impactful innovations merely amounted to a necessary prerequisite and introduction to an even larger-scale cultural eruption. The political and ideological pillars of the agrarian society broke down, the slow evolution of manufacturing was bringing along a technological as well as organisational "preparedness" for the start of a scientific-industrial revolution. (2008: 45)*

In the following, will be provided some other historical examples of personae and discoveries that helped transform humankind.[37]

It is worth remembering that Albert Einstein made his first discoveries on the side of his main job, e.g. the discoveries of 1905 (special theory of relativity, explanation of the photo-electric effect and diffusion). The invention of the microscope, however, dates back to more distant history, the authorship of which is credited to Zacharias Janssen (1585-1632) and his father Hans who started experimenting with glass lenses to develop eyeglasses. The micro-scope, created as a result of the Jannsens' experiment, can rightfully be considered the most direct predecessor of today's microscope; Zacharias Jannsen was also the inventor of the first telescope some years later. Thomas Edison also started researching science as a hobby, trying as a child to replicate the examples from the book by Michael Faraday "Experimental Researches in Electricity".[38]

The main catalyst in the case of the aforementioned descriptions was undoubtedly inquisitive spirit, desire to adapt to a multi-layered space of knowledge. But there have also been strange situations, in the course of which (as a secondary aim or byproduct) important discoveries were made in the history of humankind. The other side concerns the popularising of science. For example the book "Newtonism for Ladies" published in 1737 (Count Francesco Algarotti), or the public lectures and publication of a popular science magazine of Sir David Brewster in the 1830s. Another good example is a key figure in popularising science, Sir Charles Vernon Boys, active at the end of the 19th century and start of the 20th century. He authored the book "Soap Bubbles: Their Colours and the Forces Which Mould Them", first published in 1890. (Kemp 2000: 76–77)

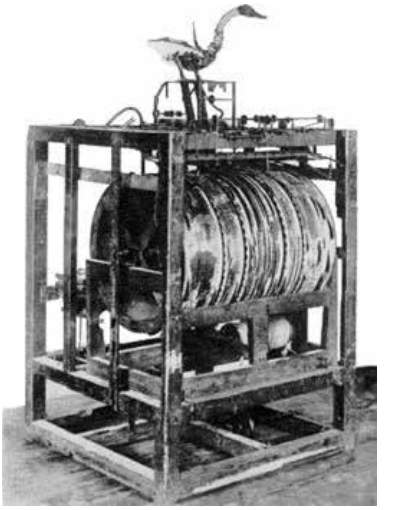


Figure 64: *Johannes Vermeer "The Astronomer" (1668)* ***Figure 65:*** *Jaques de Vaucanson duck automaton (1739)*

Figure 66: *Wim Delvoye "Cloaca Original" (2000)*

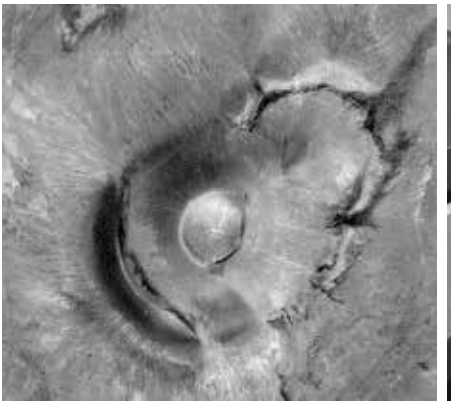


Figure 67: *James Turrell "Roden Crater" (1979–...)* ***Figure 68:*** *J. von Bismarck "Versuch unter Kreisen" (2012)*

Artists have always historically had a role in intervention in science, making it public and commenting on it in their own exciting way. For example, "The Astronomer" (1668) by the Dutch artist **Johannes Vermeer** (1632–1675) clearly expresses how important the inquisitive spirit became in the 17th century. The particulars of the zodiacal signs on a globe, open book (Adriaan Metius, *Institutiones Astronomicae et Geographicae* – 1640), historical instrument astrolab, the sunlight streaming into the room and the contrasting of the ancient figural composition to the then so-called modern scientific situation clearly expresses the search and longing for the "new". (Ibid. p. 32–33)

An exciting treatment can be found in the mechanical puppet devised by French inventor and artist **Jacques de Vaucanson** (1709–1782), "The Digesting Duck" (1739).
More than 400 moving parts were supposed to mimic the work of the digestive system.
In a way it served as a precursor to the birth of Darwin's theory of evolution and the Linnaean taxonomy because respect for nature had been replaced by a sincere wish and need to understand, find out, influence, take apart and put back together. What's special about the "Digesting Duck" as a mechanical contraption is its concept that did not only serve as an aimless system from the perspective of rational use or scientific value. Ironically, this system was set up to conduct an unpleasant process from the aesthetic standpoint - digestion. It designates a substantial change of perspective that could be said is one of the most important questions in today's contemporary art: how to show the society life without glorification and to ask awkward questions among others, to portray life as it really is.

A contemporary interpretation of the "Digesting Duck" can be seen in **Wim Delvoye's** series of artwork "Cloaca" (2000–2007). Original idea was about a giant machine that replicates the human digestive process, bringing together various trends of contemporary art. It addresses life's questions more widely and technology as a powerful phenomenon affecting people in culture. Wim Delvoye himself has said about the artwork that on the one hand it shows a process that everyone knows about, at the same time he wants it to emphasise the duality of the soul and the body and raise questions about mass production and the environment. (Delvoye, Cameron 2002)

Continuing contemporary examples, can be listed many art projects that in some way or another bring science closer to society. One of the most grand in scale is undoubtedly **James Turrell's** "Roden Crater" (1979–...), a system of viewing rooms connected to tunnels built on an extinct volcano, which allows visitors to the volcano to fully experience nature, the ultimate force and power of the universe. Turrell himself says it is an "endless project" that will last as long as Earth itself. Roden Crater is one of the most famous Earth art works, marrying the visual experience of humanity, cosmology, geological reckoning of time, theories of sensibility, celestial events and much else. The installation is expected to open to the public in the years ahead. The artwork is also undoubtedly in the spirit of transdisciplinary scientific inquiry. (Skystone Foundation 2010)[39]

A work by the first resident artist at CERN, **Julius von Bismarck's** "*Versuch unter Kreisen*" *(Experiment among Circles)* (2012) should also be mentioned.
During the two months, the first artist in residence, Bismarck, had an extraordinary opportunity to work in cooperation with theoretical physicist James Wells in creating the kinetic installation "Versuch unter Kreisen". The installation made of four large disharmoniously swinging lamps is vivid demonstration of how an ostensible disharmony becomes harmony at some point in the course of scientific investigation – a concord that provides the possibility for something "new" to take shape. The circular motion of the lights, not in concert with each other, achieves a level at a certain point in which they are moving in parallel.
The artist brings out an interesting idea that the laws of physics have a certain aesthetics that can be conveyed to audiences through art. (Koek 2012; Fronczak Rogers 2012)[40]

Citizen science

> *As participants in techno-culture and in the media, ordinary people are already making science [...] The currency of investment in the creation of new science is not strictly monetary; it is also symbolic. Capital and wealth are not only monetary; they are also symbolic. There is a media culture public sphere which is literary, imaginative, playful, psychoanalytical, creative, innovative. This literary imagination drives scientific invention. (Shapiro 2010)*

Both the work of single inventors and popularising of science are specific directions that are also apparent in today's scientific research. Initial ideas, sketches and drawings may be the start of subsequent extensively researched and scientifically accepted knowledge or even something that may have practical value for the society in a longer perspective. All kinds of talent searches, study programmes oriented to creativity and collective brainstorming clearly indicate that not only scientists are expected to provide answers to "big questions" but that anyone interested and knowledgeable can participate in it. Because we do not know who will become the next Nobel Laureate or "microscope inventor".

"Citizen science" is a term used quite frequently to describe collaboration between art and science. This term is confusing and until this date there are discussions on whether it encompasses individual enthusiasts' interest in science or projects sponsored by large scientific institutions involving members of the society that offer new value for science and the broader public. It is also not possible to identify the author of the term, however it is certain that this is a form of work based on the principle of voluntariness that encompasses the genuine desire to discover something new. And it is important that scientists themselves also participate as a side activity, going beyond their narrow field.[41]

The context of citizen science contains keywords "amateur", "autodidactic", "democratization of science", "home laboratories", "garage science", "crowdsourcing" and "distributed computing" in our contemporary world (Debatty et al 2011: 57). On the one hand, the words "amateur science" and "garage science" indicate a somewhat belittling attitude, on the other hand it permits work in exciting directions and use of research methods that advanced science cannot employ. It is important that our understanding of science as a very expensive and secretive field significantly conflicts with the activities of amateurs, the latter is too open, cheap and without excessive ambitions in order to be so-called advanced science.

A big breakthrough in citizen science is related to the 1990s digital revolution and wider reach of the Internet. The spread of information broadened but high technological resources also became cheaper and more accessible. Through sharing experience and a major cheapening of technology, mythical high technology became in quite a few fields a "do-it-yourself" (DIY) reality enabling participation on multiple levels. While high technology was mythical also for media artists in the beginning and it was addressed on the level of quite foggy dreams or primitive experiments, at present time it could be said that faith in utopian possibilities has been replaced by more practical inquiries and more decisive aims towards high technology.

An advocate of citizen and amateur science, the columnist Forrest M. Mims III, says the following in emphasising the fact that technological possibilities have broadened tremendously:

> *... modern science uses considerably more sophisticated methods and instruments than in the past. And so do we amateurs. When we cannot afford the newest scientific instrument, we wait to buy it on the surplus market or we build our own. Sometimes the capabilities of our homemade instruments rival or even exceed those of their professional counterparts. (Mims 1999)*

Why it is important to highlight citizen science? Because citizen science is very often also discussed in the context of media art, it is an art genre in close alignment with science and various high-end technologies. Although artists may be more careless and hasty in their research but they, in addition to individual inventors and groups of society included in scientific work, are an important force asking questions that are consequential and breaking

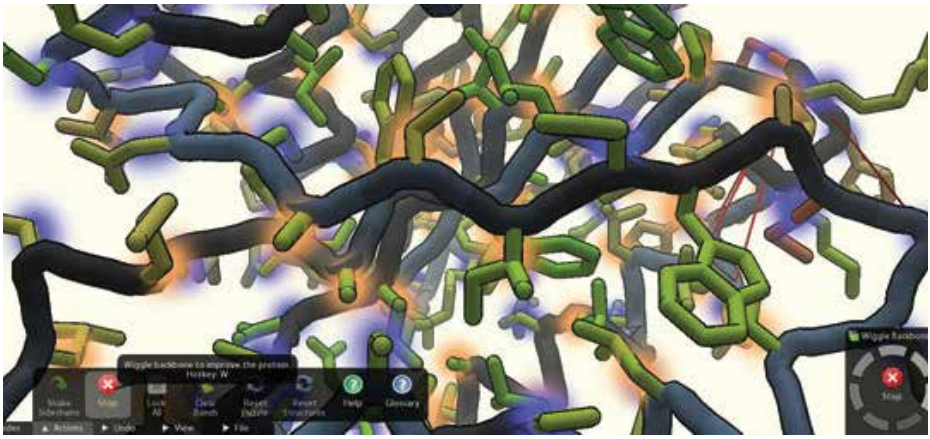


Figure 69: *The online game "Foldit" (2015)*

boundaries and for whom not expert knowledge but experiential knowledge is important (Debatty et al 2011: 59, 73).

Additionally, Mims indicates that ordinary people not only contribute to modern science with practical work but there is an increasing number of examples where authors of research papers include people from outside fields of science and it is accepted (Mims 1999). This fact is another proof of the fact that citizen science and subcultures in all their special forms are quickly growing and the potential that they have to offer to our culture must increasingly be taken into consideration. Because next to science and creative work, activities of the social society will grow more important in all their shades.

Citizen science initiatives in society

The inclusion of large groups of society in scientific work is a widespread practice in many fields. One good example is the study of nature and birds. The bird watching project **"Christmas Bird Count"** has been credited as a pioneer in citizen science, held for more than 100 years.[42] Scientists are also engaged in similar work, for example in the Cornell Lab of Ornithology in the United States and in numerous other scientific institutions.

An exciting field that can also be pointed out as an example of society-based initiative is amateur astronomy. The study of stars and monitoring of satellites requires the participation of far more people than the resources of science centres permit. A special science award is given to amateur astronomers since already 1979. Examples of projects that have received wider recognition are **Seti@Home**, **Stardust@Home** and **Galaxy Zoo**.[43] The latter of those is a project that started in 2007 and invites volunteers to view galaxies and define their visual characteristics. Already in its first year it attracted more than 150,000 participants from across the globe.

The popular online game **"Foldit"** that was created in collaboration between artists and scientists is a good example of the use of online gaming technology by project creators to demonstrate and offer participants to intervene in creating three-dimensional chains of amino acids. Project creators optimistically invite all Internet users interested in science and supporting science to download their programme and place acids in chains.[44]

It is also interesting to note that amateur scientists and volunteers are not only willing to contribute their time but also money by using personal funds to conduct studies. For example, French taxi driver and self-taught entomologist Pierre Morvan has for 20 years spent his free time in the Himalayas where he studies beetles. This indicates that large science foundations, good funding and research teams comprised of many scientists may not be the only possible prerequisites for giving birth to new discoveries. (Mims 1999)

DIY, open source and hackers

The hacker culture, tactical media and *bricolage* are largely based on DIY philosophy and the sharing of free software (Tenetz 2013: 156).[45] These are voluntary initiatives born from the need to interpret science and technologies, find simple and creative solutions that do not depend much on the criteria of advanced science, academic institutions and interests of the business world.

Open source software and hardware platforms such as openFrameworks, Arduino, etc, are of substantial assistance to artists in creating their works. As was also described in chapter 2.6 the activities of A. P. I. in creating technology through which people in the North are taught development of radio communication tools based on the schemes and software of cheap, simple and accessible Arduino, another example also concerns Arctic regions – at Kilpisjärvi research station, those same A.P.I. creators, artists Matthew Biederman and Marko Peljhan used unmanned flying drones known from crisis regions (2012). (Tenetz 2013: 154) As drone usage is moving more into civilian hands, a so-called culture of drones has become a discussion subject (Kroker, 2013: 74). The activities of Biederman and Peljhan could indeed be described using two goals: **1)** objective information about the ground surface and its various terrains, **2)** giving an additional dimension to perceiving the environment, discussion about how technology widens our space of perception.

One vivid example of free software use also concerns my work. In 2007, we organised as part of the Plektrum festival in Tallinn an urban event called **"Lasertagging"** in which we used a special freely distributed software to display virtual graffiti on a gigantic building wall. L.A.S.E.R. Tag software (graffitiresearchlab) do not talk much about themselves but their extensive practical work is grouped under the slogan "Free Art and Technology!" and their aim is to supply artists with open source software that could give character to the urban space.[46]

Free sharing and collective voluntary initiatives are also related to hackers because the boundaries between DIY movements, free software distribution and hacking are blurred. Who are hackers? A very broad answer could be – anyone. They are operators who represent a very powerful subculture phenomenon but about whom we know the least because they generally do not wish to disclose their identity, they also do not care about institutional membership. They are not afraid to create or modify any technology on their own, they are often characterised by anarchist behavioural patterns because their activities are generally not limited by academic approaches, copyright, patent agreements or the Commercial Code. At the same time, their goals are mainly altruistic and they are sincerely interested in "how things work". (Debatty et al 2011: 29–31)

But there is one other opinion that directly relates hackers to artists' activities. The radical attitude of hacker artists has roots in 20th century art, we only need to examine the attitude by Marcel Duchamp, Pablo Picasso, Andy Warhol, Roy Lichtenstein and others in the relations between the original and copy in art. Because the rejection of this same relationship is also one of the main principles of hackers – everything can be modified, replicated, copied. Other characteristics can be found from the so-called "tactical media" movements that wish to convey far more with radical actions than merely about technology. (Ibid.: 30)
Timo Toots also points out an idea about art and hackers:

> *On the websites that I go to, people often do not engage in art but I see a lot of creativity there and I very much like what they are doing. Maybe I could even point out a parallel with naïve art – hence, I visit naïve media art websites. People engage in projects that they do not refer to as art... these are some hacker sites where items are repurposed, they are creating whole new items and their attitude to technology is extremely creative. (Toots 2014)*

In the context of hybrid art, an important example is also the DIYbio movement, its aim is primarily to bring together enthusiasts and open discussions on biology, as well as sharing professional and technological information and information about safety.[47] It is understandable that artists interested in biology and hybrid art forms also take part in these discussions –

Figure 70: *"Voestalpine ABC-Klangvolke", Ars Electronica festival 2012, Linz (2012)*

on one hand, grassroots treatments of biology and the availability of means make biology a medium that is ever easier to deal with for art objectives; and artists can so participate as "ethically thinking catalysts of society".

As an intersection between bioart and hackers, the activity of **hackteria.org** is undoubtedly worthy of mention.[48] It is a unique web platform created to share bioart ideas and collect works in 2009 with highly ambitious goals – introduce bioart, free hardware and software, DIY biology, broader collaboration between art and science and technological experiments in biology. The founders of the web platform share not only information but invite everyone to intervene, discuss and participate in workshops both on the individual and institutional level. Keywords might be enthusiasm, widening thinking, as well as a global network and open future. In a way, what is also exciting is the fact that even though the aims of the hackteria.org website are not limited to disciplinary or regional boundaries, part of the activities it is involved with is related to Asia (including Indonesia). This is a vivid example to demonstrate that the world contains no isolated regions in terms of science and art, it clearly shows that the current division of the world into "us" and "third countries" is not justified.

Having arrived at addressing boundaries, one must also talk about the attitude of political power structures towards voluntary movements. The head of the Finnish Bioart Society, Eric Berger, told a story about how at the DIYbio Outreach Workshop in 2012 in the United States, local FBI was also represented. The meeting was allegedly set up due to the FBI's desire to be better informed of the activities of biology enthusiasts. I am not aware of any previous cases in art history where artists attract such an acute interest of power structures. Artists expressed their categorical objection to such a "controlling eye" – they found that this does not constitute communication on equal grounds. Just like media, power structures also see artists' activities from the wrong viewpoints – by underestimating their abilities and overestimating the possibilities for violating ethical principles.[49]

Socially shared authorship

Media art practices that have become prominent lately indicate clearly how important the aspects of societal inclusion and shared authorship have become next to science and technology. Therefore, I dare to opine that there are many potential developments, i.e. many future genres, more and more groups of society will participate in science who have so far not been considered as creators in the context of traditional scientific work. In addition, several different levels in scientific research, allowing to approach human existence using extraordinary methods.

I would like to add a part of my article about social intervention of art making:

> *A boundless opportunity to change daily lives using smartphones and other technological devices is a tremendous source of inspiration, global Internet offers unprecedented interconnection and opportunities to feel included in the society in very different ways, by commenting on it and to innovatively take advantage of these opportunities.*
> *An example is the social event titled Voestalpine ABC-Klangvolke of the new media art festival Ars Electronica held in Austria in 2012. The close to 90,000 people who came to Donaupark, the popular leisure destination of the city of Linz, enjoyed a powerful light and audio show demonstrating collective creation in its most direct sense. Crowds were included in the preparation of the party already days before, enabling everyone who wanted to make large cardboard letters for themselves equipped with LED lights and special radio receivers in various workshop locations around the city. The letter sculptures that were beautifully and very personally decorated, worn by people above their heads, were connected into a radio network and were made to blink according to the rhythm of the music and the creators' ideas using complex technology in real time. Letter holders applied their creativity in all kinds of ways, forming words and sentences with meanings that were a big surprise for the authors (idea by Hideaki Ogava and Emiko Ogava) of the project (e.g. "Release Pussy Riot", "We love social equality"). For those that were indifferent towards the used technology, it was just a great show in the dead of the night, for those with a deep interest it was a highly poignant approach to unite people and make them work together for a collective idea. A deeper question by the creators of the idea was how do single letters form messages for us, what power do letters, words and sentences have in our global village of today. It is after all ideas constructed of those that are the basis for our communication, no single letter has great significance but by combining to form words, sentences and phrases we create meaning. (Piirma 2013)*

When addressing time in terms of the future, it must be said that even though futurology as a genre of thought is popular, particularly in the context of technological progress, people are careful when describing potential futures. How well can we predict future developments in culture or science? Any predictions regarding the increase in the pace of technological progress and efficiency of scientific research upon the adoption of increasingly powerful technology sound mystifying although the arguments confirming such views seem poignant. Speaking of practice – real life, various popular and pop-culture phenomena, the spread of popularity of social networks and weakened authorship in cultural creation indicate that besides top-level science and high technology very different genres of thought and creative groups operating on various levels must be considered because the future is not merely about the technological capability of humankind. This is the reason why I described a social project that is quite simple but involves many authors. This might be one of the potential futures in which the transdisciplinary approach is still gaining confidence. Hence, it is reasonable to conclude with the words of Basarab Nicolescu:

> W*e are now living in a new period of the advancement of transdisciplinarity. The theory of transdisciplinarity is fully developed. Now time for action has arrived. In the past, our actions were concentrated in the field of education, a fact which is natural because of the central role of education in individual and social life. But now are obliged ethically to extend our activities in the scientific, social, political and spiritual realms. (2007: 154)*

5 OVERVIEW OF FINDINGS

Introduction

The objective of this research paper is to utilise theoretical and practical approaches to seek answers to questions pertaining to co-functioning of different disciplines (art and science). Why is this topic important? Because both are situated in the world around us, neither of them is isolated; they exist in a net of exciting reciprocal influences. A more holistic inquiry into the world and the surroundings is equally important for both artists and scientists and the main goal is to optimise the knowledge that is yielded by the research.

The term is used in this dissertation for artwork in which the two of them, art and science, meet is "hybrid art". Although new and exciting directions far exceed the established genre definitions and evaluation criteria permit, I hold that the phrase "hybrid art" is the best characterisation of artwork that transcends the boundaries of different and at ostensibly incompatible disciplines. The term artscience is also in use in some cases – it, too, refers to the inter- or transdisciplinary collaboration and cooperation between science and art.

Transcending boundaries, the increasing interest in the humanities regarding science and the merging of fields all led me to study what the terms "interdisciplinary" and "trans-disciplinary" mean. Interviews I conducted in the course of the research with Alan N. Shapiro and Madis Listak yielded interesting indications of how the interdisciplinary methods of inquiry and creation have reached the next, even more deeply analysed stage of development – the transdisciplinary level. The latter takes into consideration broader contexts than before, and questions that are not only within or between disciplines but in fact beyond disciplines. As to how science impacts art or vice versa, this becomes clearer through practical examples of art and collective initiatives, which are described in the various chapters and sections.

RESEARCH QUESTION 1: How to understand cooperation between science and art? How does this influence my art practice and contemporary media art in general?[51]

To resolve this question, the following topics are studied: 1. differences and similarities between disciplines; 2. common goals of artists and scientsists; 3. Similarities and differences between results – prototypes and scientific/useful models.

Differences and similarities of disciplines

To analyse interdisciplinary cooperation, one has to mark the boundaries as to what should be construed as art and science, and what are the differences and similarities. In chapter 4.3, "Differences and similarities of the results: Question about prototypes and scientific/useful models", I highlight a comparison based on Jill Scott's system where she categorises science as cold and strong and art as warm and soft, adding keywords to each. The table below has a few more keywords that I have added to show that such a categorisation may not apply to interdisciplinary cooperation – nearly all the keywords are intertwined. Thus artists and scientists alike work in a broad field with a potentially endless number of results.

COLD/HARD/SCIENCE	WARM/SOFT/ART
Reliable – *mutable for wider audience*	Mutable – *reliable for art society*
Well-defined / *area of many possibilities*	Ill-defined / *area of many possibilities*
Comprehensible – *not comprehensible for wider audience*	Not comprehensible – *more comprehensible for wider audience*
Sharp / *new undefined questions*	Flaccid or spongy / *sharp in terms of art audience*
Precise / *new undefined questions*	Imprecise / *new undefined questions*
Difficult – *easier to understand*	Easy – *difficult to understand*

Common goals of artists and scientists

Besides art practice and several interviews, theory of cooperation between science and art plays an important role in this dissertation.
In chapter 4.2, "Collaboration between Art and Science: Common goals", I describe characteristics of interdisciplinary research. These each have techniques characteristic of science and the humanities. For this reason I call the activity of both artists and scientists "creative practice" because both cases involve a search for new questions and research fields.

Creativity and creative practices are what incite:

- the asking of new questions;
- asking for new possibilities and methods that lie outside the fields we engage in ourselves;
- find solutions for which a rigorous scientific way of obtaining proof may not exist but that are of a pioneering nature;
- involve so-called "external observers", i.e. partners from outside a specific discipline.

The same chapter lists the principal features that characterise the roles of both sides in the collaboration (artists and scientists) in interdisciplinary cooperation.

Artists' role in collaboration with scientists is to:

- ask questions expanding scientific approaches;
- ask questions that differ from the opinion of scientific expert systems;
- ask "wrong" questions, thereby indicating the obstacles that a researcher deeply focused in their own discipline may not perceive;
- publicise and interpret scientific messages, be the so-called demystifiers of science;
- pose questions within the discipline, between disciplines or before the broader public about the ethics of science and culture;
- be the catalyst in creating a new situation to research;
- thereby create opportunities for cultural and scientific development in terms of a more united approach to the aggregate.

Scientists' and engineers' role in collaboration with artists is to:

- invite artists "down to earth" from their grand visions, i.e. restrict grand ideas to problems that can be narrowed down and resolved;
- show the option that "verifiable knowledge" can be an important link between artists, scientists and the broader public, i.e. general understanding starts through the precise definition of the problem and mapping of potential working methods;
- show that the result may also offer a completely functional solution in addition to the aesthetic experience or raising new questions with inchoate boundaries;
- interpret artists' ideas in the name of scientific knowledge, thereby finding new research questions;
- be the catalyst in creating a new situation to research;
- thereby create opportunities for cultural and scientific development in terms of a more united approach to the aggregate.

Differences and similarities of the results: Question about prototypes and scientific/ useful models

The discourse concerning differences between results attained by scientists and artists sprang from my first collaboration, "Holy Cow", which was conceived at the Tallinn University of Technology Centre for Biorobotics in 2010.
In a conversation with Madis Listak, a robotic scientist, we discussed whether we could notionally categorise artists' results as prototypes and scientists' results as scientific/useful models. This is in spite of the fact that both sides proceed in their work from creative thinking, asking new questions and using working methods that are not always within their specialised remit, and thus their results are different.
The main difference in evaluating results is that in science, the research results are mainly explanatory and descriptive, while in art, the result generally raises additional questions and is "fuzzy."

Based on the above-described discussion, we can conclude that there are no firm boundaries between an inquiry conducted in the fields of science and art because:

a) the borders between science and art are personal, and do not follow the dividing lines between disciplines.
Classifying science and art using categories such as "cold" and "warm" is not all that objective, as there are people in every discipline who understand other disciplines and are able to position themselves taking into account all disciplines. Thus the boundary between "warm" and "cold" does not follow the boundaries of professional competence but instead takes into account personal aptitude. (*see chapter 4.3*)

b) the terms prototype and scientific/useful model are in use in both art and science.
Although the results of artists' work can tentatively be called a prototype and the researcher's result a scientific or useful model – mainly due to the time spent on it, the precision of the solution and the difference of reproducibility – each of these terms is found in both science and art. Rendering analysis of the topic especially complicated is the fact that in art, there is a fine art and an applied art side, just as we distinguish theoretical science and experimental science on the science side. Nevertheless, my goal was never to distinguish science and art by setting criteria but instead to bring them closer together. These terms are highlighted to show that we use similar expressions and finding a common working language to meet common goals is not as remote a possibility as one might think. (*see chapter 4.3*)

c) the knowledge obtained from the research is different.
The knowledge obtained from research is very important in describing the results.
If a researcher proceeds from the principle that expert knowledge achieved in the case of the matter studied, the goal of artists is to achieve experiential knowledge. But today's research, collective objectives and outcomes are described well by the idea that both art and science strive through approximation to optimisation and standardisation of knowledge, even though they contain different attitudes, methods and instruments for presenting complicated acquired knowledge. (*Orkan Telhan, see chapter 4.1*)
An exciting question related to transdisciplinary research came up, too – whether ALL directions and phenomena we perceive could be present in the creation of science. Why are esoteric and paranormal phenomena not utilised in science?
A well-known Estonian philosopher of science Ülo Kaevats has said that first of all, the knowledge has not yet "matured" to the required level, and thus could lead to fatalism, randomness or chaos. Secondly, any kind of knowledge that cannot be rationalised is non-scientific knowledge, a evidence-based knowledge must be related to a possible rational explanation from the outcome of practical activity (2009). (*see chapter 4.1*)
Still, assuming that time, process, system dynamics and information are also important alongside the investigation of object, subject and the relationship between them, rational proof cannot be the only basis. Questions that cannot be defined from the standpoint of provability also have to be taken into consideration as lines of reasoning. Combining multiple

one research areas can lead to more new approaches to science; it is no longer possible to declare these taboo, and the distinction of "scientific or provable knowledge vs non-scientific knowledge as irrational and unknowable" does not necessarily have clear dividing lines.

d) the role of the artist in visualising and publicising is secondary.
The question of visualisation and public communication is also an important aspect. Conventional wisdom is that the artist's work involves visualisation and publishing of scientific activity. This could be true in a certain sense if the objective was set out as such and we are talking about the designing of research results in the sense of applied art. This cannot be treated as actual cooperation, however, but rather as a relationship between the customer and person executing the work, and this relationship lies outside our current discussion.
Speaking of fine art and science-art cooperation practices, it must nonetheless be stressed that the most important thing is artists' ability to ask the "wrong" questions or ones related to the ethical side of science, thus creating ways for finding new approaches in research and a unified theory that is more consistent from the standpoint of development of culture and science. (*see chapter 4.3*)

e) the time spent on investigation and the material resources vary.
One of the most salient issues is about the time spent on research. There is a fundamental difference in the results produced by art and science – the former often develops merely thin, sparsely-tested and poorly functioning, unstable systems where instead of operating reliability it is important to present a fresh idea and to precisely time its publication. A scholar can permit him or herself very long research periods, in which case the awareness that it did not produce the needed result or yields negative responses is itself valuable. The specifics of an artist's work requires constant public communication, however, and a long process without outcomes does not substantiate his or her work as an artist. (*see chapter 4.3*)
What is also certain is that science and high tech have been extremely costly over the years and this makes it difficult for media artists to operate. Even though in chapter 4.4.4., I discussed how technology is becoming cheaper, and DIY movements and civil initiates are springing up, many media art projects still require state of the science labs that do not come cheap.
We can rightly ask whether the time and money that is to be spent on hybrid art is justified and generates corresponding intangible gains in the form of the audience's satisfaction or informing society, or is what artists doing in the lab merely flirting with science, and wasting scientists' money and time. In certain cases, the latter can indeed be the case if the parties engaged in cooperation set the wrong goals with regard to each other. Such collaborations are not inter- or transdisciplinary cooperation in the deeper sense. Thus artists who enter the lab have to thoroughly prepare their work, set goals and optimise their activity. Only in this manner can substantive cooperation happen. An artist who enters the lab has to first ask the question: Why? (Why did he or she come here?), not What? (What does he or she wish to create?).

RESEARCH QUESTION 2:
How to interpret the terms "interdisciplinarity" and "transdisciplinarity" in the context of new media art?

How to approach art practices that integrate science and fine art? The terms "interdisciplinarity" and "transdisciplinarity" are most common in precisely this context. But first, let us define the terms for the reader and explain why it is important to treat them in the context of new media art.

Interdisciplinarity and transdisciplinarity

These two terms give us a few avenues for understanding and interpreting hybrid forms of art and science. To examine the possibilities of interdisciplinary collaboration, will be looked at the background, bringing out the most important aspects of interdisciplinary and trans-

disciplinary collaboration and showing that above all, transdisciplinary research should be our focus, as it allows to ask questions that have not yet been asked.
The fundamental differences between interdisciplinarity and transdisciplinarity are highlighted and referred to the fact that today's transdisciplinarity does indeed essentially transcend disciplines, but instead of totally denying the boundaries between fields, it behoves researchers to devote more in-depth study to the specifics of various disciplines.
While interdisciplinarity – a term from education and educational science – combines two or more academic disciplines to create a new and unique one, the main property of transdisciplinarity is an even more radical crossing of disciplinary borders. I.e. becoming engrossed in questions that are outside disciplines.
In elucidating transdisciplinarity, I rely on the theory of B. Nicolescu, in which he brings out its principal characteristics – three methodological axioms (ontological axiom, logical axiom and epistemological axiom) in which he concluded that:

1. there are different levels to understanding of reality
2. the transition from one level of reality to another succeeds as there is a third level, the included middle, between these realities);
3. perception of reality has a complicated structure where each level exists simultaneously and because all other levels also exist.

To sum up: there aren't necessarily "yes" or "no" answers to scientific questions; there is also a middle way. A "third", "fourth" or "fifth" level of understanding and interpretation are always possible in the case of knowledge. In this sense we can no longer see the world only in accordance with a logical explanation or sensibility. Based on the understanding of knowledge – knowledge is always open. (*see chapter 4.4.2*)

If the substance of interdisciplinary and transdisciplinary inquiry is not fully grasped, the following "developmental problems" can occur:

- the interdisciplinary and transdisciplinary goal can remain just a slogan, as there is no interdisciplinary dialogue or it was constructed on a fallacious or unequal footing;
- any academic treatment becomes vague and dilute, a hybrid form with no sustainability;
- the interdisciplinary or transdisciplinary field becomes institutionalised to the point that it becomes closed up within the confines of the new discipline and ceases to be interdisciplinary or transdisciplinary, i.e., it risks remaining closed to other research areas.

How do these terms fit into the context of new media art? In what examples of art can we see inter- or transdisciplinary collaboration? A large part of the examples I describe, including my own art practice, is predominantly interdisciplinary if we assess the results of the work. I.e. the boundaries of the discipline are quite plain – robotics – art; biology – art etc. But lines of reasoning are in contrary motion, and artists and scientists who continually ask bolder, more transgressive questions look confidently toward the future; interdisciplinary cooperation groups have the potential of finding questions where transdisciplinary methods are used to resolve them. I therefore find that transdisciplinary thought contains a key to resolving many important questions that have previously run up against the obstacle of the boundaries of disciplines. Hybrid art is one way of mapping these questions.

RESEARCH QUESTION 3:
What is hybrid art and what are the most important working methods for this art form? How can hybrid art forms be seen in the Estonian context?

What is hybrid art?

The expression Hybrid Art was first largely mentioned as the title of the 2005 Ars Electronica festival. The impetus of the selection of topic was to examine the explosive impact of technologies on society, to bring various cultural forms and their blurry boundaries closer to

one another. But the lack of precise definition of today's lines of thought allows us to use the world hybrid (in the sense of artwork) in many other areas that do not integrate technology with art in the most direct sense of the word.

What phenomena might be analysed in the sense of future-oriented hybrid art?
As the term "hybrid" comes among other definitions also from biology, it is understandable that one of the very definitive directions of hybrid art is bioart. It is an art current with importance for the future in the sense that science, too, is recognising more and more of a need to treat biology as co-existing with other scientific forms.
I have detailed my personal developments in cooperation between art and science (*see chapter 2*), I have surveyed Estonian artists and scientists (*see chapter 3*), studied examples of hybrid art from elsewhere in the world and also bioart as an exciting direction in media art, and I have also compared the results of scientists and artists' work (*see chapters 4.2 and 4.3*). From this, I gained answers to the question of what the working methods of hybrid art are – on one hand, they are adaptations of techniques used in science; on the other hand the roots of hybrid art lie deep in modern fine art developments. I.e., the art direction I study takes into careful consideration all of the possible media and idea-trajectories, as this is its basic nature – thoroughly seeing one's surroundings, studying them and asking questions about it all. Through the examples I analyse, it can be said that for hybrid art practitioners, there is no scientific discipline they are not interested in. In spite of the ostensible confusion in finding a common term for the methods in this field and for setting criteria, it can be said that it is a energetically developing research and practical field.

What to make of hybrid art from the perspective of the audience?

Audiences have a hard time understanding hybrid art for very many reasons. In the following, I detail some of the questions that I have tried to find answers to in my theoretical and practical activities.

a) The substantive complexity of scientific research texts

Justified questions regarding the viewer's competence came up in the process of creating and presenting the exhibitions "Hybrid practices and "Hybrid practice – from general to specific". (*see chapters 2.1 and 2.2*) To what extent must the artist be proficient in the knowledge used in his or her work? And to what extent must the audience understand the work in its displayed form? It is clear, that that fruitful collaboration can only be based on mutual understanding – the parties taking part in the work must be capable of intellectually comprehending each other. Although it is complicated to expect both parties to understand perfectly the theories and to be proficient in each other's working methods, both parties must make compromises – i.e. go back a couple steps to the level of ideas. All parties have certain roles in this collaboration. What is important is not to weigh who is more competent in a given area but to merge their roles toward a common goal.
There are also very different art audiences – those with a sincere interest in the idea or theory behind the work; those who focus on the primary visual experience; and ones who create their own individual experience of knowledge on the basis of what they experience. None of these groups should be written off, as the role of both art and science is, above all, to be a definite part of the development of society, and understanding the work at different levels enriches culture in the broadest sense.

b) Complexity of technological solutions

At new media art exhibitions, artists experience situations that typify the audience's confusion with regard to the creation of complex technical solutions and public understanding of them. It often happens that a major work of research remains remote due to the complicated technological content or the work's mechanical part experiences a technical malfunction. Installations don't work or the use of interactive materials is so complicated that more casual exhibition-goers skip them. Yet there are more successes each year, because just as the technical means at the disposal of artists are broadening each year, audiences, too, are much

more knowledgeable about science and technology, more bold about using the various opportunities afforded by interactivity. There is also a discernible trend of technological solutions growing simpler. Instead of complicated solutions, interest is focused on concepts with less technological trickery.

c) Educating artists

An important aspect is to educate the artists themselves, to familiarise them with the work in the fields, to find ideas and research questions and to convey their message to the public. One possibility is to hold workshops that give artists a good way of learning about institutes, research centres and labs to set directions for future research. January 2012 saw a bioart workshop *"Elu märgid"* (Signs of Life) take place at the Tallinn University of Technology. The goal was to give architecture, design and new media students theoretical and practical knowledge about synthetic biology. As an example of bioart, which was described in chapter 4.4.3, A.P.I. (Arctic Perspective Initiative) and the Finnish Bioart Society's activity in educating artists and staging collective actions. Thus we see that many labs have opened their doors, and the public is not only being educated in the galleries when it comes to creating and presenting hybrid art forms.

d) Understanding the importance of artscience at the institutional level

A conference held at the Estonian Academy of Arts, "Art and science – hybrid art and interdisciplinary research" and the related exhibition "Rhizope" was initiated by the academy's doctoral school and the graduate school of cultural studies and arts. (*see chapter 2.3*) The core idea of the event was to hold interdisciplinary cooperation between different universities and disciplines. One of the keynote speakers, Simon Penny, stressed in his article "Interdisciplinarity in theory and practice" that interdisciplinarity is one of the new symptoms of an academy with disciplinary structure. And one of its outputs is hybrid art, which is seeing the practical implementation of the idea of merging incompatible disciplines.
Penny says:

> *Interdisciplinarity has of late become a mantra of universities because, presumably, it has been noted that significant innovation originates form outside disciplines at least as often as it originates from within them [...] If the entire institution cannot flow, then at least one hopes that there can be some flow around and between the immovable objects [...] An instrumental approach to interdisciplinarity brings together practitioners of relevant backgrounds to address complex projects which demonstrably cross disciplines, for example, the designing of a levee system to protect a city from floods while maintaining river ecology and navigability for cargo transport.*
> *The second mode is more abstract and is addresses epistemological and ontological concerns: the elucidation and clarification of the structures and commitments of disciplines themselves and the relations between disciplines. Such consideration can in turn lead to a third function: the identification of new areas of research and practice. This third can arise out of the first, but without serious commitment to the second, it may founder on misunderstandings arising out of mismatches of technical jargon or, more deeply, incommensurabilities in the assumptions which ground disciplines. (2014)*[50]

e) If artscience/hybrid art a topic for science centres or art galleries? How do science centres and art galleries present artscience?

As was mentioned in chapter 4.3 that the boundaries between the overlapping parts and differences of science and art are personal and not related to a given discipline, we have to take into consideration the persons who wish to present their work. Even though the boundary doesn't run directly along the lines of disciplines, we see clearly that artists engaged in artscience find their outlet above all through presenting their results in galleries. The reason is the context into which we wish to place a work and the goal of the intended audience and purpose for the work. Hence galleries are, in terms of their openness, more available to the general public, they are so-called public venues that can be entered by anyone. But the research centres and

universities that gladly present such collaborations are in no way out of the question. One good example in Estonia is the Veronika Valk-curated artscience exhibition *Elu märgid* (Signs of Life), which was aired in 2012 at the Estonian Academy of Sciences and the University of Tartu Institute of Molecular and Cell Biology.

The Estonian context

Above all, I proceeded in drawing conclusions from my own art practice (three exhibitions – "Hybrid practices", "Hybrid practice – from general to specific" and "Rhizope"). (*see chapters 2.1, 2.2 and 2.3*) Based on my conclusions, the following ideas characterise Estonian artscience practice:

- even though discussions held at foreign media art festivals and conferences have long centred prominently on art and science collaborations, this direction in Estonia is only now crystallising and there is a lack of well-funded cooperation programmes;
- it is easy to contact scientists, but it's another matter how fruitful and mutually comprehensible the collaboration will end up being in practice. I.e., collaboration based on simple personal contacts and letters proved possible, in all cases, it was enough just to clearly express one's idea, interest and forthcoming attitudes from scientists;
- Thanks to a situation where there is a lack of clear boundaries in artscience, Estonia is a great place to also present works that may be banned elsewhere;
- as to broader publicity for artscience in Estonian cultural life – the exhibition "Rhizope" pointed both to the existence of this art form as well to artists' definite role in creating academic scientific work. I.e., awareness may increase regarding artists' thus far unclear role as researchers and scientists.

But apropos of the Estonian context, we should also note the more important ideas advanced by a number of Estonian artists and scientists I interviewed. The following conclusions can be drawn regarding them:

- The prevalent directions in Estonian media art follow very carefully outside developments – the development of free ideas, broader theoretical and experimental science practices and the DIY movements that due to their fairly incidental occurrence should only now start to be mapped and which do not depend too much on national boundaries (Timo Toots). (*chapter 3.3*)
- the interdisciplinary programmes established on an institutional level do not necessarily ensure fruitful cooperation. Thus spontaneous creative communities that have arisen due to internal need also play a very important role (MIMproject). (*chapter 3.2*)
- Estonia media artists undoubtedly have a major need to place themselves in the world context. Even though it isn't a goal unto itself, it is important to be "visible" in scientific inquiry as well as in the broader art perspective, which means, present one's work in Estonia thoroughly but also find outlets abroad – the feedback from foreign exhibitions can be much more substantial than Estonian reviews (Kärt Ojavee). (*chapter 3.1*)
- Estonian scientist are very open to new ideas and they are motivated to take part in projects that incite interest. For scientists it's important that their work and science centres communicate with the outside work and that they find new potential angles. (Madis Listak, Inga Lips, Karin Ojamäe). (*chapters 3.4, 3.5*)
- Estonia is a small country which is seeing exciting internal developments, yes, but in the sense of technology and science, many centres of research are affiliated with key international centres, as domestically it would not otherwise be possible. Thus artists have a theoretical possibility to become familiar with what is going on in larger institutions.

A final word

In the context of hybrid art and bioart a question justifiably comes up: can there be unforeseeable consequences if scientific means and data fall into the hands of artists or amateur scientists?
Undoubtedly, unscientific use of technology and unethical goals are a problem in today's world, but artists' critical nerve and desire to bring urgent questions into the public eye tends to be driven by a desire to educate the public and draw attention to undesirable developments, nipping them in the bud. In particular, it is questions about the ethics of potential scientific developments that spurs, say, bioartists to engage in broader public outreach.
The last decade has also seen many art exhibitions that deal with man's ecological footprint and climate change problems. And broader awareness and public interest cannot certainly lead to undesirable developments – the more we know, the better we are able to understand the future developments.

It is also important to understand that in addition to their artist careers, many media artists are also active as scientists; thus it is misleading to consider them to be dealing with areas they don't understand, or that they are misusing information and means. On the contrary, their work stems from the need for broader understanding and more public discussions.
The fact that centres of scientific research are increasingly involving "ordinary people" in their work points to the need for fostering broader understanding and a more thorough knowledge.

In what sense is this work of research important and special? First of all, it is a topic that has become more and more popular, it is forward-looking and allows artists and scientists to find solutions based on common cooperation in understanding the world. In this sense, broader groups in society are engaged, and there is reason to believe that the analysis of the topic will result in cultural dividends in the Estonian context and beyond. The topic is also important because the methodological techniques and evaluation criteria in hybrid art are only developing.

Above all, I want to survey my art practice and moreover, show that there are enough examples in Estonian art practice in general to put us clearly on the hybrid art map and to show that we are especially open to participate as scientist and practitioners in the wider global context. Additionally, it is exciting to note the fact that the creation of interdisciplinary cooperation on the local level is extraordinarily easy, even though there is as yet no support for it on academic or foundation level.

In connection with organising the exhibition "Rhizope", I can add that such undertakings in Estonia require much less material resources, and projects that arise as interdisciplinary collaborations are even now based on altruistic motivations; there is also a lack of major institutional obstacles to such cooperation. Yet the most important factor that describes the Estonian context is the fact that our small country has become very aware of the need to be on the world map – we have the courage to invite well-known artists and theoreticians to speak here and develop lines of thoughts that could end up generating broader social benefits in the future as well.

The 1920s Bauhaus slogan, "Art and technology – a new unity!" will probably never become an unvarnished truth, but I do appreciate McLuhan's description of (media) art as a cultural "radar" that helps us understand the processes around us better (1964: xi). In tracking the hybrid art phenomena that have come up in public in the last years, I can say that dreams of mechanical steel robots have been replaced with an interest in synthetic biology, genetic and nanotechnology, increasingly wider-ranging art forms are boldly adapting scientific fields that no one dared dream of a decade ago. Art forms have become dissolved in each other.
And not only that: art and science are forming exciting symbioses on the strength of numerous fertile projects. This can only bring greater benefit to culture as a whole. Critical questions are not asked only about everyday life, politics, the economy or globalisation but topics like environmental themes, bioethics and the sustainability of life on Earth are also important. The more questions there are, the greater the possibility that culture will influence society and general development in a positive direction.

6 KOKKUVÕTE

HÜBRIIDSED PRAKTIKAD
Kunst ja teadus loomepõhises uurimistöös

Käesoleva uurimistöö eesmärgiks on läbi teoreetilise ja praktilise tegevuse otsida vastuseid küsimustele, mis käsitlevad erinevate valdkondade (kunst ja teadus) koostoimimist. Miks see teema on oluline? Sest mõlemad, nii kunst kui teadus, eksisteerivad meid ümbritsevas maailmas, kumbki neist ei ole isoleeritud, vaid need toimivad vastastikku põnevates mõjusuhetes. Maailma terviklikum uurimine ja ümbritseva kohta küsimine on nii kunstnike kui ka teadlaste jaoks võrdselt oluline ning põhieesmärgiks on uurimisest saadava teadmise optimeerimine.

On selge, et piiride ületamine, humanitaaralade järjest tõusev huvi loodusteaduste vastu ja näiliselt ühildamatute valdkondade sulandumine on tänapäevane nähtus, mis nõuab uut terminoloogiat ja käsitlusi. Kunstiloomingut, milles ühinevad kunst ja teadus, nimetan ma hübriidseks kunstiks. Ehkki uusi põnevaid suundi on kaugelt rohkem, kui senikehtestatud žanrimääratlused ja hindamiskriteeriumid võimaldavad, leian, et sõnapaar „hübriidne kunst" iseloomustab kõige paremini kunstiloomingut, mis erinevate ja näiliselt ühildamatute valdkondade piire ületab. Samuti on mõnel puhul kasutusel termin „teaduskunst", mis viitab samuti teaduse ja kunsti valdkondadevahelisele ja –ülesele koostööle.

Uurimistöö meetodid

Praktilist ja teoreetilist uurimust läbi viies on kasutatud väga erinevaid strateegiaid: kunsti ja kultuuri uurimise strateegiad, meediakunsti uurimise eristrateegia ja teadusuurimuse strateegiad. Viimaseid olen püüdnud hoolikalt jälgida, sest minu töö iseloom nõuab teatud määral ka reaal- ja loodusteaduste töömeetodite mõistmist ja nendega arvestamist.
Metodoloogia, mida kasutan, on välja arenenud minu doktoritöö teemaga tegelemiseks kulunud aastate jooksul, võlgen tänu paljudele eeskujudele ja autoritele, kelle töid, seisukohti ja meetodeid olen eeskujuks võtnud. Väitekirja pealkiri sisaldab viidet kahele erinevale valdkonnale – kunst ja teadus, seega püüan omavahel siduda põhiprintsiipe, milleks on nii kvantitatiivne (andmete kogumine) kui ka kvalitatiivne lähenemine (interpretatsioonid). Ehk teisisõnu, selleks, et kunsti ja teadust koostoimivana näha, tuleb mõista mõlema valdkonna töömeetodite eripärasid ja püüda neid ka kasutada.

Käesolevas väitekirjas püüan ma lähtuda eesmärkidest, mis jagunevad 4 põhikategooriasse:

- isiklikud kogemused, mis on seotud näituste ettevalmistamise ja läbiviimisega;
- intervjuud valitud ala professionaalidega;
- näited, mis valitud diskursust iseloomustavad;
- praktilise ja teoreetilise töö põhjal tehtavad tähelepanekud, järeldused ja tulevikuvisioonid.

Kvantitatiivsed ja kvalitatiivsed uurimismeetodid teoreetilises uurimuses

Näituste ettevalmistamisel läbi viidud laboritööd Tartu Ülikooli Raku- ja Molekulaarbioloogia laboris (2012) ja Tallinna Tehnikaülikooli Meresüsteemide instituudi mereökoloogia laboris (2013) sisaldavad rohkete andmete kogumist, vaatlemist, andmete töötlemist ja saadud mater-

jaliga eksperimenteerimist.
Samas otsisin ma andmete kogumisel võimalust teadusliku informatsiooni interpreteerimiseks, lõin seoseid ja tähendusi laiemas sotsiaalses kontekstis. See tähendab, et minu eesmärgiks ei olnud kvantitatiivsele uurimisvormile omane erapooletus, uuritavate andmete kogus, teaduslik täpsus, kontrollitavate faktide või hüpoteeside tõestamine, vaid küsimused, mis puudutavad teaduse ja ühiskonna vahelist kommunikatsiooni, diskussioonide tõstatamist ja uute kvalitatiivsete väärtuste loomise võimalust. Oma töös tegelen ma fenomenide, mitte faktide uurimisega. Selles osas on olulisel kohal kvalitatiivsele uurimusele omased põhikomponendid: dokumenteerimine, vaatlused, intervjuud, analüüsid, interpretatioonid ja omapoolsed hinnangud.
Doktoritöö raames toimunud praktilise töö kirjeldamisel ja analüüsimisel toon välja näited personaalnäitustest ja koostöövormidest, mille raames ma näitusi ette valmistasin. Kirjeldan lühitekstide ja illustratsioonide kaudu oma töökogemusi TÜ Molekulaar- ja Rakubioloogia laboratooriumis ja TTÜ Meresüsteemide instituudi mereökoloogia laboris. Samuti toon välja hübriidse kunsti näituse „Rhizope" ja konverentsi „Kunst ja teadus – hübriidne kunst ja interdistsiplinaarne uurimus" kureerimiskogemuse, mille käigus tuli mul kolme aasta jooksul kokku puutuda nii ürituse vormilise kui ka sisulise korraldamisega. Praktilist loometööd kirjeldades viitan ka põgusalt oma esimesele töökogemusele, mille sain TTÜ Biorobootika keskuses robotskulptuuri „Püha lehm" luues (2010-2011) ja mis oli üheks olulisemaks algtõukeks valitud teema uurimisel.

Uurimistöö struktuur ja lühikirjeldus peatükkide kaupa

Käesolev doktoritöö on jaotatud neljaks põhiosaks:sissejuhatus(1.), näitused(2.), Eesti kontekst (3.) ja kunst ja teadus loomepõhises uurimistöös(4.). Kuna antud töö põhisisuks on isiklik loominguline tegevus ja Eesti hübriidse kunsti praktika laiemalt , on need välja toodud töö esimeses pooles. Kunsti ja teadust loomepõhises uurimistöös laiemalt uuritakse teoreetilise analüüsi ja välismaiste näidete kaudu hilisemates peatükkides. Kokkuvõtvas peatükis 5. on välja toodud töö tulemused uurimisküsimuste kaupa.

Peatükis **1. Sissejuhatus** kirjeldatakse uurimistöö eesmärki ja olulisemaid inspiratsioonallikaid, formuleeritakse uurimisküsimused ja tuuakse välja meetodid, mille abil püstitatud küsimustele vastuseid leitakse.

Peatükis **2. Näitused** antakse ülevaade doktoritöö raames loodud kolmest kunstisündmusest, mis on toimunud ajavahemikus 2013–2014. Nende sündmuste ettevalmistamise periood on olnud palju pikem, ulatudes aastasse 2011 ja need on viinud mind koostöö eesmärgil kokku väga mitmete erinevate kunsti- ja teadusvaldkondade esindajatega.
Kaks näitust „Hübriidsed praktikad" ja „Hübriidne praktika – üldiselt üksikule" ning kolmas, kuraatoriprojekt „Rhizope. Kunst ja teadus – hübriidne kunst ja interdistsiplinaarne uurimus" on koostatud vastavalt doktoritöö arengule. Esimese näituse „Hübriidsed praktikad" loomise eesmärgiks oli kaardistada erinevaid potentsiaalseid teadusvaldkondi, mille baasil ja raames oleks võimalik doktoritöö praktilist osa läbi viia. Teise näituse „Hübriidne praktika – üldiselt üksikule" loomisel fokusseerusin ma (mere)bioloogia ja kunsti ühendamisele. Kolmanda projekti, konverentsi „Kunst ja teadus – hübriidne kunst ja interdistsiplinaarne uurimus" ja näituse „Rhizope" puhul oli tegemist rahvusvahelise suursündmusega, mis tõi Eestisse kokku 32 teadlast ja kunstnikku, neist 21 esinejat olid välismaalt. Toimunu kajastamiseks anti välja ka kataloog „Rhizope. Art and Science – Hybrid Art and Interdisciplinary Research"/"Rhizope. Kunst ja teadus – hübriidne kunst ja interdistsiplinaarne uurimus (EKA Kirjastus, 2014). Lisaks näituste kirjeldustele on iga sündmuse puhul lisatud ka nende põhjal tehtud kokkuvõtted ja järeldused.

Peatükis **3. Eesti kontekst** on välja toodud lühikokkuvõtted intervjuudest nelja eesti kunstniku ja kolme teadlasega. Intervjueeritavaiks olid tekstiilikunstnik Kärt Ojavee, meediakunstnikud Taavet Jansen ja Maike Lond, kunstnik-tarkvarainsener Timo Toots, robotiteadlane Madis Listak ja merebioloogid Inga Lips ja Karin Ojamäe. Kunstnike valikul sai oluliseks nende viimaste aastate praktika hübriidse kunsti loomisel, teadlaste valikul lähtusin aga dok-

toritöö käigus toimunud loomepraktikast, mille raames ma nende teadlastega koostööd tegin. Peatüki lõpus tuuakse välja olulisemad järeldused ja võimalikud tulevikusuunad.
Peatükk **4. Kunst ja teadus** loomepõhises uurimistöös on teoreetiline uurimus, mis sisaldab põhjalikku analüüsi valdkondadevahelise koostöö erinevatest aspektidest. Kõigepealt pööratakse tähelepanu teaduse ja kunsti põhimõttelistele erinevustele, mis nende valdkondade vahelise koostöö üsna keeruliseks muudab. Järgnevalt on analüüsitud võimalikke ühiseid eesmärke ja töötulemuste erinevusi/sarnasusi.
Doktoritöö 4. peatükis on alapeatükkide kaupa välja toodud ka olulisemad suunad ja terminid, milleks on inter- ja transdistsiplinaarsus, hübriidne kunst ja kodanikuteadus. Kõikide nende mõistete illustreerimiseks on kasutatud mitmeid välismaiseid näiteid vastavatest kunsti- projektidest ja kollektiivsetest algatustest.

Uurimistöö tulemused

UURIMISKÜSIMUS 1: Kuidas mõista teaduse ja kunsti vahelist koostööd? Kuidas see mõjutab minu kunstipraktikat ja tänapäeva meediakunsti laiemalt?[52]

Sellele küsimusele laiemate vastuse leidmiseks on uuritud järgmisi teemasid: 1. valdkondade erinevused ja sarnasused; 2. kunstnike ja teadlaste ühised eesmärgid; 3. töötulemuste sarnasused ja erinevused – prototüübid ja teaduslikud/kasulikud mudelid.

Valdkondade erinevused ja sarnasused

Vastandades (või pigem kõrvutades) teadlasi ja kunstnikke, võib mõlemalt poolt leida käsitlusi, mille kohaselt vastasleeri püüdlused ja tegevused tunduvad teisele poolele keerulised. Selleks, et kunsti ja teadust kooseksisteerivatena ja kunstnikke/teadlasi võrdväärsete koostööpartneritena näha, analüüsitakse nende valdkondade põhimõttelisi erinevusi (*vt. ptk. 4.1*), jõudes järeldusele, et mõlemad liiguvad aina enam ühinemise ja distsipliinidevaheliste piiride hägustumise suunas. Selle tingivad ühelt poolt praktilised vajadused, teisalt aga laiemad eesmärgid, mis on üllatavalt sarnased. Seetõttu ei saa teadust liigitada „külmaks" ja kunsti „soojaks", sest peaaegu kõik kunsti ja teadust iseloomustavad märksõnad on omavahel tihedalt põimunud. (*vt. ptk. 4.3*)

Kunstnike ja teadlaste ühised eesmärgid

Lisaks kunstipraktikale ja mitmetele intervjuudele on käesoleva väitekirja oluliseks osaks teoreetiline uurimus, mis puudutab teaduse ja kunsti koostööd laiemalt.
Peatükis **4.2 Teaduse ja kunsti vaheline koostöö: ühised eesmärgid** on välja toodud valdkondadevahelist uurimust iseloomustavad töömeetodid, mille puhul on võimalikud nii reaalkui ka humanitaarteadusele omased võtestikud. Seetõttu on nii teadlaste kui ka kunstnike tegevust nimetatud loovaks praktikaks, sest mõlemal puhul on tegemist uute küsimuste ja uurimisvaldkondade otsimisega. Loovus ja loovad praktikad on need, mis sunnivad küsima uusi küsimusi ja otsima „koduvaldkonna"-väliseid meetodeid. Leitavad lahendused, mis ei pruugi olla küll teaduslikult tõestatavad, võivad aga olla teedrajava iseloomuga. Oluline on ka nn „välisvaatlejate", st kindla distsipliini väliste koostööpoolte kaasamine.

Samas on välja toodud põhilised punktid, mis iseloomustavad koostöös osalevate poolte rolle valdkondadevahelises koostöös. Selle kohaselt võib öelda, et kunstnike ülesandeks on küsida küsimusi, mis laiendavad teaduskäsitlusi või erinevad teaduslike ekspertsüsteemide arvamusest, aga ka teaduslike sõnumite avalikkuse ette toomine, teaduse interpreteerimine ja demüstifitseerimine. Kuid ka „valede" küsimuste esitamine, näidates seega kitsaskohti, mida oma distsipliini piiresse süvenenud uurija ei pruugi hoomata.

Teadlaste ja inseneride roll on kitsendada suuri ideid kitsamalt lahendatavateks probleemideks ja näidata võimalust, et „tõestatavad teadmised" võivad olla oluliseks vahelüliks kunstnike, teadlaste ja laiema avalikkuse vahel. Samuti on teadlastel võimalus näidata, et tulemus võib (lisaks kunstnike poolt taotletud esteetilisele elamusele) pakkuda ka funktsionaalset

lahendust ning interpreteerida kunstnike ideid teaduslike teadmiste toel, leides seeläbi ka tippteaduse ja teadusloome tarbeks laiemalt uusi uurimisküsimusi. Mõlema osapoole ühiseks eesmärgiks on algatada uusi olukordasid, mida uurida, luues seeläbi võimalusi nii kultuuri kui ka teaduse arenguks senisest ühtsema tervikkäsitluse mõttes.

Töötulemuste sarnasused ja erinevused – prototüübid ja teaduslikud/kasulikud mudelid

Peatükis 4.3, kus on välja toodud teadlaste ja kunstnike töötulemuste võrdlus, esitatakse küsimus töötulemuste tinglikust liigitamisest prototüüpideks (kunst) ja teaduslikeks/kasulikeks mudeliteks (teadus). Selles peatükis sisalduvast arutelust Madis Listakiga järeldus, et kindlaid piire teaduses ja kunstis tehtava uurimuse vahele tõmmata ei saa, sest:

- teaduse ja kunsti vaheline piir on personaalne, mitte erialavaldkondade piire järgiv;
- terminid prototüüp ja teaduslik/kasulik mudel on kasutusel nii teaduses kui ka kunstis;
- uurimisest saadav teadmine on erinev, kuid vastandus „teaduslik ehk tõestatav teadmine vs mitteteaduslik teadmine ehk põhjendamatu ja teadmatu“ ei pruugi omada kindlaid piirjooni;
- kunstniku roll teaduse visualiseerija ja publitseerijana on teisejärguline, seega on reaalset tulemit kindlate terminite abil nimetada võimatu, pigem võib tulemust hinnata selles sisalduva ühiskondliku ja kultuurilise sõnumi järgi;
- uurimisele kuluv aeg ja materiaalsed ressursid on erinevad, seega on töötulemusi võrrelda keeruline, pigem tuleb hinnata töö eesmärke.

UURIMISKÜSIMUS 2: Kuidas mõista termineid „interdistsiplinaarsus” ja „transdistsiplinaarsus” uue meedia kunsti kontekstis?

Kuidas läheneda kunstipraktikale, mis seob omavahel teaduse ja kujutava kunsti? Üsna tihti kõlavad selles kontekstis terminid „interdistsiplinaarsus” ja „transdistsiplinaarsus”. Need valdkondadevahelist ja -ülest koostööd iseloomustavad mõisted annavad käesoleva uurimistöö tarbeks olulised mõtteliinid hübriidsete loome- ja teadusvormide mõistmiseks ja mõtestamiseks. Uurimaks valdkondadevahelisi koostöövõimalusi on inter- ja transdistsiplinaarsuse mõistmiseks süvenetud nende terminite tagamaadesse, tuues välja valdkondadevahelise ja -ülese koostöö olulisemad aspektid ja näidates, et erilist tähelepanu tuleks pöörata valdkondadeülesele ehk transdistsiplinaarsele uurimisvormile, mis võimaldab küsida küsimusi, mida senini küsitud ei ole. Peatükkides 4.4.1 ja 4.4.2 on välja toodud inter- ja transdistsiplinaarsuse põhimõttelised erinevused. Olulisim on asjaolu, et tänapäeva transdistsiplinaarsus on oma olemuselt küll valdkondadeülene, kuid totaalse valdkondlike piiride eitamise asemel seab selline uurimisviis uurijate ette ülesande senisest enam erinevate valdkondade spetsiifikasse süveneda.

Sidumaks inter- ja trandistiplinaarseid uurimisvorme konkreetse loometegevusega, analüüsitakse mitmeid kunstinäiteid, tuues välja muuhulgas ka selle, et hoolimata transdistsiplinaarse uurimisvormi olulisusest saab käesoleva doktoritöö raames läbiviidud loomingulist praktikat hinnata siiski pigem interdistsiplinaarseteks, sest selgelt joonistuvad välja valdkondlikud piirid – robootika – kunst; bioloogia – kunst jne. Kuid aina julgemaid ja piire ületavaid küsimusi esitavad kunstnikud ja teadlased vaatavad siiski julgelt tuleviku suunas, interdistsiplinaarsetes koostöögruppides on potentsiaal leida küsimusi, mille lahendamiseks rakendatakse transdistsiplinaarseid meetodeid. Seetõttu võib kokkuvõtvalt öelda, et transdistsiplinaarses mõtlemisviisis peitub võti lahendamaks mitmeid olulisi küsimusi, millele seni on takistuseks saanud valdkondlikud piirid või kindlad käsitlused „teaduslikust” ja „mitteteaduslikust teadmisest”.

UURIMISKÜSIMUS 3: Mis on hübriidne kunst ja millised on selle kunstivormi olulisemad töömeetodid? Kuidas näha hübriidseid kunstivorme eesti kontektsis?

Selle küsimuse lahendamiseks tuli lisaks termini „hübriidne kunst” lahtiseletamisele

analüüsida ka kunstipubliku suhtumist sellesse kunstivormi. Oluline oli leida vastavaid kunstiprojekte ka Eestist, sest ehkki vastav kunstipraktika on siin vähene, on valitud näited end jõudsalt tõestanud mitte üksnes meil, vaid ka mujal maailmas.

Mis on hübriidne kunst?

Väljend „hübriidne kunst" (Hybrid Art) kõlas esmakordselt aastal 2005 toimunud Ars Electronica festivali peakirjana. Teemavaliku algtõukeks oli uurida plahvatuslikku tehnoloogiate mõju ühiskonnale, tuua erinevaid kultuurivorme ja nende häguseid piire üksteisele lähemale. Tänapäeva mõtteliinide täpne määratlematus lubab aga sõna „hübriidne" kunstiloomingu mõttes käsitleda ka suundades, mis ei seo tehnoloogiat kunstiga kõige otsesemas mõttes. Terminil „hübriidne kunst" on kahtlemata kaasaja trendimõiste hõng, kuid leian, et see on käesoleval hetkel sobivaim antud kunstisuuna kirjeldamiseks.

Milliseid nähtusi võiks tulevikku suunatud hübriidse kunsti mõttes analüüsida? Kuna hübriidsuse mõiste on muuhulgas tihedalt seotud bioloogiaga, on mõistetav, et hübriidse kunsti üks väga kindlaid suundi on biokunst. Tuleviku mõttes olulise kunstisuunaga on tegemist seetõttu, et ka teaduses nähakse aina enam vajadust bioloogiat käsitleda koos-eksisteerivana teiste teadusvormidega.

Olen toonud välja kunsti ja teaduse koostöö arenguid, küsitlenud Eesti kunstnikke ja teadlasi, uurinud hübriidse kunsti näiteid mujalt maailmast, biokunsti kui uut põnevat suunda meediakunstis ning võrrelnud ka teadlaste ja kunstnike töötulemusi. Siit saan ka vastused küsimusele, millised on hübriidse kunsti töömeetodid – ühelt poolt adapteerivad need teaduses levinud võtestikke, teisalt on hübriidse kunsti juured väga sügaval kaasaja kujutava kunsti arengutes. See tähendab, et uuritav kunstisuund võtab hoolikalt arvesse kõiki võimalikke meediumeid ja ideeliine, sest põhjalik ümbritseva nägemine, uurimine ja kriitiline küsimuste esitamine on selle põhiolemuseks. Läbi analüüsitud näidete võib öelda, et hübriidse kunsti praktikute jaoks ei ole teadusdistsipliini ja meetodit, mille vastu nad huvi ei ilmutaks.

Hoolimata näilisest segadusest selle valdkonna määratlemisel võib öelda, et tegemist on jõudsalt areneva uurimis- ja tegutsemisvaldkonnaga, millega seoses arenevad kiiresti ka hübriidsete kunstivormide hindamiskriteeriumid ja vastav kunstikriitika.

Kuidas mõista hübriidset kunsti publiku seisukohalt?

Hübriidse kunsti mõistmine publiku jaoks on keeruline väga mitmel põhjusel. Läbi praktiliste näitusekogemuste ja teoreetilise uurimuse käigus saadud teadmiste võib teha järgnevad järeldused:

- teaduslike uurimuste/teadustekstide sisu mõistmine on publiku jaoks keeruline, kuid vastava erialakompetentsi puudumine ei välista kunstiteoste sisu laiemat ja erinevatel tasanditel mõistmist;
- tehnoloogiliselt keerulised lahendused on muutunud publiku jaoks vastuvõetavamaks, ka kunstnikud liiguvad lihtsamate ja tehnoloogiliselt vähemkomplitseeritud lahenduste suunas;
- lisaks publikule on oluline ka kunstnike harimine – aina populaarsemaks saavad koostöö-programmid ja spetsiaalsed kunstnike/teadlaste koostöö eesmärgil loodud teaduslaborid;
- teaduskunsti ja valdkondadevahelise loomingu olulisuse mõistmine on tõusnud ka institutsionaalsel tasemel;
- teaduskunsti esitamine teaduskeskuses või kunstigaleriis sõltub eelkõige selle loojatest ja kontekstist, millesse looming soovitakse asetada.

Eesti kontekst

Eesti hübriidse kunsti kohta järelduste tegemisel on lähtutud näituste „Hübriidsed praktikad", „Hübriidne praktika – üldiselt üksikule" ja „Rhizope" korraldamise käigus saadud kogemustest.

Eesti teaduskunsti praktikat võiksid iseloomustada järgmised mõtted:

- Eestis on vastav mõttesuund alles tekkimas ja esialgu selgelt piiritletud ja hästi-rahastatud koostööprogrammid puuduvad;
- teadlastega personaalselt ühendust võtta on lihtne, iseküsimus, kui viljakaks ja vastastikku arusaadavaks kujuneb koostöö praktilises plaanis;
- Eesti on tänu olukorrale, kus kindlad teaduskunsti piirid puuduvad, suurepärane koht esitamaks ka töid, mis võivad mujal keelatud olla (*vt. ptk. 2.3.3 – R. M. Matysik "Beyond Humans: Organ-Like Organism Made Of Human Cells"*);
- kui rääkida teaduskunsti laiemast teadvustamisest Eesti kultuurielus, viitas näitus „Rhizope" ja sellega kaasnenud konverents nii huvile hübriidsete kunstivormide vastu siin, kui ka kunstnike olulisele rollile akadeemilises teadusloomes.

Eesti kontekstist rääkides tuleb välja tuua ka olulisemad Eesti kunstnike ja teadlastega läbiviidud intervjuude põhjal tehtud järeldused:

- Eesti meediakunstis valitsevad suunad järgivad väga hoolega väljaspool toimuvat – vabade ideede arengut, laiemaid teoreetilise ja eksperimentaalteaduse praktikaid, aga ka DIY-liikumisi. (*Timo Toots, vt. ptk. 3.3*)
- institutsionaalsel tasemel loodavad interdistsiplinaased programmid ei taga ilmtingimata viljakat koostööd. (*MIMproject, vt. ptk. 3.2*)
- Eesti meediakunstnikel on suur vajadus end maailma konteksti seada. Ehkki see ei ole eesmärk omaette, on teaduslikus uurimuses, aga ka laiemas kunstiperspektiivis oluline olla „nähtav", st esitada oma tööd siin küll põhjalikult, kuid leida väljundeid ka väljaspool meie riigipiire, sest välismaa näitustel saadav tagasiside võib mõningatel juhtudel olla sisukam. (*Kärt Ojavee, vt. ptk. 3.1*)
- Eesti teadlased on avatud uutele ideedele ja motiveeritud huvitekitavates projektides kaasa lööma. Teadlaste jaoks on oluline nende töö ja teaduskeskuste kommunikatsioon väljaspoole, samuti ka uute võimalike vaatenurkade leidmine, ehkki eesmärkide erinev püstitamine tekitab teatavat segadust ja nõuab harjumist.
  (*Madis Listak, Inga Lips, Karin Ojamäe, vt. ptk. 3.4 js 3.5*)
- Eesti on väikeriik, milles toimuvad küll sisemised põnevad arengud, kuid tehnoloogia ja teadusloome mõttes on paljud teaduskeskused seotud oluliste välismaiste suurkeskustega, sest riigisiseselt ei ole see võimalik. Seega on ka kunstnikel teoreetiline võimalus tutvuda läbi meie teaduskeskuste suuremates institutsioonides toimuvaga.

Lõpetuseks

Õigustatult kerkib hübriidse kunstipraktika (eriti biokunsti) kontekstis üles küsimus, kas teaduslike vahendite ja teabe sattumine kunstnike või amatöörteadlaste kätte võib endaga kaasa tuua ka ettearvamatuid tagajärgi?

Kahtlemata võib tehnoloogiate mitteteadlik kasutamine ja võimalike ebaeetiliste eesmärkide püstitamine olla probleemiks, siiski on kunstnike kriitiline meel ja tahtmine põletavaid küsimusi avalikkuse ette tuua pigem ajendatud soovist publikut harida ja ebasoovitavaile arengutele võimalikult vara tähelepanu juhtida. Just küsimused teaduse võimalikest arengu-test või väärarengutest ajendab näiteks biokunstnikke oma ideid laiemalt avalikustama, samuti on viimasel dekaadil korraldatud rohkelt kunstinäitusi, mis tegelevad nii ökoloogilise jalajälje kui ka kliimamuutuse problemaatikaga. Laiem teadvustamine ja avalik huvi ei saa kindlasti viia ebasoovitavate arenguteni – mida rohkem me teame, seda paremini oskame me loodetavasti ka tulevikuarenguid mõista. Samuti on oluline mõista, et mitmed kunstnikud on lisaks oma kunstnikukarjäärile tegevad ka teadlaste või inseneridena, seega on vale arvata, et nad tegelevad aladega, mida nad ei mõista, või kasutavad infot ja vahendeid vääratel eesmärkidel. Pigem on nende töö ajendatud vajadusest laiema arusaamise ja avalikumate diskussioonide järele. Asjaolu, et ka teaduskeskused oma töösse aina enam tavainimesi kaasavad (*vt ptk. 4.4.4*), viitab selgelt vajadusele laiema mõistmise ja põhjalikuma teadmise loomise suunas.

Mille poolest on käesolev uurimistöö oluline ja eriline? Kõigepealt on tegemist teemaga, mis on aina enam populaarseks muutumas, tulevikku suunatud ja võimaldab kunstnikel ja teadlastel leida uudseid koostööl baseeruvaid lahendusi maailma mõistmisel. Lisaks on

teemakäsitlus oluline ka seetõttu, et hübriidse kunsti metoodika ja hindamiskriteeriumid on alles arenemas ning igakülgne selleteemaline arutelu saab hübriidse kunsti mõistmisele vaid kasuks tulla.

Eelkõige soovin anda ülevaadet oma kunstipraktikast, teisalt ka näidata, et Eesti kunstipraktikas laiemalt on piisavalt näiteid, mis paigutab meie riigi hübriidse kunsti kaardile ja me oleme eriliselt avatud osalemaks nii teadlaste kui praktikutena ka laiemas globaalses kontekstis. On põnev välja tuua ka asjaolu, et lokaalses plaanis on interdistsiplinaarse koostöö loomine erakordselt lihtne, ehkki laiem toetus sellele veel puudub.

Seoses näituse „Rhizope" korraldamisega võin lisada, et sellelaadsed ettevõtmised on Eestis ilmselt oluliselt väiksemaid materiaalseid ressursse nõudvad, valdkondadevahelises koostöös loodavad projektid sünnivad tänini altruistlikel eesmärkidel ja institutsionaalsel tasemel puuduvad ka märkimisväärsed koostööd pärssivad piirangud. Olulisimaks eesti konteksti kirjeldamisel pean aga asjaolu, et meie väike riik on jõuliselt teadvustanud vajadust olla maailmakaardil, meil on julgus siia esinema kutsuda tuntud kunstnikke ja teoreetikuid ja arendada ka siin mõtteliine, millest võiks laiemat ühiskondlikku kasu tõusta tulevikuski.

7. AUTHOR'S NOTES

1. The Pig Wings, 2000–2001. The Tissue Culture & Art Project (Oron Catts & Ionat Zurr) in collaboration with Guy Ben-Ary. See also: http://www.tca.uwa.edu.au/pig/parts.html
2. I have come to general questions through my own art practice, but those questions concern also the art works of my colleagues and the new media art in general. Therefore I will bring internationally known examples and theoretical background out later.
3. I worked two weeks at the Institute of Molecular and Cell Biology, University of Tartu, 2012. By well-known game theories I mean subjectively choosen ideas of Aristotle, Spencer, Patrick, Buytendijk, Freud, Berlyne etc.
4. Great Oxygenation Event, shortly called GOE.
5. Based on a conversation with professor Raivo Vilu in 2012.
   See also: Global Footprint Network. http://www.footprintnetwork.org/en/index.php/GFN/page/earth_overshoot_day/
6. See more: *Infectious*. Exhibitions' webpage. Science Gallery Dublin. https://dublin.sciencegallery.com/content/infectious;
   KISS CULTURE at INFECTIOUS – https://www.youtube.com/watch?v=MiRPJ2nDOCk
7. Biosemiotics, a direction fusing nature (biology) and semiotics, has arisen quite assertively in disciplines uniting art and science as a field that seeks a broader way of understanding the world, and a possibility of merging life and cultural phenomena (i.e. biology and humanitarian sciences, especially semiotics as a field investigating signs). As bio art deals with many matters of evolution and ecosystem, it is appropriate in my opinion to refer to biosemiotics as a discipline that sets the tone for precisely this art direction. The main postulate can be considered the idea that no living creature can cope without a semiotic system. The role of biosemiotics from the standpoint of the humanities is undoubtedly the fact that, using means sourced from the humanities themselves, it enables access to life outside language, to "texts" not created my human culture (Kull 2011). One clear reason for interest in this field is the Estonian context, too: ever since Jakob von Uexküll (1880) and Yuri Lotman up to Kalevi Kull today, Estonian researchers are in the vanguard in this area.
   See also: *International Society of Biosemiotics* – http://www.biosemiotics.org/
8. Speakers at the 2012 autumn symposium were internationally recognized theoreticians and practitioners Alan N. Shapiro, Marina Gržinič, David Rothenberg, Erich Berger, Benjamin Jacquemet-Boutes, Carolyn Wittendal and Michael Weinstock.
9. The collection "EVOLUTION HAUTE COUTURE: Art and Science in the post-biological age" was premiered in the framework of the IX MediaForum – one of the official programs of the XXX Moscow International Film Festival (MIFF, 2008). The Evolution Haute Couture project had its international premiere at the program of special projects of the Third Moscow Biennial of Contemporary Art (Moscow, Russia, 2009). In 2012 the Evolution Haute Couture project was presented in the framework of the program of the Maribor – European Capital of Culture 2012 (Bulatov 2014: 107).
10. Mark Tribe mentions strategies developed over time for preserving media art: *Notable strategies for preserving works of New Media art include documentation (e. g. taking screen shots of Web pages), migration (e. g. replacing outdated HTML tags with current ones), emulation (software, that simulates obsolete hardware) and recreation (reproducing old work using new technology)* (*2006: 25).*
11. Biotoopia 1995 – Third annual exhibition of the Centre for Contemporary Arts Estonia. 11 November to 17 December 1995, curators Sirje Helme, Eha Komissarov (Biotoopia 1995).

12. Tehnobia, Estonian Artists Union annual exhibition. 3 June – 9 July 2006, curator Leonhard Lapin (Kard 2006).

13. See also: *The 12th International Symposium on Electronic Art ISEA 2004* – http://www.m-cult.org/projects/isea-2004

14. Biomimicry is a Greek word meaning "to imitate life". In general, it refers to the idea that nature, with its 3.8 billion years of experience, is the best designer, and has found and designed solutions to many problems. Humankind could use this experience in order to solve human challenges (Benyus, 1997; Ojavee 2013: 102).

15. An exciting direction in its own right is "mistakology". New media artist and thinker Norman White argues that each scientific discipline essentially integrates mistakes that scientsits try to ignore in the interests of objectivity. New media art has used these mistakes in various ways (for parody and irony as well); for example mistakology was part of the official conference programme at the Transmediale Festival in 2005.
I do not however discuss this topic further in the scope of this work.
Source: http://pastwebsites.transmediale.de/05/page/whatis/detail/detail.0.releases.62.html

16. What the robot cow did was stand in a public place, swallowing Estonian kroons and excreting euros through the robot cow's digestive tract.
See video: http://www.youtube.com/watch?v=-Ro3xaCY6JU

17. This quote comes from the original text by Simon Penny, article "On interdiscsiplinarity – in theory and in practice" in *Sirp* was published in abridged version and in Estonian translation. Full text is in the possession of the author of the dissertation.

18. There is another well-known term, "multidisciplinarity" – questions are asked in multiple genres but all in all the discussion stays in their own discipline, however I will not study this further in my research.

19. In this instance I mean the evaluation not within the work process itself but of interdisciplinary collaboration in general. I find that for the sake of well-functioning interdisciplinary collaboration it is important that various criteria and methods complement each other in the best way possible, also involving all other surrounding knowledge into this collaboration – knowledge about societal, political, economic and environmental developments.

20. This quote comes from the original text by Simon Penny, article "On interdiscsiplinarity – in theory and in practice" in Sirp was published in abridged version and in Estonian translation. Full text is in the possession of the author of the dissertation.

21. The word "transdisciplinarity" itself first appeared in France, in 1970, in the talks of Jean Piaget, Erich Jantsch and André Lichnerowicz, at the international workshop "Interdisciplinarity – Teaching and Research Problems in Universities", organised by the Organisation for Economic Co-operation and Development (OECD), in collaboration with the French Ministry of National Education and University of Nice (Nicolescu 2007a).

22. Hybrid art is understood according to current definitions to be forms of creation addressing physical sciences and technologies, I hereby reserve the right to expand the definition of hybrid art from here on when addressing transdisciplinarity.

23. Alan N. Shapiro expressed the idea that specialists from various fields must try to understand each others' work more than ever before. When addressing the form of analysing the mutual relations between visual art and science, I use the approach according to which boundaries between disciplines and fields of research are quite strongly intact. As different parties (i.e. in this context artists and scientists) have an ever-increasing need to enter each others' domains, they must do extensive mutual research both with regard to the substance and working methods of the disciplines in order to gain a thorough understanding of each others' tools and objectives.
(Based on my interview with Alan N. Shapiro, recorded in Tallinn on 18 November 2012. Full interview is in the possession of the author of the dissertation).

24. The Ars Electronica centre continues the tradition of popularising hybrid art by giving out an award in the hybrid art category among other awards as part of its annual festival. See also: http://www.aec.at/prix/en/kategorien/hybrid-art/

25. See also: *CCS - Cloud Core Scanner - an artistic experiment in zero gravity.* http://www.blubblubb.net/microgravity/index.html

26. See also: *MOON GOOSE COLONY* http://www.pollinaria.org/en/Arte/agnes-meyer–brandis.aspx

27. See also: *MOON GOOSE COLONY* – http://www.forschungsfloss.de/mga/index.html Video documentation: http://vimeo.com/38986659

28. *"The dramatisation of these discussions in "The Man in the Moone" is at once a form of popular science and also a form of popular fiction. This is the age-old problem of fiction – the probable impossible intermingled with the possible improbable..."* Original text from the web page: http://www.forschungsfloss.de/mga/mga-intro.html

29. The term "bioart" has been written in different ways: bioArt, BioART, bio-art, bioart etc. Eduardo Kac used this term first as "BioArt". See also: http://www.ekac.org/figs.html

30. See also: *Realsnailmail* – http://www.realsnailmail.net/; *Boredomresearch* – http://www.boredomresearch.net/; *Gateways 2011* – http://www.goethe.de/ins/ee/prj/gtw/enindex.htm

31. My free interpretation from the text of Paul Virilio, "The Aesthetics of Dissapearance" (Virilio 1991: 111)

32. See also: *SymbioticA* – http://www.symbiotica.uwa.edu.au/

33. See also: *BiofiliA* - http://biofilia.aalto.fi/en/about/

34. See also: *Finnish Bioart Society* - http://bioartsociety.fi/1-2

35. Author of this dissertation visited Kilpisjärvi research station in September 2015 for the "Field_Notes HYBRID MATTERs" workshop. Source: http://hybridmatters.net/ See also: *Ars Bioarctica Residency* – http://bioartsociety.fi/ars-bioarctica-residency *Kilpisjärvi research station* – http://www.helsinki.fi/kilpis/english/index.htm

36. See also: *Arctic Perspective Initiative* – http://arcticperspective.org/

37. The source of inspiration of the following description of history is a Forrest Mims quotation: *"Contemporary science has its roots in the achievements of amateur scientists of centuries past. Although they lacked what we would define as formal scientific training, they deciphered the basic laws of physics and principles of chemistry. They invented instruments. And they discovered, documented, sketched, and painted planets, comets, fossils, and species."* (Mims 1999). The following information based on my conversations with Andi Hektor (2012).

38. Faraday's book was first published in three volumes between 1839 and 1855.

39. See also: *Roden Crater* - http://jamesturrell.com/roden-crater/roden-crater/introduction/

40. See also: *Versuch unter Kreisen* – http://juliusvonbismarck.com/bank/index.php?/projects/versuch-unter-kreisen/; and *CERN welcomes its first artist in residence* – http://press.web.cern.ch/press-releases/2012/03/cern-welcomes-its-first-artist-residence

41. Read more about citizen science in Lewenstein 2004 "What does citizen science accomplish?". Cornell University.

42. See also: *Christmas Bird Count. National Audubon Society* – http://birds.audubon.org/christmas-bird-count; http://fl.audubon.org/what-citizen-science

43. See also: *SETI@home* – http://setiathome.berkeley.edu/; *Stardust@home* – http://stardustathome.ssl.berkeley.edu/; *Galaxy Zoo* – http://www.galaxyzoo.org/; *Plankton portal* http://www.planktonportal.org/

44. See also: *FoldIt* – http://fold.it/portal/

45. *Bricolage* – French word for "tinkering". This is a known term characterized by the incidental use or re-use of materials. DIY - do it yourself . As a comment, I would add that instead of the word "yourself, the word "ourselves" could be used in today's collaborative environment. Or the word DIWO (Do It With Others) derived from the same source (Garrett, Catlow 2013).

46. See also: *L. A. S. E. R. Tag. Graffiti Research Lab* – http://www.graffitiresearchlab.com/blog/projects/laser-tag/

47. See also: *DIYbio* – http://diybio.org/

48. See also: *Hakteria.org* – http://hackteria.org/

49. DIYbio Outreach Workshop, June 12–14, 2012 – Walnut Creek Marriot CA, US. Read the texts on the following website: http://diyhpl.us/wiki/transcripts/fbi-diybio-2012/security-issues-session.txt

50. This quote comes from the original text of Simon Penny. Article "On interdisciplinarity – in theory and in practice" in *Sirp* was published in abridged version and in Estonian translation. Full text is in the possession of the author of the dissertation.

51. Although these issues should be analysed on the basis of the broader context of the new media art, the main influence comes still from the personal artistic practice of the author of this dissertation. This fact allows to lead research question starting from author's practice to more general questions

52. *Ehkki neid küsimusi tuleks lahata lähtudes laiemast uue meedia kunsti kontekstist, on käesolev isiklikule kunstipraktikale toetuv uurimistöö üles ehitatud nii, et alustatakse töö autori enda kunstipraktikast. See asjaolu tingib ka uurimisküsimuse sõnastuse ja järjekorra.*

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Courtesy: Tomás Saraceno; Pinksummer contemporary art, Genoa; Tanya Bonakdar Gallery, New York; Andersen's Contemporary, Copenhagen, Esther Schipper Gallery, Berlin.
© *Tomás Saraceno, 2013*

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Piibe Piirma 2012

9. APPENDIX

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HYBRID PRACTICES – FROM GENERAL TO SPECIFIC

Piiba Piirma

Estonian Academy of Arts, Studiose School, Tallinn, Estonia

Sirp

ARHITEKTUUR

Andmesidekultuur - kaasamine, lihtsustamine ja põgenemine

Piirma, P. 2015. Hybrid Practices – from General to Specific. In Fuks, S. (Ed.)*WATER VIEWS: CARING AND DARING. 3WDS14 – waterwheel world water day symposium 2014 waves, ripples, & splashes.* Igneous Incorporated. Igneous Incorporated. Pp. 134-139.
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Hübriidne kunstiuurimus

Rändajate portreed

CODA

Kui siga lendaks!

Piirma, P. 2014. *Hübriidne kunstiuurimus. Rändajate portreed.* – Positiiv 17/2014, pp. 11–15

Catts, O., Piirma, P. (Ed.) 2013. *Kui siga lendaks! Kunstnik Oron Catts eluteaduse, tehnoloogia ja kunsti koostööst.* – Eesti Arst 2013: 92(1), p. 56


Sirp

Kunst Petri tassis


horisont.ee

kunstist, pärmirakkudest ja kosmosemissioonist

Piirma, P. 2013. *Kunst petri tassis.* – Sirp, 27 March.
Retrieved from: http://www.sirp.ee/s1-artiklid/c6-kunst/kunst-petri-tassis/ (11.08.2014

Piirma, P. 2013. *Kunstist, pärmirakkudest ja kosmosemissioonist.* – Horisont 3/2013.
Retrieved from: http://horisont.ee/node/2020 (11.08.2014)


Uued elu märgid tänapäevases kunstis


„RHIZOPE" VÕTAB UUE KUNSTILIIGI LUUBI ALLA JA TOOB TEADUSKUNSTI NÄITUSESAALI

Piirma, P. 2012. *Uued elu märgid tänapäevases kunstis.* – Eesti Arst 2012; 91(9): 512

Paas, M. 2014. *"Rhizope" võtab uue kunstiliigi luubi alla ja toob teaduskunsti näitusesaali.*
– Müürileht. May. Retrieved from: http://www.muurileht.ee/rhizope-votab-uue-kunstiliigi-luubi-alla-ja-toob-teaduskunsti-naitusesaali/ (11.08.2014)


Sirp

Interdistsiplinaarsusest teoorias ja praktikas


WADER

BEHAVIOURAL FORMATION – TIME, LATENCY AND UNCERTAINTY

Penny, S., transl. Piirma, P. 2014. *Interdistiplinaarsusest teoorias ja praktikas.* – Sirp, 29 May.
Retrieved from: http://www.sirp.ee/s1-artiklid/c6-kunst/interdistsiplinaarsusest-teoorias-ja-praktikas/ (11.08.2014)

Valk, V. 2014. Behavioural formation – time, latency and uncertainty", – Müürileht, 16 June.
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RHIZOME

RISOOPNE UURIMUS EHK KUKKUV ÕUN KUNSTISAALIS


Sirp

Teaduskunsti võimalustest ja piiridest

Piirma, P., Valk, V. 2014. *Risoopne uurimus ehk kukkuv õun kunstisaalis.* – Horisont 3/2014

Kelomees, R. 2014. *Teaduskunsti võimalustest ja piiridest.* – Sirp, 16.07.2014
Retrieved from: http://www.sirp.ee/s1-artiklid/c6-kunst/2014-07-16-18-43-32/ (11.08.2014)

9.2 Exhibition reviews

Retsensioon näitusele „Hübriidsed praktikad”

Raivo Kelomees

Piibe Piirma tegevus hübriidsete teadus/kunsti praktikate valdkonnas on ambitsioonikas ja sihikindel.
Näitusel Disaini- ja Arhitektuurigaleriis esitles ta kolme projekti „Minu seitse pead”, „Saccharomyces cerevisiae ja pärmi missioon” ning „QR-Quorum Protocols”.
Määratleksin rõhuasetuse, mida Piirma näitusel tuleks vaadata, kasutades autori enda sõnu:

> *„Näitusel esitlen kolme erinevat koostöövormi, mis on viimaste aastate jooksul minu osavõtmisel aset leidnud.”*

Arusaadavalt ei ole näituse sisuks ainult „koostöövormid”, vaid ka kunstiteoste esitamine traditsioonilises tähenduses.

Üldised märkused

Piirma suunavõtt on kaasaegne ja, nagu öeldakse - *cutting edge* - see tähendab piire ja uusi võimalusi kompav ja seda eelkõige Eestis. Vormivõtete ulatuse mõttes on esitatava skaala reaalsest füüsilisest installatsioonist („Minu seitse pead”) kuni kontseptsiooniesituseni, mille puhul selle „kunstiteoslikkus” ei ole autori jaoks määrav („Saccharomyces cerevisiae ja pärmi missioon”). Esitusobjekte on arendatud reaalsest kunstiteosest kuni imaginaarse projektini (mis õnneks siiski teostub). Rõhutada tuleks projektide koostööpõhisust, kunstnik ei ole ainuautor, vaid meeskondade liige või nende juht. See asjaolu viitab taas Piirma tegevuse murdejoonelisusele ja mittetraditsioonilisusele.
Ta teadvustab seda ka ise:

> *„Lisaks oma ideede väljendamisele küsin ma ka laiemaid küsimusi, nt kuidas teha koostööd teadlastega nii, et see mõlemale poolele huvi pakuks ja mõlemapoolset kasu toodaks? Kas on võimalik luua ühist unikaalset teaduskeelt (inter-, transdistsiplinaarset?), mis oleks ühtmoodi arusaadav nii kunstnikele kui ka teadlastele? Milline on selles protsessis minu kui kunstniku roll?”*

Taotlust „teaduskeele” loomiseks võib mõista ehk ka metafoorsena. Pigem on tegu ikkagi hübriidsete esitustavadega kombineeritud meediumites, mis sisaldab „teaduslikku” ja „kuns-tilist” komponenti.
Kuidas eksponeerida teadusinfot publikule arusaadavas keeles on teema, mis on teadlasi ja kunstnikke üha enam huvitanud. Siin ongi appi tulnud kunstnikud, kes valdavad avaliku visuaalse suhtlemise oskust paremini. Piirma näitus ei tegele ainuüksi sellega, siiski võib “Pärmiprojekti” näha kui teadusprojekti esitlust, ja see esitus on võrdlemisi traditsiooniline. Arvestades aga asjaolu, et tegu on teostamist ootava projektiga, peaks selle „kuiv” esitus olema mõistetav.
Olgugi et Piirma näitusele võib omistada meediakunstile iseloomulikke tunnuseid, nagu immateriaalne esitus, interaktiivsus, koostööpõhisus, kohtame näituse traditsioonilisena mõjuvat kunsti, mis annab vaatajale võimaluse sellega suhestuda ning tajuda teoseid kolmemõõtmeliste objektidena.
Vaadeldes teoseid lähemalt, kergitaksin kõigepealt ühe olulise küsimuse, mida on võimalik tehnoloogilise, interaktiivse ja kontseptuaalse kunsti puhul tähele panna. Selleks on kunstnikupoolne vastutuse üleandmine vaatajale ja teose mõtte/tähenduse peitmine intellektuaalse „müra” sisse. Neid kahte asjaolu silmas pidades võiksime küsida, kuidas suhestub neisse Piirma näitus?

Neile iseärasustele ja küsimustele ei tuleks omistada hinnangulisust, sellegipoolest nad „hägustavad" autorsust. Saabudes näitusele, on eksperdi ja ka tavalise inimese ootuseks kohtuda autoriga. Nüüdiskunsti näitustel võib seevastu tähele panna tendentsi, et autorsus on hajutatud või sootuks vaatajale üle antud.

„Saccharomyces cerevisiae ja pärmi missioon"

„Pärmiprojekt" jätab selles kontekstis mulje „intellektuaalset müra" sisaldavast projektist, millesse on peidetud häid mõtteid, mida meie, inimesed, peaksime hindama.
Piirma kirjutab:

> *„Evolutsiooniuurijad on täheldanud, et lisaks sarnasele ehitusele võib leida teatud ühisjooni ka pärmi ja inimese raku käitumises. Näiteks olgu mängimine. Vaatamata pärmiraku lihtsusele on selle osakestel täheldatavad tegevused, mida võime selgelt interpreteerida sotsiaalse käitumisena."*

Näitusekülastaja võib sellega nõustuda või mitte. Põhjalikumaks vastamiseks tuleks pöörduda allikate poole. Milleski on see väide isegi uskumatu, patafüüsika valda kuuluv juhuslik oletus maailmaasjade käigust.
Lugedes alapeatükki „Tuisumäng – kooperaatorid ja petturid", kus autor viitab Jeff Gore'i, Hyun Youk'i ja Alexander van Oudenaardeni teosele, tekib küsimus, kas inimkäitumisest pärinevaid mõisteid „petturid" ja „kooperaatorid" on sobiv kasutada rakkudevaheliste protsesside kirjeldusena. Arusaadavalt võib seda mõista metafoorse keelena, mille sihiks on panna „inimkeelde" käsitamatuid evolutsiooniprotsesse. Samas näib see kunstilise liialdusena, samamoodi nagu loomade antromorfiseerimine, mis on animatsioonitööstuses (varem kirjanduses ja luules) kahtlemata tulus ja loomi mõistetavateks muutev. Siiski usaldan Piirma autoritevalikut, kes püüavad selgitada keerukaid rakkudevahelisi protsesse inimlikult arusaadavas keeles. Pärmiprojekt on huvipakkuv selle ambitsioonikas „maailmapäästmise" idees. Et kui inimkonda enam ei ole, ehk õnnestuks pärmirakkudel tsivilisatsiooni bioloogilist ainet edasi kanda.
Piirma kirjutab:

> *„Selleks, et elu jätkuks kaugetes kosmoseavarustes, ei ole vaja palju muud, kui imetillukesi rakukolooniaid, soodsaid tingimusi ja antroopsusprintsiibi rakendumist..."*

Täiendades hiljem:

> *„Nii otsustasin ma mõned miljonid pärmirakud kuivatada ja teha meie satelliidiehitajatele koostööettepanek, mille käigus võiks kõige muu olulise juures ka pärmikolooniad kosmosemissioonile lähetada. Ja elada teadmisega, et kusagil on väike osake Eestist, mis elu edasi kannab."*

Projekt **„QR-Quorum Protocols"** võimaldab vaatajal esitada banaalseid küsimusi. Projekti märksõnadeks on „teadus + tehnoloogia + ühiskond ja sotsiaalne suhtlus + internet + virtuaalne *versus* materiaalne". Tõeliselt „hübriidse" projekti määratlus. Tagasisideks on peeglite „noogutamine" nõustumise märgina vastuseks küsimusele või „pearaputus" – eitusena.
Autor kirjutab:

> *„Minu eesmärgiks on teada saada, miks siiski meie inimesed, aga ka kaasaegne teadus usaldab sotsiaalvõrkudest saadavat informatsiooni. Samuti näidata, kui ebaoluliste ja naljakate küsimustega võib tegemist olla."*

Piirma on toonud välja ja muutnud füüsiliseks tagasisideme, mille saame masinast. See on väärtuslik. Lugedes teose juurde käivat leheküljepikkust selgitust, tekib tunne, et „point" on kadunud arutelu sügavustesse. Autor püüab ju ühelt poolt netipõhise sotsiaalsuhtlemise banaalsust esile tuua ja viidata globaalsematele protsessidele, mida see puudutab, ehk kuidas nt Twitteri meeleolud peegeldavad aktsiaturgude lainetusi.

Selle projekti puhul on lahendus minu arvates mõnevõrra peidetud. Esiteks tavakülastaja peaks olema varustatud nutimoblaga, võibolla galeriiruumi paigutatud lugeja kergendanuks suhtlust teosega. Teose teostamisse rakendatud masinavärk ja kompetents tundub üleloomulikuna, seda on kuidagi palju ning peeglikeste tagasiside tekitab küsimusi, „kas see oligi kõik" ning õigustatud ootuse lõpetatud elamuse järele. Probleemiring on siin kahtlemata olemasolev, kuid teos on saanud kuidagi „ebapuhas". See tähendab, et installatsiooni väljendusrikkuse saavutamiseks tuleks lahendust „tuunida", eemaldada ülearune ja lihtsustada vaataja suhtlemist installatsiooniga.
Kolmas projekt **„Minu seitse pead"** märksõnadega „frenoloogia + pseudoteadus + neuropsühholoogia + teaduse ajalugu ja tulevik + koostöö + interaktiivsus ja helikunst" on ehitatud 19. sajandi pseudoteaduse ideele inimese võimete peegeldumisest peakonarustel. Praeguseks tagasilükatud õpetus on lähtepunktiks installatsiooni loomisel.
Piirma lahendus on tõhus, see toimib: skulptuuripea erinevate piirkondade puudutamisel aktiveeruvad videoread, mis on projitseeritud peakujulisele siluetile. Installatsioon töötab, aga tekitab küsimusi, et miks frenoloogia ja miks peakujuline projektsioon. Selle puhul hakkab minu maitsemeel tõrkuma, kuid tahaks tunnustada projekti funktsioneerimist ja mõnevõrra „klassikalist" interaktiivset vormi, et kui vaataja midagi teeb siis midagi ka juhtub. Tõsi küll, asetleidev on muutus ekraanil ning ei ole selgelt arusaadav, kas see leiab aset vaataja tegevuse tulemusena või muul põhjusel.

Kokkuvõttes tahaksin tunnustada Piibe Piirma tegevuse interdistsiplinaarsust, julgust ja oskust hübriidseid projekte teostada, suutmist teha koostööd teadlaste ja inseneridega. Kahele viimati analüüsitud projektile heidaksin ette (lähtuvalt oma maitsest) „ebapuhtust", mis ei ole küll teaduslik määratlust, kuid peaks olema mõistetav. Erilist esiletõstmist väärib „Pärmiprojekt" juba ainuüksi ideena see kosmosesse saata. Kuid see ei ole tühipaljas kavatsus, vaid reaalne teostus. Siin ma ei hakanud projekti analüüsima nn „Space Art" kontekstis, kuid kahtlemata paigutub see projekt ettevõtmiste galeriisse, mida on kunstnikud teinud „kosmosekunsti" kategoorias.

Retsensioon näitusele “Hübriidsed praktikad”

Marek Strandberg

Näitusel on esitatud kolm tööd, mille sünd pole olnud mitte pelk teadusliku süsteemi ja lähenemise imiteerimine kunsti vahenditega, vaid teaduse meetodit harrastavate inimeste ja kunstniku loova ja uuriva suhte tulemus.
Universumil on oma rütm, harmoonia, resonants nii mõistuse kui tunnetega, mis on samuti läbi inimese ju Universumi osad. Just seetõttu ka teaduse meetodiga puutumuses olev kunstilooming köidab ja haakubki. Ilmselt mitte alati, kuid kindlasti antud näituse puhul. Seda enam, et loodu alusmeetodiks ei ole olnud mitte imitatsioon, vaid kommunikatsioon: suhe teadlaste ja teaduse probleemidega.
Näitusel oli tunda teatud haprust ja ettevaatlikkust teemakäsitluses ja seda tuntavalt töö MINU SEITSE PEAD puhul, kuid samas ka õigustatult, sest autor käsitleski selles just pseudoteadust.

PÄRMI KOSMOSEMISSOON oli seevastu kunsti ulatust suisa maaväliseks sirutav esitlus, mille raames ka vorme ja struktuure moodustav pärm plaanitakse ESTCube kosmosesondiga Maa obiidile lähetada. Pärmi, kui vahest ühe ürgsema Maa või võimalik, et ka Universumi asuka, orbiidile lähetamine on kui omaette metamissioon võrreldes mahukate kosmosejaamade ja sellega Maa lähedasse kosmosesse saadetud ahvide, koerte ja inimestega. Pärmiseened, kui ühed kohanemisvõimelisematest ja ürgsematest olenditest Maal, võivad olla elu rännutamiseks mujale maailmaruumi ühed paljulubavamad tegelased. Võib ju küsida, kas alguses oli sõna või hoopistükkis pärm? Eks ole ju kunsti asi panna vibreerima alateadvus ja tekitada nii emotsioone, kui kalkulatsioone, kui küsimusigi. Need mõõtmed on PÄRMI KOSMOSEMISSIOON endasse kindlasti haaranud.

QR-QUORUM ei toiminud küll moel, nagu see oli kavandatud ja kindlasti mitte nii organiseeritult nagu pärmiseened, kuid ka see on masindatud maailma märk. See ei peagi ehk toimima just siis, kui selleks on vajadust. Võrgus oleva teadmise, inimeste ja masina interaktsioon ning selle suhtestamine juhitavate peeglite kaudu hetkeoludesse, on huvitav leid. On ilmselt üsna paratamatu, et selliste indekseeritud teadmiste ja indekskeelte kontekstis hakkab me ümber olema ilmselt juba lähitulevikus mitmesuguseid masinaid või masindatud olendeid. Mitte ainult lõbuks, vaid ka vajaduste katteks. Kuidas muidu – aga neid ja nende toimimist pole veel võimalik muul moel ette aimata, kui asjakohast kunsti luues ja selle objektide suhte ning struktuuridega mängides.
Oma loomuses meenutas QR-QUORUM veidi 1980. aastast pärit ja Tallinna postimajja installeeritud Kurismaa, Härmi ja Präätsa eskalaatorite vahel paiknenud veidralt häälitsenud objekti, mis oli samuti vahemeheks esklaatoritel liikuvate inimeste ja ilmselt mitmeid kordi läbi otsitud postisaadetiste vahel. Mõistagi polnud toonane kommunikatsioon niivõrd interaktiivne ega saanud ja ehk ka ei tohtinud olla.

Autor on oma töödega katsetanud ja mind kindla peale veennud, et puutumusest teadusega, seda nii inimeste kui meetodi mõttes, saab kujuneda ja areneda sootuks teistlaadi kunst. Kunst, mis nii samas avab teaduse meetodit, kui ka loob selle juurde mõnegi ligipääsutee lisaks.
Mõnigane haprus või dissonants näituse puhul pole aga kindlasti mitte niivõrd puudus, kui kinnitus võimalusele leida veel paremaid harmooniaid teaduse ja kunsti meetodite ja loomingu vahel. Muud moodi ei saa ju ollagi.

Retsensioon näitusele „Hübriidne praktika – üldiselt üksikule"

Kristjan Kannike

Näitusel esitletakse nelja projekti, milles kasutatakse küllaltki erinevaid väljendusvahendeid: laboriatribuutika, mikrofoto, installatsioon ja animatsioon. Piirma üritab kunsti vahenditega tõlgendada teadust – antud juhul mere mikrobioloogiat laiemas kontekstis, milleks on teaduse ja kunsti vahekord, maailm kui tervik ja tehnoloogia mõju sellele.
Kuidas teadust kunstimaailma üle kanda? Üks võimalus on eksponeerida teadlaste või teaduse vahenditega (mikroskoobid, teleskoobid, kiirendid) tehtud visuaalselt huvitavaid jooniseid, fotosid vedelkristallidest, tähtedest ja galaktikatest või mikroorganismidest.
Näituse tutvustavas tekstis ütleb Piibe Piirma:

> *„Miks meri on sinine? Miks liblikas lendab? Mis päike tõuseb?", nii küsib laps, kombates ilmaelu olemust ja piire. See on oluline algus teadusliku ja loova mõtlemise ühendamisel. Meie kultuuriline sümboolika on tänu teadusele ning üha populaarsemateks saavatele interdistsiplinaarsetele uurimis- ja käsitlusvormidele tohutult laienenud.*

Nõnda võib võtta mõned teaduse ideed või küsimused ja neid kunsti keelega markeerida. See on märksa keerulisem. Kunsti abil on raske anda edasi mingit ideede kogumit, pigem võib edasi anda emotsiooni, mida idee tekitab (näiteks relatiivsusteooria ja Dali sulavad kellad). Mulle – teadlasena – näib, et kui eesmärgiks on küsida küsimusi looduse ja ühiskonna suhete kohta, ärgitab inimest mõtlema kaasaegsest kunstist märksa enam populaarteaduslik raamat või film. All üritan tõlgendada projekte neist endist lähtudes.

Installatsioon aknal: „Metagenoomiline muuseum"

Metagenoomika on molekulaarbioloogia haru, kus uuritakse otse keskkonnast kogutud pärilikku materjali DNA-d ja RNA-d. Looduslikes kooslustes, näiteks mullas või merevees on koos tuhandeid või kümneid tuhandeid bakterite liike. Suuremat osa neist on raske või suisa võimatu laboris kasvatada ja metagenoomika on ainuke võimalus nende uurimiseks.
Mõistaksin näituse kontekstis nii ka projekti motoks olevat Gregory Batesoni tsitaati *"The unit of survival is a flexible organism-in-its-environment."* Kui kaob keskkond, lähevad alatiseks kaduma ka paljud sellega seotud organismid. Kunstnik kõrvutab siin vetika ja mere suhet inimese ja universumi suhtega.
Ilmselt on tegu ka „üldisega" näituse pealkirjas: organismide paljusus oma elukeskkonnas ja teadus, mis püüab seda haarata. Muidugi ei saa aknal olevates katseklaasides haarata tervet mere ökosüsteemi, paratamatult on tegu ainult näidisega, markeeringuga.
Teisalt võib installatsiooni võtta katsena mitte kasutada kunstis teaduse vahendeid, vaid hoopis viia kontseptuaalse kunsti võtted loodusmuuseumi: jätta muuseumist ära väljapanekud ja näidised, asendades need paljaste siltide või kirjeldustega.

Fotoseeria „Rändajate portreed"

„Rändajate portreed" on sari mikrofotosid planktonist. Kas mikroorganismide esteetilisena mõjuvad värvifotod on vastuolus metagenoomilise muuseumi ideega jätta väljapanekud ära? Mitte tingimata, mõeldes, et tegu on konkreetsete näidetega tohutu suurest hulgast vetikatest ja mikrofaunast, kelle kõigi portreed ei mahuks ära ka suurde näitusesaali.
Näitusetekst ütleb: Mikroskoopilised organismid, kes elavad kõigis veekogudes, etendavad kogu elus Maal üliolulist rolli. Kunstnik tunneb muret Maa ökosüsteemi saatuse pärast ja toob nähtavale olendid, kes selles on olulised, aga keda me palja silmaga ei näe.

Video „PacMan – jaht plastiididele"

Mikrofotodest tehtud animatsioonis on tuntud videomängu kõrvutatud kleptoplastiidsusega. Arvatakse, et plastiidid on ise saanud alguse endosümbiontidest tsüanobakteritest, kelle neelasid alla praeguste vetikate eellased. Mikroskoopilisi ripsvetikaid jahivad aga ripsloomad,

neid omakorda vaguviburvetikad, kes kõik algselt ripsvetikas olnud ja toiduahelas ülespoole liikuvaid plastiide fotosünteesiks kasutavad.
Metafoorid, mida teaduses kasutatakse, pärinevad tihti tehnoloogiast. Näiteks aju on mõne sajandi eest peetud kellamehhanismi, käesoleval ajal aga arvuti sarnaseks. Hea metafoor aitab nähtusest kergemini mõelda, tehes selle „käegakatsutavamaks". PacMan kui metafoor ütleb, et looduses ja arvutimängudes kehtib sama „Söö või ole söödud" põhimõte.

Interaktiivne installatsioon „Roboautotroofid"

Piibe Piirma küsib näitusetekstis:

> *Mis oleks, kui lakkaksime mõtlemast Alan Turingi poolt kehtestatud 0-dest ja 1-dest koosneva binaarsüsteemi loogika järgi? Mis oleks, kui meie arvutimaailma valitseks bioloogilised ja keemilised superarvutid? Mis oleks, kui inimkond suudaks luua tehislikel protorakkudel baseeruvad andmebaase? Kui säärane tehnoloogia suudaks ise end energiaga varustada ja taastoota? Mis oleks, kui bioloogilised ressursid suudaksid panna meid lõplikult lahti ütlema kallitest tootmisviisidest, raskest metallist, tohututest juhtmejadadest ja skeemidest*?

Kahtlemata huvitavad küsimused, millele teaduse ja tehnoloogia poolt esitatavad vastused võivad määrata selle, kui kauaks meie tsivilisatsioon kestma jääb.
Installatsiooni osaks on akvaariumis kasvavad vetikad, mille juhuslikult heljuvad niidid muudavad läbi akvaariumi fotosensorile langeva valguse intensiivsust. Sensorist tuleva signaaliga liigutatakse peegleid, mis heidavad lakke aeglaselt muutuvaid valgusmustreid. Peegleid valgustavad vetikaniitide kujulised lambid. Elektrienergia, mis lampides valguseks muundub, on omakorda pärit päikesevalgusest ja vetikatest, mis miljonite aastate meres kasvasid ja põlevkiviks muutusid.
Muuseas, pigem võiks installatsiooni nimetada aktiivseks, mitte interaktiivseks, sest peeglite liikumist ei mõjuta näituse vaataja, vaid installatsiooni osaks olevate vetikate tihedus. Võibolla on aga kunstnik tahtnud näidata, et vetikad on samasugused maailma subjektid nagu meiegi.

Retsensioon näitusele „Hübriidne praktika – üldiselt üksikule"

Raivo Kelomees

Piibe Piirma käesolev näitus esitab autori innukat liikumist biokunsti suunas. Seda toetab autori institutsionaalne seos Soome biokunsti ühinguga ja asjaolu, et biokunst kipubki vähemast Ars Electronica kontekstis kuuluma "hübriidse" kunsti kategooriasse. Sest tõepoolest, kompetents, mis on vajalik taoliste kunstiteoste loomiseks, pärineb mitmest professionaalsest valdkonnast. Kui see kokku saab, on tulemuseks uurimislik hübriid. Võib ka juhtuda, et spetsialistid ei pruugi teise kolleegi kompetentsi isegi mõista ja selles näen sellise kunsti, mida iseloomustab kollektiivse kompetentsi liitmine, teatavat riski ja ka puudust – tulemust kui tervikut on üha raskem kontrollida kui ei olda alavaldkondadega kursis.
Piirma viitab Oron Cattsile, kes on arvamusel, et kunstnikud peavad olema spetsialistid – st kunstnikud on kohustatud tegema väga palju kodutööd enne laborisse saabumist ja töö alustamist. Lisades aga, et eelkõige peavad kunstnikud jääma kunstnikeks, niisamuti teadlased teadlasteks ... Kuigi see ei ava meie jaoks seda, mis need kunstnikud ja teadlased siiski on.

Piibe Piirma lähenemist see tuntavalt ei ähvarda, kuna ta orenteerub selles, milles teda aitavad spetsialistid. Kuid ta küsib oma sissejuhatava teksti alguses põhimõttelisi küsimusi:

> *„Kuidas näha, uurida, hoida ja hoolida, kuidas teaduskeelt tõlkida poeetilisse kunstiloomise viisi? Kuidas hoomata maailma moodustavat suurt süsteemi ja mõista, kui unikaalne see on? Ja mida ütleb teadmine merebioloogiast meie tehnoloogiakesksele*

ühiskonnale või milliseid traditsioonilistest uurimisharudest väljaspoole jäävaid alasid on meil tulevikus veel võimalik kombata?"

Minu arvates need küsimused ongi innustanud Piirmat näitust korraldama. Et siin on tähelepanu suunatud merebioloogiale, on valiku küsimus, samuti nagu selleks võinuks olla mõni teine teadusala. Peaküsimus on teaduse vastu huvi tundval kunstnikul selles, kuidas laiendada kunsti piire ja ka teaduse piire? Kuidas tuua kunsti uusi lähenemisi? Kuidas väljuda kunsti vandlitornist ja otsida sidemeid teiste valdkondadega? Neiks ei pruugi alati olla teadus.

Jättes spetsiifilisema arutelu näitusesaalis toimuva retsenseerimise tarbeks ja aktsepteerides, et Piirma näitus tegeleb valdavalt merebioloogia kompetentsi näitusesaali toomisega, esitaksin mõned põhimõttelised küsimused, millele ootan vastust kunstnikult, kes tegeleb hübriidsete praktikatega, ehk mittetraditsiooniliste ja multispetsiaalsust nõudvate praktikatega.

1) Näitusel ja hübriidsel kunstil on teatav analoogia teistsuguste kinnistunud kunstivormidega, nagu kontseptuaalne kunst, kus kunstiteose sisu selgub teksti lugemise tulemusena. Teos ise ei pruugi visuaalselt arusaadav olla. Alles peale tekstiga tutvumist muutub see kõnekaks. Kas siin ei ole oht teatava kujutavale kunstile omase vahetu suhtlusvõime kadumisele? Kas kujutav kunst ei peaks kõnelema meiega ka otse, läbi visuaali, mitte tekstide ja mõistusliku info kaudu?

2) Ekspertide kompetents teose loomiseks muutub üha olulisemaks ja kunsti "kultuur" on keerelnud ümber ainuautori. Kaasajal ainuautor, originaator ja autori institutsioon üldse on kahtluse alla pandud, peaaegu hüljatud. See on sageli ka pettumuse allikaks. Samas teame, et orkestrile sümfoonia kirjutanud muusik ei oska mängida kõiki pille, millele ta muusikateose kirjutas. Samuti arhitekt ei pruugi osata ehitada, kuid peab teadma materjalide omadusi, et ehitis püsiks. Kui kaugele võib minna teiste ekspertide kogemuste ärakasutamisel ja nende usaldamisel? Millisel viisil hübriidsete praktikate kunstnik peab autoriseerima oma teoseid? Millisel määral ta peab oskama "pille" mängida, mida tema teoses kasutatakse?

3) Kunstinäituse terviklikkuse küsimus. Millises ulatuses peab kunstnik taotlema seda, et näitus keerleks ühe idee ja teatava korduva visuaali ümber? Tänapäeva infotihedas maailmas on üha raskem ennast maksma panna. Sellele järgnev tegevus on äratuntavate visuaalide kasutamine, kordamine ja nende kaudu vaatajale meeldetuletamine, et kunstnik teenib pühendunult ühte muusat, ta on seesama. Hübriidsete ja ratsionaalsete strateegiate tulemusena kunstnik vahetab muusasid, vahetab oma kunsti visuaalset esindust, kaotades sageli järjekindluses ja terviklikkuses, kuid võites isiklikkus arengus. Kuid me teame, et kunstniku tegevus peegeldub publikul. Järelikult, kui kunstnik tahab olla arusaadav, peab ta teatud sõnumeid kordama ja esitama neid arusaadaval ja terviklikul viisil, rõhudes pealispinnalisele äratundmisele. Missugune on siinse näituse "pealispindne äratundmistasand", millega kunstnik vaatajale vastu tuleb? Mis aitaks meil mõista näitust terviklikuna?

Eelretsensioon Piibe Piirma projektile (kureeritud näitus ETDM-s, konverents, artists talks ja kataloog) „Rhizope. Kunst ja teadus – hübriidne kunst ja interdistsiplinaarne uurimus”

Hilkka Hiiop, PhD

Olles erilaselt võhik hübriidse/inter-/transdistsiplinaarse[1] kunsti diskursuses ning positsioneerimata ennast ei (loodus)teadlase ega loovkunstnikuna, pean kohe alguseks ära ütlema, et ei sea endale ambitsiooniks hinnata kriitiliselt Piibe Piirma tegevusvaldkonna sisulisi aspekte. Pean tunnistama, et mul tekkis suur dilemma retsensiooni lähtepunkti osas – ponnistus end lühikese ajaga kurssi viia teaduspõhise kunsti sisu ja laiemate tähendusväljadega jääks nii või teisiti küündimatuks; neutraalse kunstinautleja pilk aga pinnapealseks. Pakun järgnevalt välja analüüsi lähtepunktina mu enda tegevusvaldkonna tehnilise kunstiajaloolasena[2], mis pealtnäha koosneb hübriidsele kunstile sarnastest komponentidest ja tegeledeb kunsti, humanitaar- ja reaalteaduste, infotehnoloogia jmt puutepunktidega. Olemuslik erinevus on siiki selles, et erialseks väljundiks ei ole mitte uus looming vaid panustamine humanitaarvaldkonda kuuluvatesse kunstiuuringutesse loodusteaduslike meetoditega; sealjuures on uuritav kunstiteos juba varem ja kellegi teise poolt loodud.
Teisalt vaatlen hübriidkunsti väljundeid läbi muuseumi prisma, tuginedes oma uurija-tegevusele nüüdiskunsti säilitaja-konservaatorina.

1. Mõlemad valdkonnad, nii (loodus)teaduspõhised kunstipraktikad kui (loodus)teaduspõhine kunsti uurimine on interdistsiplinaarsed nähtused, mille eessmärgiks on erinevate distsip-liinide põimimisega luua valdkondadeüleseid/-vahelisi lisaväärtusi. Nii uurija kui looja peavad orienteeruma erinevate distsipliinide laial maastikul ning olema võimelised paigutama informatsiooni uudsetesse kontekstidesse. Loodusteaduspõhiste kunstiuuringute puhul on panus selgelt ühesuunaline – see avardab kunstiteose interpretatsiooni, st panustamine toimub reaalialt humanitaaria suunas. Hübriidse kunsti puhul näen aga võimalikku kahesuunalist lisaväärtuste loomist: kahtlemata avardab hübriidlooming kunstimaailma piire, kuid kas ka teadusmaailma omi? Kunstilised väljendusvahendid võimaldavad nihutada teaduselt nõutud objektiivse lähenemise subjektiivsuse, intuitiivsuse, interpretatiivsuse, performatiiv-suse, teooriapõhisuse suunas ning anda (reeglina) kvantitatiivsetele meetoditele tuginevale teadusele kvalitatiivse lisatasandi. Tänasel kvalitatiivsete uurimismeetodite võidukäigu ajastul näib, et hübriidne kunst võiks panustada ka (loodus)teadusliku mõtte arengusse, andes sellele uudse vaatepunkti ja väljendusvahendi. Mulle isiklikult näivad selles valdkonnas suuremat väljakutset pakkuvate projektidena just teadlaste poolt või teadlaste-kunstnike koostöös sündiv kunstiloome.[3] Kui traditsiooniliselt on teaduse väljendusvormiks limiteeritud ringile suunatud teadusartikkel ja sealt edasi ehk mingit eluvaldkonda edendav avastus, siis kunstiloome võimaldab interpretatsiooni viia täiesti uudsele ja vastuvõtja erinevaid meeli kaasavale tasandile. Siit ka esimene küsimus doktorikraadi taotlejale: kuidas Sa ise loovkunstnikuna hindad, kas teadustegevuse väljendamine kunstiliste meetoditega võiks tuua ka teaduse vaatevinklist analüütilise/metoodilise nihke?
Ps. Siinkohal olen ise „teadlasena” (st konserveerimisteadlasena) tabanud end sageli mõttelt anda kunstiteoste materjalitehnilise uurimisega kaasnevale ääretult põnevale informatsioonile (nt instrumentaalanalüüside põhised pigmendi- ja sideaineuuringud, erinevate lainepikkuste põhised stratigraafilised uuringud jms) loomingulist väljundit, et selle kaudu omamoodi rekontekstualiseerida vana kunst ning luua teatud nihe eksiteerivate nähtuste interpretatsioonis.

2. Teine pähe turgatanud erialane paralleel on populariseerimise aspekt. Isiklikus professionaalses tegevuses olen sellele palju rõhku pannud, kasutades loodusteaduste ja infotehnoloogia rakendusi lisaks teaduslikule analüüsile ka esitlus- ja populariseerimisvahendina.

Ka hübriidse kunsti puhul jäi mulle erinevate konverentsi- ja kataloogitekstide juures silma-kõrva vaatajani jõudmise ja populariseerimise aspekti rõhutamine. Kui mu enda distsipliini sees on populariseerimine suunatud pigem kunsti mõtestamisele ja mõistmisele (siiski, mingis aspektis saab sellega ka teadust ennast populariseerida), siis hübriidse kunsti puhul tekkis mul küsimus, kas populariseeritakse kunsti, teadust või mõlemat korraga? Kunstilise väljundina on hübriidsel praktikal kindlasti omad miinused, nõudes tänaselt, enamasti vähese süvenemisvõimega vaatajalt liigset intellektuaalset ponnistust, et jõuda taolise kunsti sügavamate tasanditeni. Teaduse populariseerimisel on aga kindlasti Ahhaa-keskuse tüüpi ettevõtmised sammuke ees, kuna seavad endale üheselt eesmärgiks (teaduse) populariseerimise. Seevastu kunstiteosed, mis loovad enamasti uudset intellektuaalset või emotsionaalset (lisa)väärtust, võivad kohati vaatajani jõuda vaid Ahhaa-keskuste haledama versioonina. Küsimus doktorikraadi taotlejale: kuidas Sa ise seda aspekti käsitled, kas populariseerimine (ja kui, siis mille populariseerimine) on üldse eesmärk omaette või peaks hübriidne kunst jääma ikkagi spetsialistide kitsasse ringi? Ehk siis, kui palju on sellise kunstiloome puhul tähtis osaleja/vaataja suhestumine ja kes on publik, keda oodatakse suhestuma?

3. Kolmanda aspektina mõtlesin hübriidse kunsti võimalikule „musealiseerimisele". Kahtlemata on teaduspõhine kunst nähtusena midagi sellist, mis võiks kuuluda nüüdiskunsti arengusuundi kajastavate kunstimuuseumite kogudesse. Eesti Kunstimuuseum on tehnoloogia- ja teaduspõhiseid kunstiteoseid ka omandanud (tegelikult juba näiteks ka varane kineetiline kunst on muuseumi seisukohalt sarnane multimediaalne kunstiliik, mille puhul ei saa tegeleda üksnes visuaalse ja materiaalse objektiga). Aga et tegemist on erakordselt kompleksete ja üha keerulisemaks muutuvate objektidega (!!! mille puhul kohati materiaalsel OBJEKTIL kui sellisel polegi enam tähtsust), on see vaieldamatult suur väljakutse suhteliselt traditsioonilise formaadiga kunstimuuseumitele: kuidas omandada koos kunstiteosega selle ideelised ja intellektuaalsed tasandid sellisel viisil, et need oleks hoomatavad ka tuleviku vaatajale? Erialasest vaatevinklist lähtuvalt küsiksin kaitsjalt: kas ja kui palju Sa ise oled säilivuse ja musealiseerimise aspektile mõelnud (nii kuraatori kui loojana), kas Sa tegeled ka oma teoste või kureeritud näitusekoosluste dokumenteerimisega ning milliste meetoditega?

Lisaks oma erialast lähtuvatele momentidele tahaksin esile tõsta projekti „Rhizope" ja Piibe Piirma tegevusega seotult mõningaid aspekte:

– Tundmata küll põhjalikult selle kunstivaldkonna ajalugu ja hetkepositsiooni, julgeksin siiski esile tuua Piibe Piirma tegevust, mis on viinud hübriidse kunsti mõtte Eestis uuele, teaduslikule ja kompleksselt analüüsitud tasandile. Tuginedes kuuldule-loetule, on selles vallas nii kuraator- kui kunstiprojektidena olemas selge eellugu (Biotoopia, 1995; Tehnobia, 2006), kuid Piibe tegevus on toonud sellesse teadusliku ja analüütilise aspekti ning käsitlenud valdkonda vajaliku kompleksusega.

– Antud ürituse puhul tahaksin rõhutada projekti terviklikkust. Mulle näib, et üksiku kunstiteosena või üksiku kuraatorprojektina võib taoline looming jääda vastuvõtjale küllalt kaugeks, nõudes väga suurt intellektuaalset, emotsionaalset või performatiivset kaasatust.
– Isegi ette heitmata kaasaja inimese süvenemisvõimetust on selge, et niivõrd kompleksete kunstinähtuste metatasandid jäävad pealsipindsel süvenemisel hoomamatuks. Minu jaoks töötas „Rhizope" just tervikuna, kus näitusega kaasnenud konverents, publikatsioon ja eriti „artists talki'd" avasid ühtse komplektina nähtuse kompleksse iseloomu ja mitmetasandilisuse.

– Näituse puhul tõstaksin ühe momendina esile ka selle distsiplinaarset mitmekesisust. Kui üldiselt seostub „teaduspõhine" kunsti nö kõvade teadusharudega (loodusteadused ja infotehnoloogia), siis kureeritud näituse üks võlu oli selles, et pea iga projekt lähtus täiesti erinevast (teadus)distsipliinist või nende sümbioosist: psühholoogia, sotsioloogia, etnograafia, antropoloogia, bioloogia, infotehnoloogia ... jne jne. Nende kõigi ühendavaks lüliks oli teadus-

meetodite ühendamine kunstiliste väljendusvahenditega. Kui näitusekoosluse kui terviku seisukohalt võib see vähese eelinformatsiooniga vaataja jaoks pigem segadust külvata, siis hübriidse kunsti kui valdkonna analüüsi jaoks lõi vaatenurkade paljusus erakordselt hea laiapõhjalise pildi. Kuna mulle näib, et Piibe tegevuse seisukohalt ei ole eesmärk niivõrd ühe näituse kureerimine, kui valdkonna arendamine ja analüüsimine, siis täitis kuraatorprojekt just sellisena oma eesmärgi.

Lõpetuseks tõstaksin esile ka Piibe mahukat tööd, mis sellise kompleksse ürituse organiseerimisega kaasneb ja mis sellest ühtselt tajutava terviku loob! Ühtlasi olen tänulik (sundolukorrast tingitud) võimaluse eest süveneda minust seni suhteliselt eemale jäänud kunstivaldkonda. Isegi ajanappusest tulenev põgus osalus oli väga inspireeriv ja valgustav – mis omakorda on märk kildudest koosneva ürituse toimimisest ühtse tervikuna.

Viited:

1. *Siinkohal ei süvene retsensent erinevate mõistete analüüsi, mida Piibe Piirma on kataloogitekstis "Inter- ja transdistsiplinaarsusest hübriidse kunsti võtmes" väga hästi teinud; kasutan "hübriidse" kunsti mõistet üldterminina, nagu see on välja pakutud ka ürituse pealkirjas.*
2. *Tehniline kunstiajalugu on kunstiuuringute valdkond, mis tegeleb (ajalooliste) kunstiobjektide uurimisega läbi reaalteaduslike uurimismeetodite (mikroskoopia, instrumentaalanalüüsid, pildindus- ja infotehnoloogiad jne).*
3. *Põgusal tutvumisel näituse, konverentsi, kataloogi ja "artists talki'dega" köitsid mind eelkõige projektid, mis ei lähtunud kunstniku, vaid teadlase positsioonilt (nt Lennart Lennuk) või teadlase-kunstniku ühisloominguna sündinud ettevõtmised (KIWA, Terje Toomistu).*

Pre-review of Rhizope project – creative activity as a part of forthcoming dissertation by Piibe Piirma

The pre-review is written on a bases of submitted material – "Rhizope" Exhibition and Conference catalogue and photo-series.

Asoc. prof. Rasa Smite, Riga, June 1, 2014

Analyzing submited materials, namely, "Rhizope. Art & Science – Hybrid Art and Interdisciplinary Research" Exhibition and Conference catalogue, no doubts that Piibe Piirma has caried out elaborated research on art and science collaboration in art and creative practices of the 21st century. The author has chosen one of the most relevant themes in contemporary art discourse, which – saying it with the words by author – *"has become common vocabulary of the 21st century"* (Piirma 2014, 7). The novelty of this research also lies in the aspect, that the Rhizope project aims to "discuss the emergent phenomena of the 21st century..." by involving "in the process as broad a spectrum as possible from social sciences and humanities to technical sciences" (Piirma 2014, 7).

From the catalogue, I draw the conclusion that the conference of Rhizope project is organized with the intent to serve a theoretical background for artist's thesis in general and Rhizope exhibition in particular. The research questions of the conference are well articulated and they set clear framework for the territory that Piirma aims to explore: *"What is artscience? How should we see cross- disciplinary and trans-disciplinary phenomena? ... How to expand the dialogue between science and art and how might artists position themselves in this process?"* (Piirma 2014, 55).

The exhibition, how I perceive it, is more focused on showing current tendencies in art and science discourse. In a recent past it was rather narrow art field, yet today "artscience" is challenging not only the traditional notion of art, but it is also opening up new ways for further development of previously so called "media art". But more then focusing on art in narrow sense, Piirma is willing to put an emphases on emerging diversity or artscience practices and its potential in creation of new knowledge: *"we see ourselves surrounded by cultural forms that broaden our imagination and knowledge about the possible ways of artistic expression". Rhizope is an exhibition in which "fine arts and applied art intertwines with biotech and computer technology, network culture, robotics, music, social sciences, history and many other fields".* (Piirma 2014, 113)

In her own article "Interdisciplinarity and Transdisciplinarity in Hybrid Art", Piirma has introduced a theoretical background in art and science development mainly by focusing on terminology issues. In this article author is less focusing on analysing theory and/or art and science history. Nevertheless, this article is invaluable contribution in terminological analyses with regards to the diversity of terms and meanings that relate to describe variety of cross-disciplines (that are using prefixes inter-, trans-, multi-, etc.). I consider it as a novelty in Piirma's research, as she has made an attempt to understand and conceptualise inter- and transdisciplinarity by examining some well-known works of art. In her article Piirma is analysing most important and pioneering works and projects that are hybrid – crossing the boundaries with the sciences. Also important aspect is to include Estonian artist works in this analyses. However, I would prefer also to see more diversity in the works that are chosen, in order to better explain that "artscience" today is not anymore a narrow field (e.g. based on artists interest in biology or techno-sciences only), but it actually incorporates today many of the previously called "new media art" practices such as collaborative creation, participatory culture, open source, etc.

Nevertheless, I would like to highly evaluate Piirma's creative activity Rhizope as novelty research, which contributes to both – conceptualizing these new "hybrid art" practices into the broader context of art and society, and developing new methodologies for inter/trans-disciplinary art research. In a conclusion of her article, Piirma wrote: "The modern creative practice shows that transdisciplinary research is not about intermixing disciplinary boundaries, unprecedented freedom of thought or total rejection of traditional research methods, but rather about reciprocally complementing different fields by clarifying and approaching issues that cross disciplinary boundaries" (Piirma 2014, 28).

In a conclusion of this pre-review, I would like to make a summary of comments and to raise questions to the author for the further consideration in her research:

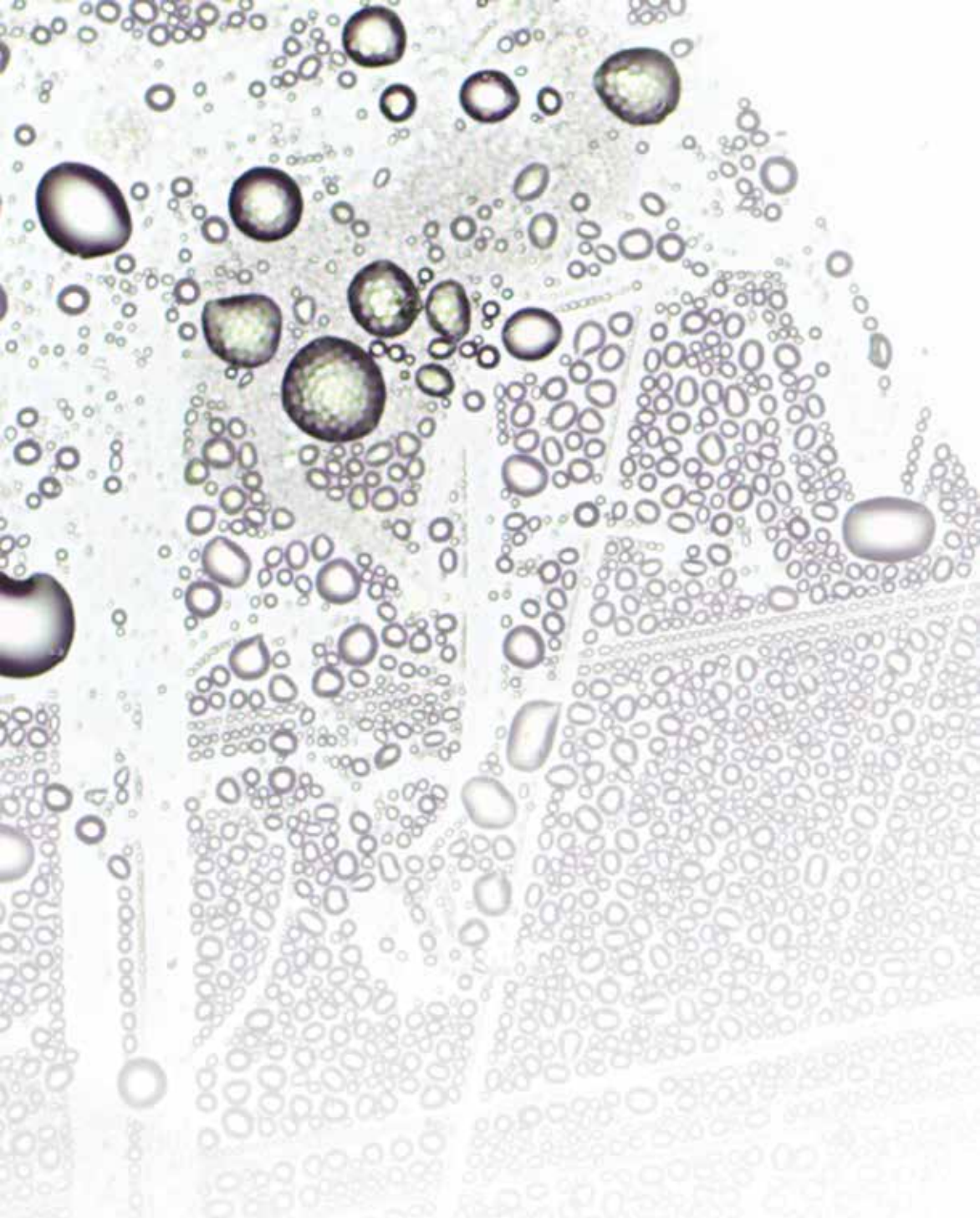
– How you plan to develop theoretical context in your dissertation – which authors will you study (or plan to study)? Namely, will you focus more on science philosophy, history of modern and post-modern art, or on social and media theories?

– What are your main conclusions regarding the terminology after Rhizope conference and exhibition – which terms you prefer to make use for describing artscience practices (trans-, multi-, interdisciplinary, hybrid, complementary, cross-fields, etc.)?

– Have you come to conclusion already, what is the role of art today, when it has become cross-disciplinary field?

– How you would analyse the changes from earlier art-science discourse to the more contemporary hybrid art which can be called "post-media art" (accordingly to Peter Weibel), "techno-ecological art" (Eric Kluitenberg and RIXC) or "post-biological" (Dmitry Bulatov)? For instance, you participated in FIELDS Exhibition Opening event and Renewable Futures conference in Riga (May 15-19, 2014), which also explores the issues you address in your research. Do you plan also to make a comparision between Rhizope exhibition, and other cases – such as FIELDS exhibition by RIXC in Riga, or Project Genesis/Synthetic Biology in Ars Electronica Center (Linz)?

– And last but not least, about the status of art-science field – how do you see this territory to be integrated in contemporary art practices? How you would describe the relation between contemporary art practices, and artistic research in academic context?



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